COMMENTS – DECEMBER 7, 2007

PAW & Member Companies

Waste & Water Advisory Board Meeting

CHAPTER 1 WATER QUALITY RULES AND REGULATIONS

Resubmitted by

PETROLEUM ASSOCIATION OF WYOMING

August 26, 2008

PETROLEUM ASSOCIATION of WYOMING

PETROLEUM ASSOCIATION OF WYOMING

951 Werner Court, Suite 100
Casper, Wyoming 82601
(307) 234-5333

fax (307) 266-2189
e-mail: paw@pawyo.org
www.pawyo.org

December 5, 2007

Mr. David Waterstreet
Water Quality Division
Department of Environmental Quality
122 West 25th Street
Cheyenne, Wyoming 82002

Dear Mr. Waterstreet:

The Petroleum Association of Wyoming (PAW) welcomes this opportunity to present comments to the Department of Environmental Quality, Water Quality Division (Division) regarding the proposed revisions to the Water Quality Division's Agricultural Use Protection Policy (Section 20 Policy).

PAW is Wyoming's largest oil and gas trade association, members of which account for over 90% of the natural gas and 80% of the crude oil produced in the state.

PAW has reviewed the Section 20 Policy and the implementation will directly and negatively affect our membership if implemented.

While we understand the Division's desire to review existing standards through its contract with the University of Wyoming (UW) we do not agree that the proposed limits have a scientific basis that appropriately recognizes risks or shows a need to proceed with the proposed limits. PAW recommends the livestock watering limits be removed from the proposed policy/rule.

PAW supports the grandfathering clause with the intention of protecting discharges from oil facilities that have been discharging for many years. However, we are concerned how the Division will allow for continued discharge if the clause is challenged. If the clause is removed, the proposed limits would most likely then apply to all NPDES permits. If the proposed limits are applied statewide, much of the water currently available to livestock and wildlife could be deemed unsuitable. In an arid state, during a drought, available water is clearly very important, and would be at risk if this policy/rule continues in its current form. PAW believes the use of produced water, both historically and in the future will continue to play an important role in the management of livestock and wildlife. The current proposal will put historic, current and future discharges as risk, thereby removing the opportunity for water to be available for use throughout Wyoming. PAW is not aware of any problems to livestock and wildlife that would dictate such changes from existing standards. To prevent risking a loss of numerous good water sources, PAW suggests the Division not incorporate new standards.

Under Livestock Watering (b)(i) PAW has concerns with the paragraph that begins "In addition...". PAW is concerned that this provision in the policy/rule is too broad. As written, it does not specify where the limits will need to be met. This section does not take into account any constituent that may be naturally occurring and is thereby unfairly associated with a discharge. This provision needs to be further explained and detailed.

In the statement of principal reasons, the Division explains that for the limit of sodium, 99% of the existing coal bed natural gas wells and between 75% and 99% of the oil discharges will not be affected by the proposed limits. The same holds true for sulfate, 99% coal bed natural gas and more than 75% oil producers will not be affected. This only underlines the suggestion that the existing standards are and have been properly protective.

In the table on page H-2, three new constituents are listed. Boron, chromium, and molybdenum are listed as possible permit limits. PAW does not understand why the new limits are being proposed. The Division states that 99% of the coal bed natural gas wells will not be affected. How will these limits affect the oil producers? The Division has admitted, in the statement of principal reasons, that the data necessary to determine if these limits will be necessary is unavailable at this time. How can anyone assess how these constituents will affect production if no data is available? PAW requests these constituents be removed from a constituent limit list that may be applied to a discharge, "if there is reason to believe they may be associated with a discharge".

PAW appreciates the intent of the Division by allowing for landowner waivers. The practical application of landowner waivers does not seem feasible in all circumstances. The Division has possibly given any one landowner in any given drainage basin the power to prevent any water from flowing to their neighbor downstream. Clearly, the problems associated with this type of solution could very easily render it moot to those who would try to implement it. The policy/rule does not address how discharges prior to January 1, 1998 will be affected by this provision. PAW requests the Division clarify this situation.

PAW requests (b)(iii) be revised to read, "...pollutant and the ~~landowner~~ ***livestock operator*** requests..." PAW believes the landowner could be a state or federal agency for which the request may not be easily obtained. By allowing for livestock operator, the confusion would be eliminated.

While PAW was unable to attend the last Water and Waste Advisory Board meeting held in Jackson on September 14, 2007 I understand Ms. Penny Hunter testified to the Board on PAW's behalf. In reviewing the Division's response to comments PAW does not see that her testimony was addressed. PAW suggests strongly the Division review Ms. Hunter's testimony and all filed reports regarding a risk management approach to setting new livestock and wildlife drinking water limits and reissue a revised response to comments.

To better protect the livestock and wildlife that are or will be allowed to use the available water; PAW suggests the Division remove the proposed livestock and wildlife drinking water standards listed in the proposed policy/rule. The Division's statement of principal reasons demonstrates that there is no need to change the standards. If most of the active discharges will not be affected, then the standards that have been in place prior to this rulemaking must have been protective. The Division already has standards for livestock and wildlife in Chapter 2, Appendix H, and these standards should continue to be followed.

PAW appreciates this opportunity to comment on the proposed revisions to the Water Quality Division's Agricultural Use Protection Policy (Section 20 Policy). Thank you in your consideration of these comments and suggestions.

Sincerely,

John Robitaille
Vice President

TESTIMONY – DECEMBER 7, 2007

PAW & Member Companies

Waste & Water Advisory Board Meeting

CHAPTER 1 WATER QUALITY RULES AND REGULATIONS

Resubmitted by

PETROLEUM ASSOCIATION OF WYOMING

August 26, 2008

MR. WAGNER: Marvin Blakesley.

VICE CHAIRMAN WELLES: Marvin Blakesley.

MR. BLAKESLEY: I'm going to go over here and sit down where I can see a little better, and hopefully you all can hear me as well.

I'm Marvin Blakesley, and I represent Marathon Oil Company.

I'd like to thank the Board for the opportunity to comment, and I specifically thank you for coming to the Big Horn Basin. That was something we requested. These policies and rule changes potentially have a huge effect on us and our people. It's difficult for our folks to get to other areas of the state and we really appreciate you coming here.

Marathon strongly supports the grandfather provision for the discharges in existence prior to 1998. We support the livestock watering waiver and the irrigation waiver. These are necessary provisions of the rule. To exclude those historic discharges or stricter water standards cannot be met in many instances.

The agriculture industry in the Big Horn Basin and other areas of Wyoming rely on this water for their farming and ranching operations. They successfully utilized this water for decades with no measurable decrease in livestock or crop production. On the contrary, this discharge water is essential to their livestock and crop production.

That being said, Marathon believes we're going down a dangerous path by proposing new standards. Should the grandfather provision be lost -- ever be lost, we'll be faced with standards that cannot be met in many instances. This will result in the loss of discharge permits and subsequent harm to agriculture, wildlife, industry, and the economic well-being of various communities and counties.

Marathon asks what is plan B, should these provisions be lost. Marathon requests the language in livestock watering waiver be amended to the state, and exception to the limits may be made whenever the background water quality of the receiving water is of poorer quality than the value listed for the associated pollutants or the landowner requests use of the water, and thereby accepts the potential risk to his livestock.

The "or" was changed to "and" from the June 2007 draft to December 2007 draft. It should be changed back to "or," as stated in the June 2007 draft. The livestock water provisions should allow for flow of discharge water if the background water is of poorer quality or if the landowner accepts the risk.

The statement of principal reasons or rules should also specify that where drainages receive discharge water from pre-1998 discharges, then the discharge water is considered to be background water quality of that drainage. I believe this is the intent of the DEQ, but I think that needs to be stated in the rule or the statement of principal reasons very clearly.

The statement of basis of rules should state for historic pre-1998 discharge, a new landowner cannot purchase a property and then object to the existing discharge, causing the loss of water to other landowners who relied on the water for their agricultural operations. I believe this is the intent of the DEQ and it needs to be included in the rule.

If a drainage -- if a discharge is ever eliminated, it will be gone forever. An example of this is the Grass Creek field. In the late '70s or early '80s, one landowner objected to the discharge of the water from the Grass Creek field. Subsequently NPDES permits were not issued and the water was re-injected. This water has been forever eliminated from agricultural wildlife use. Today many landowners along the Grass Creek drainage would love to have this water.

The rule contains limits on many constituents that were not regulated in the past. Adequate discharge data has not been obtained from many of these constituents as they relate to conventional oil and gas treaters. We're concerned that DEQ is proposing limits on constituents that may not be met by conventional discharges; however, there's not enough data to show how many conventional discharges may be affected and may not meet these limits.

Consequently, the potential socioeconomic impact is not known. I don't know -- I don't understand how the DEQ, the WWAB and the EQC can move forward with a rule that is opposed by so many folks in the vast majority of the agriculture and its interests in Wyoming.

In summary, Marathon is opposed to any changes from the old agriculture policy that has served Wyoming well for three decades. Most provisions of the new rule were written to address issues of coal-bed natural gas development in the Powder River Basin. The reality is, almost no effect -- there will be almost no effect on coal-bed natural gas producers as relates to livestock watering, but there could be severe negative consequences to conventional oil and gas discharges. Thank you.

VICE CHAIRMAN WELLES: Thank you very much.

Do you want to take a break?

MS. BEDESSEM: Sure. Five minutes?

VICE CHAIRMAN WELLES: Sure. Can we take a short --

MR. OLSON: Maybe a little longer.

VICE CHAIRMAN WELLES: Ten? Okay.

(Hearing proceedings recessed
10:35 a.m. to 10:47 a.m.)

VICE CHAIRMAN WELLES: Okay. Let's get started, please.

We'd like to keep moving along. Hopefully, it looks like with the number of people who have signed up, we can probably work right through. We might get done by 12:30 or so, but rather than break for lunch, that way people can get home before the snow really sets in and before it gets dark.

John explained to me there were two folks who had signed up early who had forgotten to check if they were making a presentation, and they did want to, so we're going back to them, because they got here early.

So Bart Brinkerhoff.

MR. BRINKERHOFF: I represent Encore Energy, which is the Elk Basin oil field outside of Powell. It's been the old Amoco field. Anadarko recently sold it to Encore. And they took over in March, and as soon as they bought out Anadarko, I told them one of the big concerns you better get on this chloride issue. The NPDES discharge issues, because we've got issues with the new regulations that are coming down from the DEQ. And so we've spent quite a bit of money hiring consultants. They've come out and walked our streams and checked for aquatic life and things like that. And they were going to bring a crew out in September and went to the DEQ and talked to them. They held off from that, waited for some changes, but we still have been working on portions of this. So we spent quite a bit of money already on it. And we've got five discharge points in Elk Basin that we monitor. One is for Montana, and four are for Wyoming.

Now, just an example, we had our gas plant permits in 2006 -- they made some changes in July -- and they had a dissolved zinc and iron issue on the gas plant, and we signed the paper saying we thought we could meet that. Well, we started having trouble meeting it, and we went back -- we also run a public drinking water out of Elk Basin, so we have a public drinking water system which we pump water from the Clark's Fork River to Elk Basin.

And we're having trouble with our discharge water. We got to checking around and we found that we were putting a little bit of chemical in our public drinking water that had dissolved zinc in it and it was showing up in the water leaving the gas plant and it was more than what the State would allow. So we changed the chemical to a potassium-based chemical and now we have no trouble passing it, but we chased this for about a year before we finally got it nailed down to where it was good enough for public drinking water, but not good enough for NPDES.

We're very concerned about it. I just want to make that point. We're doing things about it, we're checking into things. We spent money on it already. It's a big deal to us. Probably 20 miles of creek there that would be just a dry draw, except for two or three times a year, if it didn't have our NPDES discharge water going into it. Thank you.

VICE CHAIRMAN WELLES: Thank you, Bart. David Flitner.

MR. FLITNER: My name is David Flitner. I'm a rancher from Shell, Wyoming, and I'm here speaking today really on behalf of our ranch.

And having had the opportunity to look at the previous comments, I really think that maybe my comments today are both redundant and superfluous, because of the quality -- both the quality and content of what I've already heard this morning. I compliment the presenters on what they have said. And I certainly agree with nearly everything that's been said thus far.

I think that it might be well if we begin with a little bit of a historical context. And this is addressed to the Board, and hopefully it will put a little bit of perspective in the economic situation that agriculture faces today.

Sixty (sic) years ago today, the Japanese

Finally, the flows from the Oregon Basin wells are a cornerstone of our grazing program affecting over 150,000 acres of rangeland and some 20 ranch employees. The recreational business called The Hideout is our Cowboy Adventure program utilizing the same water and area. This business employs another 30 employees and their families, many of whom live on the ranch.

In conclusion, we all recognize that we're competing in a global economy. During my lifetime, our industry has survived drought, disease, several wars and a major depression.

What we cannot survive are well meaning but misguided government regulations of livestock water sources which are not based on solid scientific data.

I thank you for the opportunity to express my views before the committee, and I'd like to compliment both the Board and the staff of the DEQ. It's very obvious that you've done a great deal of hard work in conscientious manner and I salute you for this. Thank you very much.

VICE CHAIRMAN WELLES: Thank you, sir. We appreciate very much your comments.

MR. FLITNER: Thank you.

VICE CHAIRMAN WELLES: Well said.

John Robitaille.

MR. ROBITAILLE: Thank you, Mr. Chairman.

John Robitaille, Petroleum Association of Wyoming.

I'm not sure I can say anything that hasn't already been said. I think what you've seen today is a pretty clear feeling that there is not a problem with the current standards. And to my knowledge, I haven't been aware of any problem with the current standards. So I raise the question why are we changing? Is there really a problem out there? If there is, I'd sure like to know about it.

One of the -- one of the points that keeps being raised is more data collection. And that is a point that we also raise. We very much appreciate the table that was drawn up on sulfate and sodium. I wonder, would it be possible to have all of the constituents in a manner like that, where we go back and look at what would happen to any of these outfalls. And we keep talking about outfalls. How many -- how many wells are affected? That's something that I'd also be interested to know, because, typically, more than one well goes to an outfall, so I'd be interested to see if we can get that kind of data.

But how do we know that this grandfathering clause, which we wholeheartedly support, and we very much appreciate, but how do we know that's going to stand? I think we're kind of holding ourselves out there on a gamble and that scares me greatly.

If you wonder back, what would this state really look like, especially up in this area and over in the Powder and areas where we've had oil production for many, many years, what would that area have looked like if we would have instigated these rules 50, 60 years ago? That water wouldn't be there today. If these rules are instigated now, are we then preventing? Hard to say. I guess it comes down to technology and economics.

But I've been questioning that, as I sit and listen to the testimony of these livestock producers. And it's an interesting question, and one that really I've wrestled with. And I wonder what this country would look like. I can't imagine there would be the prosperity that there is today without this water that has been used, without problems, to my knowledge, for many, many years.

So I'd just question that, why are we changing these when, as we've heard today, we have not seen a great deal of problems.

One other thing. I graduated from the College of Agriculture, University of Wyoming several years ago, and one of the things that I learned there was water was not the only thing to go in a cow's mouth. It is important. It's important to their health and it's important that they have decent water, but it doesn't need to be human drinking water. Maybe we need to look at, you know, weighing the water versus all the other factors, the other forage factors. There's a lot of thing to a cow's nutrition, or sheep, whatever you got. So I think we kind of got to step back and look at that as well. You know, how important is this limit on this water that you've set? Is it really going to affect livestock production in such a way that we would see a measurable decrease, and then we get back into that discussion again and I'm not going to take you there today.

If we could go quickly to the redline version. And on page H-2, under (B)(i), the second paragraph here, it begins with in addition to the basic effluent limitations above. I'm not really sure what this exactly means. I'm having some problems with this in that in (i), it states that the limit will be achieved at the end of pipe.

The next paragraph, I guess you could assume that, but without it being explicit, I'm wondering if I have a discharge that goes down an ephemeral drainage into a reservoir, and for whatever reason we test the water in the reservoir, and something like this molybdenum comes up, am I going to be affected by that? Because it could have been associated with the soil on the way down, and the way this reads it would be associated with the discharge. So

I'd kind of like a little clarity there, if we could get it. And I would appreciate -- you know, if this is end of pipe, then can we make that a little more clearer? Because the way this -- the way this reads to me now that's not very clear at all.

Another point that has been brought up is the change in (B)(iii), the change from "or when the livestock producer" to "and the landowner." I want to remind you that over 50 percent of our state is owned by the federal government, the surface. And the landowner could very well imply a federal agency or a state agency. And I would urge the return to the original language, which reads or when the livestock producer. I think that will solve a lot of your problems.

I also very much agree with the comments that were discussed today. I think a lot of good points were made today, and I hope that they don't slip through the cracks. Which brings me to one other point, and unfortunately, I was not able to attend the previous meeting held by this board in Jackson. I was out recovering, but we had some representatives there that presented some information. One of them was a risk assessment, and another was a report by PJH Environmental, Penny Hunter, who presented the report. As I read the response to comments, I did not see that blatantly discussed, that they were -- that they were given to the board or that -- that they were given any credence. I just -- I would ask that the division and also the board go back and review this information that we gave you, because I believe it's very good. It's very good stuff. And it may -- it may, it may not change your mind a little bit on a couple of things, but it's very important good information, and it should be reviewed and given the proper level of acceptance.

So, you know, we would very much appreciate a redraft of the response to comments with some acknowledgment of these presentations. With that, Mr. Chairman, I'll be quiet so we all can go home.

VICE CHAIRMAN WELLES: Thank you, John.

And let the record be stated that request of DEQ on those comments. Thank you.

Margo Sabec.

MS. SABEC: Mr. Chairman and members of the Board. I'm Margo Sabec, S-A-B-E-C, from Casper, representing Devon Energy. I want to speak today specifically to the grandfathering provision that's contained in the current draft, and make it very clear that Devon Energy supports that grandfathering provision. And I think you've heard from the testimony today how important that grandfathering provision is.

The reason that we support it is because the agriculture producers who have been using or have been affected by the pre-1998 discharges have testified here and previously that there is no harm to livestock or crop production associated or caused by that produced water. They've not provided any evidence of any decrease in crop or livestock production. In fact, they've testified to an increase in stock and livestock production -- or livestock and crop production, both. And they want to continue to use that water and have that water available for their agricultural operations.

The goal of Chapter 1, Section 20, is to protect agriculture production by preventing a degradation of water to the extent that it would cause a measurable decrease in livestock or crop production. And after reviewing all of the evidence that's been presented to this Board and the numerous comments that had been submitted, DEQ properly came to the conclusion that there is no indication of reduced agriculture production associated with those pre-1998 discharges. They concluded that ag producers had been "overwhelmingly in favor" of retaining the use and availability of those discharges for their operations under the current effluent limits.

And DEQ also concluded that it is not necessary to modify the pre-1998 discharges, which are the current effluent limits, to achieve the goal of no measurable decrease in crop or livestock production under Chapter 1, Section 20. And those statements are found in their statements of principal reasons.

We support grandfathering because we believe there is no evidence of any harm caused by discharges under the current livestock effluent limits. You have 40 to 50 years of data in evidence from the Big Horn Basin showing a net benefit from use of this water. And from having it available in those stream channels for both livestock and wildlife.

DEQ concluded that the continued use of the existing livestock standards is appropriate and is supported by science and evidence. And they have in their statement of principal reasons documented there is no evidence of harm associated with agriculture uses under the current standards. So why, then, do we think there is a problem with grandfathering? It's because the Chapter 1 standards are deemed necessary. Chapter 1 sets water quality standards for the entire state, and they're deemed necessary to protect a class of use of water. The class of use that's being protected here is water for livestock consumption, and there are no differences in the livestock that's raised in the Big Horn Basin versus the Powder River Basin or elsewhere in the state.

As Dr. Raisbeck said in his report, he looked at the big three, that's sheep, cattle and horses. And if you're protecting the class of use of livestock consumption, you're looking at the same class of use statewide. There are not differences in that class of use between these two basins. So if the new, more stringent standards that are being proposed are necessary to protect that class of use to protect livestock drinking in one area of the state, then how can the State defend giving and providing less protection for livestock in another area of the state when that is challenged, which I believe it will be.

The Wyoming Outdoor Council and the Powder River Basin Resource Council have already appealed a similar grandfathering provision in the new Chapter 1 rules. And they call it an illegitimate way to justify existing pollution discharges. They claim it is arbitrary, capricious and abuse of discretion and not in accordance with state or federal law. So to suggest that grandfathering in this set of Chapter 1 rules will not be challenged I think may be naive.

Another concern we have with grandfathering is we have looked at the response to comments prepared by DEQ related to EPA's comments on the Chapter 1 rules, and we conclude from those that EPA does not support grandfathering. That, I believe, is a real concern, because EPA must approve -- these are rules now, they're Chapter 1 rules, and they must be approved by EPA.

Granted, EPA does not have rules for livestock watering, but I think the vulnerability of this grandfathering provision is if the state sets stringent standards in one area of the state to protect a class of use, which is livestock drinking and consumption, then why is that standard not necessary to protect that class of use in other parts of the state? And for that reason, I'm concerned that EPA will not approve the grandfathering provision. And if they do not approve it, then in order for the Chapter 1 rules to be finally adopted, grandfathering would have to be stricken from these rules.

There is an existing grandfathering provision in Chapter 2 which pertains to effluent limits for NPDES permits. I think that was done in 1978, and I would submit to you that we're in a very different political landscape today than we were in 1978 when that grandfathering was approved by the EPA. And certainly the most recent lawsuit brought challenging grandfathering under the current Chapter 1 rules is an indication that there is a fairly concerted effort out there not to allow grandfathering to stand.

With regard to grandfathering, DEQ has selected 1998 as the date that demarks historical discharges from new discharges, historical discharges being exempt from these new standards, new discharges, anything post January 1, 1998, being subject to these numerous stringent standards.

And they, based on their statement of reasons, they justify that date by reciting the number of outfalls that existed prior to that time versus the number that have come into existence since 1998. I think that using outfalls as a justification for that -- drawing that line in the sand is very misleading, because the number of outfalls does not tell you anything about the quantity of water that's being discharged, nor does it tell you anything about the quality of water that's being discharged.

So by saying that problems developed related to produced water in 1998 and subsequently, does -- is -- to me, I believe is a political determination, separate from an examination of a quantity and quality of water that was discharged prior to 1998 versus what's being discharged today. In fact, from our review of the data on quality and quantity of water, comparing the Powder River Basin to the Big Horn Basin, we have found that in those pre-1998 outfalls, far more water of far worse quality is being discharged and has been for decades.

We concluded that in 2005, in fact, 150 million barrels more water was discharged in the Big Horn Basin, and the electro -- electrical conductivity of that water is two to three times higher than it is in the Powder River Basin. So saying that because there were only 470 outfalls pre-1998 and now there are 8,000 doesn't tell you the picture.

You really need to look at the quantity of water being discharged and the quality of that water to understand if there is suddenly something happening in the Powder River Basin that is more threatening to the class of use which is livestock consumption than what was existing prior to that. So I think what is a concern for the grandfathering provision is that DEQ proposes to grandfather those discharges that produce far more water of far worse quality, and that is, I believe, an inherent vulnerability, if you will, to the grandfathering provision if and when that is challenged.

So if this Board would recommend adoption of these standards, only because you believe the pre-1998 discharges should be grandfathered, I think it poses a significant risk to water standard -- water quality standards for produced water statewide. If the producers have coal-bed methane discharges from the Powder River

Basin have better quality and less quantity, why are they not entitled to grandfathering? If coal-bed methane discharges in the Powder River Basin won't be affected by these new standards, and conventional discharges will, but must be grandfathered, then why are the new standards necessary? What is the -- what benefit is to be achieved by these new standards?

And I think that what we conclude is that grandfathering is so essential to the protection of these historic discharges, and that grandfathering provision is vulnerable, and, therefore, if you believe that grandfathering is justified by the evidence that you've seen, then I think that that forces you to a conclusion that the new standards are not necessary.

With regard to the landowner waiver, just want to draw the dashed line, I think, between what we're looking at here, which is Chapter 1, Appendix H, which applies to livestock, water standards, but really -- and I -- and Mr. Wagner referred to this, the way these livestock standards got in play, if you will, is through Powder River Basin Resource Council petition to the EQC for new -- for rulemaking to change livestock and wildlife, effluent limits, under Chapter 2, Appendix H. So those Chapter 2 Appendix H limits, they're effluent limits. They're not standards. Chapter 1 contains standards. Chapter 2 just has effluent limits for NPDES permits. That affects the oil and gas industry in that particular Appendix. Those effluent limits are deemed necessary under those Chapter 2 rules necessary for the protection of both livestock and wildlife consumption. That issue is still open before the EQC.

And the EQC, my understanding of where they are on that today, is that they are waiting for Dr. Raisbeck's report, and then they will take that issue back up. So I think it's very likely to assume that whatever gets adopted as a Chapter 1 standard, that's more stringent than what we have as a Chapter 2, Appendix H effluent limit will get brought over into Chapter 2, Appendix H, so that there will not be inconsistent effluent limits for permits for protecting the class of use of livestock and in Chapter 2 also wildlife.

Chapter 2, Appendix H, says that effluent limits under that Appendix for oil and gas discharge permits must be consistent with the Chapter 1 rules. So anything that happens under Chapter 1, Section 20, I think is going to have to be brought into Chapter 2. So I think that with regard to the landowner waiver, the reason that I see that as a -- as also being vulnerable to challenge, is that while a landowner may have the right and the authority to give a waiver to consent to the discharge of water that doesn't meet these new Chapter 1 standards on his property for livestock, I don't believe he has the authority to give that same waiver for the protection of wildlife. So I think that the landowner waiver, while very necessary for agriculture production, has some vulnerabilities because of the Chapter 2 protection of wildlife water as well.

So where do we think we should go from here? I think that what we have here is a recommended set of standards that are based on zero risk. And as you have heard from livestock producers over and over, their business is risk tolerant. It is not risk adverse, and they are in the business of raising crops and livestock and they manage those risks and need to be able to manage those risks. And having water is part of that risk management that livestock and crop producers really need. They need that resource and they can manage around that.

A zero risk policy is going to take water that livestock producers and agriculture producers could manage around, is going to take it off the landscape. What we would like to see as a next step is for DEQ to identify the actual data on each constituent on its list for livestock standards, and then provide us the data that says how does ambient water compare to that standard, what does that standard mean in relation to ambient water quality? And then in regard to oil and gas discharges and other --

because Chapter 1 will apply to all discharges, then what -- how many outfalls are sampled for each constituent, how many outfalls, more importantly, have not been sampled for that constituent, so how reliable is that data with regard to oil and gas data and how many exceedances are there as to each consistent -- constituent?

We think there are some in that list for which there is little and maybe no data, both in ambient and oil and gas produced water, and, therefore, it's -- you know, it's hard to assess what is the risk of adopting a standard for which there is no data to tell whether discharges or ambient water quality are going to exceed those standards.

So I think the representation that 90 -- over 99 percent of coal-bed discharges would not be affected by these standards may not be accurate because we're aware of some constituents on that list for which there is no or almost no data from the coal-bed discharges. Importantly, being on that list molybdenum, which is now one that would have a livestock drinking water standard.

Secondly, we would like the DEQ to identify and report on the actual water quantities and compare. The actual water quantities discharged pre-1998 to post-1998, and the actual water qualities pre-1998 to post-1998, so that it's clear that -- and more clear and more understandable what does that 1998 date mean and how vulnerable, then, is grandfathering and landowner waivers, those concepts that would create exemptions to these new standards.

Thank you for your time and I'd be happy to answer any questions.

VICE CHAIRMAN WELLES: Thank you very much, Margo.

And, Kathy, you can take a break here. I'd like to say something that doesn't need to be recorded.

(Off-the-record discussion.)

VICE CHAIRMAN WELLES: Thank you, Margo.

Next is Joe Dennis.

MR. DENNIS: Yes, I'm Joe Dennis. I farm in the Pavillion area and I ranch over east of Thermopolis, and the Murphy Dome oil field sits on part of my ranch. I have no love for the oil companies. In particular, they're a pain in the butt, but I love that water they produce and I need that water they produce. For many of my pastures it's the only source of water.

And I guess I just have to go why are we changing, or why we changing now? Your own people have said there have been no problems reported. I'm not aware of any ranchers that have low conception rates. I'm not aware of anybody reporting fish die-offs. I don't think anybody's said wildlife has been damaged by this water.

COMMENTS – SEPTEMBER 14, 2007

PAW & Member Companies

Waste & Water Advisory Board Meeting

CHAPTER 1 WATER QUALITY RULES AND REGULATIONS

Resubmitted by

PETROLEUM ASSOCIATION OF WYOMING

August 26, 2008

? devon

Devon Energy Production Company, L.P.
20 N. Broadway, Suite 1500
Oklahoma City, OK 73102

September 14, 2007

Wyoming Department of Environmental Quality
Water and Waste Advisory Board
Herschler Building - 4W
122 West 25th Street
Cheyenne, Wyoming 82002

RE: Comments, Raisbeck et. al. *Water Quality for Wyoming Livestock & Wildlife*
Water Quality Rules, Chapter 1, Appendix H, Agricultural Use Protection

We at Devon Energy Production Company, L.P. (Devon) appreciate the opportunity to comment on the report *Water Quality for Wyoming Livestock &Wildlife* prepared by Raisbeck et. al. (Raisbeck Report), the Department of Environmental Quality's evaluation of the Raisbeck Report, and any potential revisions of the current water quality standards for livestock and wildlife under Chapter 1, Appendix H, Agricultural Use Protection. Devon produces oil and natural gas in many areas of the state. We hold a number of WYPDES permits for the surface discharge of water produced in association with our production and we will be directly affected by the Agriculture Use Protection rule or policy, as well as any revisions of the current water quality standards for livestock and wildlife. Devon hereby incorporates the comments it previously submitted to the Advisory Board and to the Environmental Quality Council (EQC) regarding the various drafts of the Agricultural Use Protection standards, as they were published in policy and rule forms. In addition, we ask the Department of Environmental Quality (DEQ) and the Advisory Board to consider the following comments.

ENVIRONMENTAL QUALITY COUNCIL'S REMAND

At its February 16, 2007 meeting, the EQC found that the format and language of the proposed Appendix H would not clarify the way in which DEQ administers Chapter 1, Section 20. (*See* Excerpts from Transcript of February 16, 2007, EQC Meeting, attached as Appendix A). The EQC directed DEQ to remove the livestock and wildlife watering issues from the policy, and start from scratch, writing a rule limited to the protection of irrigation and agricultural lands, and obtaining the Advisory Board's input. Further, the EQC told DEQ to bring back a tight, focused regulation that is supported by good science. (*See*, App. A, p. 15, l. 7-11). DEQ has not complied with the EQC's order; instead, they started with the policy that was presented to the EQC in February with only minor modifications, and failed to clarify any provisions. DEQ failed to remove the water quality standards for livestock and wildlife and has not provided additional scientific evidence to support the Agricultural Use policy/rule.

<u>RISK MANAGEMENT PROCESS</u>

We believe that, to evaluate the current livestock water quality standards or consider changes to those standards, DEQ must complete a comprehensive risk management decision-making process. This same risk management process should be implemented whenever a rule or standard is being considered, including the proposed Agricultural Use Protection rule/policy. The risk management process DEQ should use has five steps:

- Step 1: Identify the Potential Problem.
- Step 2: Collect Data
- Step 3: Assess Risk
- Step 4: Evaluate Alternatives
- Step 5: Select the alternative

Documentation by DEQ of *each step* of the risk management process is essential to providing interested parties and the public a meaningful opportunity to provide comment. It is equally essential to provide the Advisory Board sufficient information upon which a well-reasoned and balanced recommendation may be made to the EQC. The livestock and wildlife water quality standards apply statewide and they directly affect many people and their businesses. If the oil and gas industry and/or livestock producers are negatively affected, other businesses and local governments will also be impacted. Therefore, the evaluation of the livestock water quality standards and the Raisbeck Report demands a rigorous collection of data, the detailed analysis of risk, and a comprehensive evaluation of alternatives. We ask the Advisory Board to require DEQ to complete and provide a detailed report on each step of the risk management process.

In the evaluation of all aspects of the Chapter 1, Section 20 Agricultural Use Protection policy/rule, including the livestock and wildlife water quality standards, each of the five steps of the risk management process will provide valuable and relevant information that should be considered prior to making a recommendation or decision. In each step of the process, DEQ and the Advisory Board must make assumptions and decisions. These assumptions and decisions significantly affect the outcome of the process, as they may involve the scope of DEQ's investigation of reports of decreases in livestock production, data collection, identification of other factors that affect stock production, the social and economic impacts, etc. For example, if DEQ assumes that *any* negative impact to livestock, no matter how minor, outweighs the benefits of having supplemental water supplies available in areas where little or no natural water exists, it will significantly affect the outcome of the risk analysis. Likewise, if DEQ assumes the background livestock production yield in Wyoming is the same as in states having significantly different climates, precipitation, forage conditions, topography, elevation, etc., it will significantly affect the outcome of the risk assessment. Similarly, if DEQ assumes the causal relationship between sulfate levels in water and weight gain for cattle in a confined feeding operation in another state is the same as on the open range in Wyoming, the risk assessment will deliver a very different outcome than if DEQ evaluates the background or naturally existing causal relationship on the open range in Wyoming. DEQ should identify and report on the basis for each such assumption and decision so interested parties and the public may provide additional information or comments.

DEQ has begun the work of several of the steps in the risk management process. However, we do not believe DEQ has done all of the tasks necessary to complete any of the steps. For example, here are some tasks we think are essential to evaluating the livestock and wildlife water quality standards:

- **Step 1: Identify the Potential Problem**

  In this case, the potential problem has been identified only by anecdotal testimony. We are not aware of any scientific, market, or other data submitted to DEQ that verifies anecdotal allegations of decreases in livestock production caused by the discharge of groundwater produced in association with oil or gas.

  Before it can quantify or measure a decrease in livestock production, we believe DEQ must first determine which characteristics or values it considers to be "production" under Chapter 1, Section 20. Not all livestock producers value the same characteristics, so DEQ must identify those production characteristics that can be readily quantified or measured, and that can and should be protected by water quality standards. These determinations will require DEQ to make assumptions and generalizations about livestock production across Wyoming. DEQ should identify and report on the basis for each such assumption and generalization so interested parties and the public have sufficient information upon which to submit information and comments to the Advisory Board.

- **Step 2: Collect Data**

  First, DEQ must identify the background or natural conditions for livestock production in the area as well as the natural variability in livestock production in the area and across the state, among species and breeds, among ages, etc. A few of the conditions that may affect livestock production include background water quality (surface and stock water wells), water quantity (the availability of and distance to water supplies), forage quality and quantity, climate (temperature, precipitation, drought), predation, etc. Identification and quantification of this background data is essential to the calculation of a measurable—or quantifiable—decrease in livestock production.

  Based on our preliminary review, we believe DEQ would find that agricultural production data shows there is a significant variation in livestock production from state to state, and across Wyoming. We believe livestock production rates in Wyoming vary due to a number of factors or influences, and that livestock production rates in this state are below the rates in some other states. Once DEQ has determined which "production" characteristics are protected under Chapter 1, Section 20, it should identify the background or existing production rates and values across the state and in areas where produced water is or may be discharged.

  Based on our preliminary review of surface water quality in the state, we believe DEQ would find that surface water quality varies widely within drainage basins and across the state, and for some constituents natural surface water far exceeds the standards recommended in the Raisbeck Report. Also, we believe DEQ would find that the water from a significant number of landowners' stock water wells exceeds the standards recommended in the Raisbeck Report. DEQ should evaluate existing water quality data for surface water supplies available to livestock and stock water wells, and collect additional data where necessary to be able to thoroughly characterize background water quality. Livestock is fenced off from many perennial streams, as well as ephemeral streams with reasonably predictable flows, so landowners can utilize those areas for crop production and targeted grazing. Thus, DEQ should first identify which water supplies are actually available to livestock, and then evaluate existing and new water quality data from those water sources.

We understand from the Raisbeck Report that the quality and chemistry of forage (dry matter) may affect standards for some constituents. If dry matter is considered in setting livestock water quality standards, then background conditions for forage quality and chemistry must be identified and quantified. We assume that the effects of dry matter and water quality on certain livestock production characteristics in confined feeding operations are significantly different than in open range conditions like those found throughout the state. It is reasonable to expect that forage conditions in Wyoming are very different than in most other states. We believe DEQ must evaluate background conditions affecting forage quality and quantity in order to put the Raisbeck Report in context for Wyoming, and also to be able to eliminate forage quality and availability as a factor affecting livestock production.

When DEQ has determined the livestock "production" characteristics or values it must protect under Chapter 1, Section 20, and the background or natural conditions and production rates for livestock, then it should investigate and collect actual data related to the anecdotal claims that groundwater produced in association with oil or gas has caused a measurable decrease in livestock production. In so doing, DEQ must identify, evaluate, and eliminate all other potential causes of a decrease in stock production. If DEQ is unable to verify the reports and claims that the discharge of produced water has caused a measurable decrease in stock production, then it should report to the Advisory Board that the current livestock and wildlife water quality standards are adequate. Many oil or gas produced water discharges have been in existence for years, during which time the water has been utilized by livestock. In addition to investigating anecdotal claims of negative impacts to livestock production caused by produced water, DEQ should collect data on stock production rates where produced water has been made available and evaluate the impacts that the discharge of produced water under the current livestock standards has on stock production.

If the Advisory Board determines there is evidence that the discharge of produced water under the current standards has caused a measurable decrease in livestock production, then DEQ should collect data on actual impacts to livestock production due to each constituent. While the Raisbeck Report provides some useful toxicological data, it is not an adequate risk assessment and should not be considered such. Rather, it is simply a review and summary of some of the scientific literature related to water quality for livestock.

As Dr. Raisbeck told the EQC at the January 17, 2007 hearing, the objective of the study was limited to "...a thorough review of the scientific knowledge base regarding water quality for the classes of livestock and wildlife in Wyoming". *Transcript, EQC Hearing, January 17, 2007, p. 13, ln. 1-10, emphasis added.* He explained that his team was comprised of scientists and this was not a regulatory or decision-making project. For example, he said that while he would tell the EQC if the literature says a constituent at a certain concentration or level would kill livestock, that is the end of what he is capable of doing. He assured the EQC that any decisions related to setting limits or standards rests with them. *Transcript, EQC Hearing, January 17, 2007, p. 13, ln. 1-10.* When asked if he would make recommendations from which the EQC could set livestock and wildlife water quality standards, Dr. Raisbeck responded, "I'm going to waffle on that one. As a taxpayer and a voter, I've got an opinion…[but]… I don't see that as my job as a scientist. …It's not our intent to produce a…regulation." *Transcript, EQC Hearing, January 17, 2007, p. 23, ln. 18 - p. 24, ln. 12.*

We ask the Advisory Board to direct DEQ to conduct a full risk management process, of which the Raisbeck Report is a small part of data collection.

- **Step 3: Assess Risk**

An evaluation of the current livestock water quality standards and any potential changes to those standards requires a numeric risk assessment. DEQ must follow a rigorous protocol to assess the range of risks associated with each constituent at various levels of concentration, and calculate the probability of risk. However, DEQ must first define what is meant by the risk assessment objective of a "measurable decrease" in livestock production. We believe the term "measurable" means the decrease must be quantifiable with certainty. In other words, it must be both actual and quantifiable. It is not enough that there is a possible, potential, or probable decrease in stock production—the decrease must be so certain that DEQ knows it to be measurable. Section 20 does not require DEQ to eliminate all risk; rather, it is responsible for assessing and managing risks. Clearly, there is a range of risks that are allowed under Section 20. As we understand it, many of the scientific studies reviewed in the Raisbeck Report identified potential risks due to water quality, but the findings were not significantly different than the control. We don't believe those studies are relevant to a risk assessment in which the objective is to identify the range of risks that, given the background conditions, will cause a "measurable" decrease in livestock production. In evaluating scientific data, DEQ must determine its statistical relevance.

To understand the range of risks posed by the discharge of produced water, DEQ must consider background conditions. For example, even if the scientific literature indicates there will be an impact to a production characteristic in a species from ingesting water with a constituent level of 1000 mg/L, if background surface and stock water quality for that constituent is 5000 mg/L, then the discharge of water having less than 5000 mg/L will not cause a measurable decrease in livestock production.

Livestock production in Wyoming is fraught with risk—it is not a business for the risk adverse. Stock producers regularly manage a variety of risks, including those related to climate, precipitation, loss of water supplies, changes in forage quality and quantity, disease, or predation. Many risks to livestock production are unpredictable or outside the control of an individual stock producer, such as market prices. We believe stock producers have numerous and differing goals or values, and routinely balance risks and benefits to achieve as many of these goals as possible. For example, a rancher may balance the risk of using poor quality water with the benefit of dispersing his stock over a broader area and utilizing forage where there is no other water supply. Or, he may balance the risk of using poor quality water with the benefit of protecting riparian areas from overgrazing and related impacts to natural water quality, as recommended in DEQ's

Grazing Best Management Practices guidelines. In any case, the balancing of risks is common practice in livestock production. In balancing risks, the goal is not to eliminate all risk, but rather to minimize risk while maximizing benefits. Chapter 1, Section 20 recognizes this concept and requires DEQ to prevent only those risks from the discharge of produced water that will cause a *measurable* decrease in livestock production.

- **Step 4: Evaluate Alternatives**

In this step of the risk management process, DEQ should first identify the risk management alternatives based on the data collected in Step 2. One alternative should always be "no action", as it is reasonable to expect that DEQ may conclude that no action—in this case, no change in the current livestock and wildlife water quality standards—is necessary. Then, DEQ must evaluate each alternative using the balancing criteria mandated in W.S. § 35-11-302(a)(vi). These balancing criteria require the collection of data as well as the identification and evaluation of a broad range of impacts, as prescribed by statute:

> W.S. § 35-11-302:
>
> (a) The administrator, after receiving public comment and after consultation with the advisory board, shall recommend to the director rules, regulations, standards and permit systems to promote the purposes of this act. Such rules, regulations, standards and permit systems shall prescribe:
>
> (vi) In recommending any standards, rules, regulations, or permits, the administrator and advisory board shall consider all the facts and circumstances bearing upon the reasonableness of the pollution involved including:
>
> (A) The character and degree of injury to or interference with the health and well being of the people, animals, wildlife, aquatic life and plant life affected;
>
> (B) The social and economic value of the source of pollution;
>
> (C) The priority of location in the area involved;
>
> (D) The technical practicability and economic reasonableness of reducing or eliminating the source of pollution; and
>
> (E) The effect upon the environment.

DEQ should identify, evaluate, and report on a broad range of potential impacts associated with any proposed change in the current livestock and wildlife water quality standards, including those recommended in the Raisbeck Report. It is not enough to simply publish notice of proposed standards and accept public comment. These are extremely complex technical issues and few people have the technical and scientific expertise to identify and evaluate the potential impacts of a change in standards. Without a comprehensive report from DEQ that explains the risks and benefits that were identified, considered, and how they were balanced, interested parties and the public do not have a meaningful opportunity to provide comment.

- **Step 5: Select the Alternative**
  The final step in the risk assessment process is the selection of the most scientifically sound alternative that is reasonable considering the balancing criteria in W.S. § 35-11-302. Prior to making a recommendation to the Advisory Board, DEQ should prepare a report that describes the selected alternative, and provides the scientific and technical basis for the alternative as well as how DEQ identified, evaluated, and implemented the balancing criteria. Then interested parties and the public would have adequate information to be able to provide relevant, helpful comments. Based on its reports and the information generated and comments received at each of Step in the risk management decision-making process, DEQ should recommend an alternative to the Advisory Board. The Advisory Board would then have adequate information on the matter to make a recommendation to the EQC.

We believe public input and comment is an essential part of each step in the risk management process, and that, at each step, DEQ should consider and address public input received in prior steps. However, we do not believe public comment is an adequate substitute for the agency's risk management process. The interested parties and public do not have the relevant data and technical and scientific expertise to perform the risk assessment. We believe DEQ has the burden of conducting a rigorous and thorough risk assessment and, in doing so, the agency must make the risks and benefits, as well as its assumptions and decisions, available to the public so that meaningful comment and input can be provided.

While the Raisbeck Report is a start in data collection, it is not sufficient for the adoption of new water quality standards. As Dr. Raisbeck said, that was not the objective of the project. We believe the Raisbeck Report and recommendations improperly rely on scientific studies in which the results were not significantly different from the control or were not subjected to an appropriate statistical analysis. Also, we do not think the Raisbeck Report identified or considered background livestock water quality or background conditions for livestock production in Wyoming, and therefore is not relevant to a determination of a measurable decrease in stock production or setting water quality standards. We ask the Advisory Board to direct DEQ to initiate a thorough risk management process and provide a detailed report at the conclusion of each step, with notice and an opportunity to provide comments, before proceeding to the next step. DEQ routinely requires this risk assessment process to set water, soil, and air quality standards for the cleanup of a contaminated site, so the agency has expertise in implementing it.

Again, thank you for the opportunity to submit our comments. If you have any questions, please feel free to contact me.

Sincerely,

Randall W Maxey

Randall W. Maxey
Regulatory Advisor

Marathon Oil Company submitted two letters from the US BLM

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Cody Field Office
P.O. Box 518
Cody, Wyoming 82414-0518

TAKE PRIDE IN AMERICA

JUL 17 2006

3100
(020)

Mr. Marvin Blakesley
Marathon Oil Company
1501 Stampede Avenue
Cody, Wyoming 82414

Dear Mr. Blakesley:

This letter is in response to your recent request that the Bureau of Land Management (BLM) consider opposing proposed changes to water quality discharge standards in the Big Horn Basin.

As you are aware, collectively, the freshwater discharges from oil and gas production have improved the riparian and wetland values on thousands of acres of public lands within the Big Horn Basin. In order to capitalize on the produced water the Cody Field Office has invested several tens of thousands of dollars to further improve these augmented wetlands. We would view any effort to stop the surface discharges as a negative environmental impact. Produced water directly benefits a variety of BLM resources and uses including watering for livestock and wild horses, stable flows for wetland and riparian communities, and shorebird and waterfowl habitat.

Specifically, Marathon's discharges constitute approximately 75 percent of the water Loch Katrine, a playa in the extreme northern end of the Oregon Basin Oil Field, receives. These discharges help support a 1,200 acre wetlands complex and over 850 intermittent acres of water within a sagebrush and mixed grass steppe community. The produced water increases the size of the wetland by 200 to 600 acres, and directly contributes to an added annual production of 500-1000 shorebirds and 500-1000 waterfowl. Further, produced water also drains into Oregon Coulee and Coal Mine Draw which contributes significantly to stable flows in the upper Dry Creek drainage. The wetland and riparian habitats associated with this drainage is substantially enlarged by the increased flows, especially during the naturally low flow periods of late summer.

The BLM funded a contaminants study in the early 1990s to assess possible negative impacts to waterfowl and the wetland environment in Oregon Basin. The study was conducted by the U.S. Fish and Wildlife Service and the conclusion was that wetlands were benefiting significantly from the produced water.

If we can be of further assistance, please contact Mary D'Aversa at (307) 578-5900.

Sincerely,

Michael J. Blymyer

Michael J. Blymyer
Field Manger, Cody

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Cody Field Office
P.O. Box 518
Cody, Wyoming 82414-0518

RECEIVED
JUN 19 2000
ENVIRONMENTAL, SAFETY AND REGULATORY

3160
(020)

Marvin Blakesley
Marathon Oil
1501 Stampede Avenue
Cody, Wyoming 82414

JUN 15 2000

RE: Beneficial Use of Produced Water WY-0001899; WY-0022900; WY-0001911; WY-0001902

Dear Marvin:

This letter is in response to you recent request for notation of beneficial uses associated with your freshwater discharges in Oregon Basin.

As you know, part of Marathon's discharges drain into Loch Katrine, a playa lake in the extreme northern end of the field which consists of a 1,200 acre wetlands complex sustained by 866 intermittent acres of water within a sagebrush and mixed grass steppe community. Loch Katrine now receives approximately 75 percent of its water from the Oregon Basin Oil Field. Produced water increases the size of the wetland by 200 to 600 acres and directly contributes to an added annual production of 500-1000 shorebirds and 500-1000 waterfowl.

Produced water also drains into Oregon Coulee and Coal Mine Draw contributes significantly to stable flows in upper Dry Creek Drainage. The wetland and riparian habitats associated with these drainage are substantially enlarged by the increased flows, especially during the naturally low flow periods of late summer.

Collectively, the freshwater discharges have improved the riparian and wetland values on well over 1,000 acres. This office has invested several tens of thousands of dollars in further improvements of these augmented wetlands and would view any effort to stop the surface discharges as a negative environmental impact. The BLM funded a contaminants study a number of years ago to assess the possible negative impacts to waterfowl and the wetland environment. That study was conducted by the United States Fish and Wildlife Service and the concluded that the wetlands were benefitting significantly from the produced water.

If we can be of further assistance, please contact me at (307)578-5909.

Sincerely,

Tom Hare

Tom Hare, Asst. Field Manager

Ag Use Testimony: September 14, 2007

Hello, my name is Dave Applegate and I live in Casper, Wyoming at 1360 Bretton Drive. I work for Anadarko Petroleum Corporation in their environmental and regulatory group. I am testifying today on behalf of the Petroleum Association of Wyoming of which Anadarko is a member.

Anadarko has keen interest in the proposed Agricultural Use Rule as we have both conventional and coal-bed methane projects that could be affected by new rules that are being developed and that may be developed in the future for produced water discharges.

I hope to frame up for you today why the members of PAW believe that more needs to be done before new rules requiring more stringent water quality discharge standards for Produced Water are adopted. To that end, we have put together several poster boards that represents what we believe is the typical process for making risk management decisions. I would like to walk through several of these diagrams with you in a general sense. The testimony today from several industry members will connect back in many cases to this Risk Management Process.

The Risk Management Process is generally the same whether it is for cleaning up hazardous waste sites, implementing safety standards for motor vehicles or children's toys, or setting new water quality standards. The process includes as a first step the identification of a *potential problem*. I'll use as an example today, a project for which I have some detailed experience – the old Amoco Refinery cleanup project in Casper. I worked for seven years on that project – the last three as the engineering manager responsible for implementing the selected risk management alternatives. I might note it was a project that generated nearly the same level of emotional investment and controversy that we see with the proposed Agricultural Use Rule.

For that old refinery, the presence of offsite groundwater contamination, tar-like sludges on off-site properties, and oil seeps to the North Platte River were strong indicators that a problem involving environmental risk existed.

Once a potential problem is identified data is most often collected to better understand the *nature and extent* of the problem. The refinery example is illustrative of a risk management problem that involved a large degree of data collection. Groundwater, soil, air, and surface water samples were selected for a long list of chemical constituents resulted in literally tens of thousands of pieces of data.

Keeping with the refinery cleanup example, we now go to box three in our Risk Management Process and conduct a detailed risk assessment. The Environmental Protection Agency (EPA) has strict protocols on how this type of risk assessment is performed for hazardous waste sites, but suffice to say it includes conceptual models describing the various risks associated with the soil and groundwater contamination identified by the collected data, a review of background chemical concentrations, the toxicology of chemicals that have been identified to be present, and the duration of potential exposures.

One note on background – that will be pertinent later in this discussion – there are natural levels of arsenic in the soil around Casper that exceed the target cleanup levels

See Att.

that EPA would often establish for a hazardous waste site – radon and arsenic from soil, benzene from forest fires – they are natural carcinogens in the environment. The natural environment is not risk free!

If the risks identified in Step 3 are determined to exceed a certain threshold – I might add that in the world of hazardous waste the threshold is quite low – then the next step is to evaluate alternatives for managing the risk. This takes us to the fourth box in our process where *different alternatives for managing the risk are developed and evaluated* against a set of balancing criteria. The balancing criteria are imposed by statutory language and in Wyoming, cleanup alternatives - including the *no action alternative* - are compared against each other in terms of their implementability, risk reduction, and cost - to name just a few of the balancing criteria.

Finally, we get to the last box of the Risk Management Process which is selection of an alternative. In deciding what to do at the old refinery, WDEQ used a rigorous, detailed, and thoroughly documented analysis of the alternatives and public input as a basis for a negotiated cleanup agreement.

I might note - this advisory board saw the fruits of this systematic approach to risk management at their last meeting which was held in the new Wyoming Oil and Gas Conservation Commission now located on the old Amoco refinery property. Perhaps it is also worth noting that the *residual risk at the former refinery site is not zero* – the selected alternative did not eliminate all risk, at least not in the short-term. For example, groundwater contamination remains at the old refinery and will for a very long time.

I have obviously spent some time in going through a rather detailed example of the Risk Management Process with the purpose of illustrating that a similar process is at the very least consistent with the statute outlining the establishment of new water quality standards in the state of Wyoming.

To this end, I would like us to look at another chart that illustrates these same process steps in the establishment of new Agricultural Use Standards for produced water discharges in Wyoming. PAW believes that these steps should be completed in a systematic way in the development of the proposed Ag Use Rule and hope to demonstrate this point in our testimony. This is not meant to detract from the work that has been completed to date by WDEQ - in fact effort has been directed to some extent to nearly all aspects of the Risk Management Process, but we believe more needs to be done. I would like to provide just a few examples that will be described in more detail by others who will testify after me.

Data Collection: Let's start with what might be missing from the data collection aspect of the process as it pertains to the proposed Ag Use Rule.

1) What are background surface water and groundwater conditions in the geographic areas where these new rules will most likely apply? What is the quality of water, for example from groundwater wells permitted for stock use and how does that data compare to potential new livestock standards for produced water discharges?
2) What harm is being incurred at this time by produced water with the existing water quality rules? For example, anecdotal evidence is sometimes presented at

these hearings suggesting agricultural harm from produced water. Have we systematically investigated and categorized the nature and extent of this harm such that the benefits of the new rules can in some sense be quantified? *Again, I am reminded of anecdotal evidence presented by very reliable sources during the cleanup of the old refinery indicating that chlorinated solvents had been used and spilled at the old refinery during its operational life. Several soil borings samples were collected in locations that were suspected to have been impacted by this family of chemicals. The actual soil and groundwater data did not indicate that impacts from these solvents remained at the property – one can speculate that the spilled amounts were not large enough to be detected or that the solvents had either evaporated or migrated away – in any case, WDEQ concluded there was no significant risk associated with this particular anecdotal testimony.* In a similar manner, the anecdotal evidence suggesting produced water has adversely impacted – or caused a measurable decrease in – livestock production should be thoroughly investigated and documented by WDEQ.

Assess Risk: WDEQ commissioned a study to understand the toxicology of water quality parameters as it relates to livestock. That is the particular focus of today's meeting. Risk Assessment as a specialized science, however, is more than a review of literature, regardless of how comprehensive that review may be.

1) Has WDEQ defined what a "measurable decrease in crop or livestock production" means? What does the term "production" mean in the context of this proposed rule? If it is weight gain in livestock then what are the baseline conditions to which the metric of "measurable decrease" is compared? Is the comparison to baseline feedlot conditions or is it to range conditions as they might exist in the absence of produced water or stock well water, or is it to some other baseline condition?
2) What are the statistical parameters surrounding the current risk under baseline conditions and under the proposed set of new standards? In other words, will the benefits of the proposed rule be measurable? Are the benefits of the new rule statistically significant?
3) These risk assessment questions are quite technical in nature and Penny Hunter of PJH Environmental, Inc. will be testifying today to further clarify our input on the potential livestock standards as presented in Dr. Raisbeck's draft report.

Evaluate Alternatives: Finally, under the heading of evaluate alternatives we believe Wyoming Statute 35-11-302 requires a systematic and transparent evaluation of new water quality standards using a set of balancing criteria. We are not suggesting that WDEQ necessarily produce the quantity of work that was associated with the Risk Management Process at the old refinery – I brought some notebooks today to illustrate the comprehensive nature of that Risk Management Process – there were 10, 3-inch binders containing the data and data summary efforts, here is the two volume risk assessment, and here is the evaluation of alternatives. Finally – here is the Remedy

Agreement – the equivalent of a new rule – a set of soil and groundwater standards for a particular piece of contaminated ground in the heart of downtown Casper.

Yet, while the Casper refinery project involved different circumstances than we are talking about today, the process of data collection, risk assessment, and the identification and evaluation of alternatives is similar when setting water quality standards that apply statewide and effect two major industries of the state – that being agricultural and oil and gas.

Hence, PAW is suggesting that a document be developed that provides a degree of transparency on how the competing interests that will be visible today are balanced.

1) What are the social and economic values of the produced water discharges as currently allowed under existing water quality standards?
2) What is the benefit to the environment, animals, and plants of reducing pollution from current levels to the proposed levels? Are these benefits statistically significant and measurable?
3) Is the reduction in discharge standards technically achievable? Do we anticipate that less water will be discharged if the new standards are imposed? If yes, how much less water and do we have any sense where the geographic location of reduced discharges may be?
4) What of legal questions and challenges – Currently WDEQ indicates the application of these new standards only for discharges permitted after 1997. This provision will necessarily be challenged – is this provision for historic discharges technically defendable? How was this date determined? If surface discharges need to meet these more stringent livestock standards then what about future challenges to stock well water quality?

I have obviously raised a number of difficult questions. Other representatives of PAW will now testify to further clarify our input on the Risk Management Process and to provide our input at it relates to answering some of the questions that I have raised. Thank you for your time today.

Risk Management Considerations for Wyoming Livestock Water Quality Criteria

September 12, 2007

Prepared for:

Petroleum Assocation of Wyoming
951 Werner Court, Suite 100
Casper, WY 82601

Prepared by:

Penny Hunter
PJH Environmental Inc.
Boulder, CO
303-818-1978
pennyjhunter@gmail.com

Executive Summary

The Wyoming Environmental Quality Council (EQC) is considering updating numeric chemical constituent criteria in Chapter 1 of the Wyoming Water Quality Rules and Regulations. The updated criteria are proposed for the protection of livestock. The proposed ruling has been put on hold until the EQC reviews a risk assessment completed by the University of Wyoming (Raisbeck et al. 2007).

While a risk assessment is a valuable tool for identifying the nature and magnitude of animal risks, a risk assessment does not provide all of the information the EQC needs for a balanced decision-making process. As mandated by the state (W.S. 35-11-302), the EQC must consider a range of effects on the people, animals, and plants, as well as social and economic values. In effect, the state mandates that a risk management evaluation be performed before final selection of water quality criteria.

This paper reviewed the findings of the University of Wyoming's risk assessment ("UW report") in the context of a risk management framework. The review focused on three constituents: fluoride, sulfate and sodium, because these constituents are already regulated by the state and criteria recommended in the UW report appear to contradict other assessments (e.g., Geomega 2007) as well as published water quality criteria for livestock.

The review found that the UW report does not contradict the current fluoride, total dissolved solids (TDS) and sulfate criteria for the protection of livestock as defined by the EQC. The UW-recommended criteria for sulfate and fluoride differ from the current limits because toxicological endpoints considered in Raisbeck et al. (2007), which were consistent with protection of dry matter intake rates and dental hygiene, differ from the goals of the EQC: protection of growth and reproduction and prevention of acute effects. References provided in UW report support statistically significant effects from sodium exposure over 2,000 mg/L (5,000 NaCl equivalent) and sulfate exposure near 3,000 mg/L for protection of growth and reproductive endpoints. Additional literature review for sulfate, and anecdotal accounts from Wyoming livestock owners, indicate that exposure of cattle to as much as 3,100 mg/L sulfate is not likely to result in adverse effects on growth and reproduction. Available fluoride literature pertaining to growth and reproductive effects supports a 4 mg/L water quality criterion.

The data presented in the UW report and elsewhere were also considered within the larger risk management framework by evaluating three kinds of balancing criteria relevant to Wyoming's citizens and their livestock industry: practicability, natural industry variability, and incremental risk. The analysis found that lowering these criteria to levels recommended by the UW report is not practicable and will not result in any incremental risk reduction in growth or reproductive effects to cattle. Moreover, changing the water quality criteria to those recommended in the UW report will not balance the potential positive effects on livestock from changing water quality compared to negative effects on ranchers, other industries, and potentially the state from lost water availability.

Many of the conventional oil and gas produced water discharges in Wyoming will not meet the UW report's recommended water quality criteria, as well as some coal bed methane gas producers. It is not practicable for these surface water producers to treat water to meet the proposed criteria. Many producers have indicated that re-injection will be a likely alternative if faced with unnecessarily stringent water quality standards, resulting in lost water availability to Wyoming citizens and their livestock. The ramifications of lost water quantity will far outweigh the potential benefits to livestock. Moreover, it is of questionable practicability for industry to meet the UW-recommended criteria for sulfate, sodium and fluoride when the reality in Wyoming is that natural background water quality alone does not meet these criteria in many cases.

Natural industry variability in cattle production was calculated from USDA data sets and compared to a metadata analysis of literature data on sulfate exposure to cattle (there was not enough data to run a similar analysis for fluoride or sodium). The metadata analysis shows that variability in cattle production as much as 5% may occur if cattle are exposed to sulfate levels between 1,200 mg/L and 3,000 mg/L. However, this potential variability in cattle production is within natural industry variability for Wyoming, suggesting that there is no added degree of injury to livestock from exposure to current sulfate limits.

The incremental risk to livestock growth, reproduction or acute effects from exposures to current water quality limits is essentially zero compared to natural background water quality. This is because cattle are already exposed in many cases to sulfate, sodium or fluoride concentrations near current limits. Thus, there would be no reduction in the "degree of injury" to animals if the water quality limits were changed.

Table of Contents

Tables

Figures

1 Introduction

The Wyoming Environmental Quality Council (EQC) is considering updating numeric chemical constituent criteria in Chapter 1 of the Wyoming Water Quality Rules and Regulations. The updated criteria are proposed for the protection of livestock (the proposal is referred as the agricultural use rule). The proposed ruling has been put on hold until the EQC reviews a risk assessment completed by the University of Wyoming (Raisbeck et al. 2007).

While a risk assessment is a valuable tool for identifying the nature and magnitude of animal risks arising from exposure to environmental constituents, a risk assessment does not provide all of the information the EQC needs for a balanced decision-making process. As mandated by the state (W.S. 35-11-302), the EQC must consider a range of effects on the people, animals, and plants, as well as social and economic values. In effect, the state mandates that a risk management evaluation be performed before final selection of water quality criteria.

This paper presents a risk management framework and reviews the findings of the University of Wyoming's risk assessment ("UW report") in the context of this framework. Secondly, the data presented in the UW report and elsewhere are considered within the larger risk management process by evaluating some balancing criteria that are relevant to Wyoming's citizens and their livestock industry.

2 A Risk Management Framework

The risk assessment (Raisbeck et al. 2007) provided a toxicological analysis of some of the constituents under consideration in the proposed ruling. However, the risk assessment did not provide all of the information the EQC needs to achieve a risk management decision. In fact, Wyoming statute mandates that the state consider a range of criteria before recommending water quality standards. These criteria (W.S. 35-11-302(vi)) include:

(A) the character and degree of injury to or interference with the health and well-being of people, animals, wildlife, aquatic life and plant life affected;

(B) the social and economic value of the source of pollution;

(C) the priority of location in the area involved;

(D) the technical practicability and economic reasonableness of reducing or eliminating the source of pollution; and

(E) the effect upon the environment.

In effect, the state requires a risk management evaluation before setting water quality criteria. Risk management is the process of determining which action to take when a risk assessment indicates that a probability of harm exists. The goal of the risk management process should be to determine an acceptable threshold of effect that incorporates the values of the state's citizens and balances the benefits and costs to all affected parties.

Risk management is regularly employed at every level of regulatory decision-making following roughly the same procedure (Figure 1). Risk management evaluations will generally include:

1. Identification of a potential problem: a potential problem to public or animal health will be identified through anecdotal evidence, report or data collection. In the case of the proposed ruling, public input was basis of identifying a potential problem with water quality criteria for livestock.

2. Data collection: a complete characterization of the site or media in question is conducted, as well as collection of background or "baseline" conditions. This can include sample collection and/or toxicological literature review. Data collection so far for the proposed ruling has included some toxicological review.

3. Risk assessment: a rigorous protocol is typically followed, which includes problem formulation, exposure and effects analysis, and risk characterization. Considerations of background and site-specific data will be incorporated into the assessment. A risk assessment was submitted to the EQC (Raisbeck et al. 2007) for consideration in the proposed ruling.

4. Alternative evaluation: a feasibility study or equivalent is conducted that evaluatess a number of alternative actions to reduce risk. Alternative evaluation considers the impact of an action on protection of human health and the environment, of source control, feasibility of meeting the standards, and impacts to other resources as a result of the action (i.e., increased risks elsewhere). Wyoming mandates that several balancing criteria be evaluated, as listed in W.S. 35-11-302(vi)).

5. Alternative selection: the final step in the risk management evaluation is to select the best alternative. Alternative selection will involve a description of the selected remedy, and the justification for that selection. The final step for the EQC will be to select water quality criteria for livestock that are protective of growth, reproduction and acute effects.

The risk assessment partially fulfills the evaluation process for the ruling proposal (Figure 2), however, important data gaps remain. A key item needed to complete the risk management evaluation is to define the term "measurable decreases," a concept that forms the basis of EQC's criteria selection for livestock protection. This paper proposes to more precisely define "measurable decreases" by considering toxicological and statistical relevance of the UW report findings.

To achieve a risk management evaluation, however, it is not enough to identify a statistically significant and toxicologically relevant effect; the effect must be put into context of relevancy to Wyoming's citizens and their livestock industry (i.e., alternatives evaluation). Therefore, a number of balancing criteria are presented which put the risk assessment data in the context of some larger risk management considerations. These balancing criteria include practicability, normal industry variability and incremental risk.

3 Review of UW Report in a Risk Management Framework

This review focused on three constituents: fluoride, sulfate and sodium, because these constituents are already regulated by the state and criteria recommended in the UW report (Raisbeck et al. 2007) are incongruous with other assessments (e.g., Geomega 2007) as well as published water quality criteria for livestock.

According to the proposed ruling, the aim of the surface water quality criteria is to prevent a "measurable decrease" in livestock production (Appx H, a, p H-1). The proposed ruling explains that the basic concept behind protecting livestock production is to "ensure that water quality is not acutely toxic to livestock or does not contain pollutants in concentrations that would affect growth or reproduction. (section b.i., p. H-2)."

No further definition of livestock protection is provided in the proposal. Consequently, what constitutes a "measurable decrease" in livestock production is subject to wide interpretation, but not all interpretations are relevant, given the more explicit definition that follows, which is the protection of growth and reproduction, and prevention of acutely toxic responses.

Moreover, protection of livestock endpoints relevant to the livestock industry is implicit in the definition of "livestock protection" because livestock is a commodity. Thus, indices of growth, reproduction or acute effects should have industry values in mind, and these values can differ from considerations of non-commodity populations of animals.

We propose that the term "measurable decreases" can be more precisely defined by selecting appropriate toxicological endpoints and evaluating statistical relevance that are relevant to livestock industry values, and reviewing the findings of the UW report within this context. Statistical relevance and toxicological endpoints are two basic concepts utilized in risk assessments and risk management evaluations. Statistical analysis provides an objective means to determine what constitutes a "measurable" effect. Toxicological endpoints are explicit statements of an environmental value that is to be protected.

3.1 Statistical Relevance

Statistical analysis provides an objective means to determine whether an observed phenomena is the result of random chance or if there is a relationship between two variables, such as exposure to sodium and effects on milk production. Thus, statistical relevance is the essence of a "measurable" effect. A toxicological study or data analysis that does not identify a statistical effect therefore can not objectively identify a "measurable decrease."

Statistical significance is often expressed in terms of a p-value (the probability of error). The p-value represents an index of reliability of a result. The lower the p-value, the more probable that the relation between 2 (or more) variables in the test is a reliable indicator of the relation between those variables in the population. Standard statistical analyses for environmental effects include determining significant differences between populations to $p<0.05$ or in some cases, $p<0.1$ (ASTM 2002).

Furthermore, when quantifying a threshold of effect on a species, statistical differences between populations exposed to varying levels of an environmental constituent are needed. Ideally a no-adverse effect threshold or level (NOAEL) and low-adverse effect level (LOAEL) should be identified by statistical analysis. The NOAEL selected represents the highest dose reported not to have an adverse effect on the test animal, while the LOAEL represents the lowest dose reported to have a significant adverse effect on the test animal. Both LOAELs *and* NOAELs are important to the risk analysis process, because the two numbers essentially characterize the full range of probability of effect. Both risk assessments and risk managers must consider the full spectrum of probability of effect in order to draw conclusions about risk. A risk assessment which has only considered NOAEL effects, for example, has not identified a "threshold of effect;" consequently, a risk management decision based only on an evaluation of a NOAEL can bias decisions unnecessarily low.

3.1.1 Sodium

Of the endpoints identified in UW report's derivation of criteria, only sodium's endpoints are consistent with EQC's objectives for chronic livestock protection (growth and reproduction). However, upon review of the references provided for the sodium criteria (Table 1), none of the references supplied identify a 1,000 mg/L sodium (Na) NOAEL. In fact, only 2 references are provided that report effects on milk production in which only Jaster et al. (1978) shows a marginally significant effect ($0.05<p<0.08$) on milk production at 5,000 ppm Na (12,600 mg/L sodium chloride (NaCl) equivalent). Additional studies not referenced in the UW report (Table 2) show no effect on milk production from sodium intake of at least 3,500 mg/L NaCl (Bahman et al. 1993). Solomen et al. (1995) reported a faster rate of decline in milk production in cows exposed to 870 mg/L NaCl compared to a control group exposed to 325 mg/L NaCl; however both groups were essentially sodium deficient, as daily nutritional requirements of sodium for cattle are at least 0.1%, or 1,000 mg/L NaCl (NRC 2005).

Of the studies on cattle growth (3 referenced), none identified a statistically significant NOAEL. Harvey et al. (1986) attempted to identify a NOAEL of 2,250 ppm Na (5,700 mg/L NaCl equivalent) based on a growth decrease of 0.18 kg per day in corn silage-fed cattle over the 84 day trial, but this rate of growth was not statistically different than the control group. Furthermore, the study reported a growth *increase* of 0.04 kg per day in livestock given 17,890 ppm Na (45,500 mg/L NaCl equivalent) when livestock were fed roughage diets.

Some studies were only partially referenced in the UW report, for example, the sodium experiment on rats by Heller (1933) was referenced, but not the experiments on cattle or other livestock. Other relevant studies were not referenced at all. An additional 16 studies specific to chronic sodium exposure to cattle are available (Table 2) that are peer reviewed and statistically identify NOAELs and/or LOAELs. These additional studies show that a concentration of 5,000 mg/L NaCl (1,970 mg/L Na equivalent) did not affect cattle growth or reproduction.

In the absence of sodium data, the UW report recommended a default limit of 500 ppm total dissolved solids (TDS) to protect livestock. The individual constituent makeup of TDS in Wyoming's surface water bodies is variable; some of produced water effluent is NaCl-dominated (Geomega 2007). However, even with magnesium or potassium-dominated TDS waters, no effects were found lower than 6,000 mg/L TDS (Embry et al. 1959). In fact, the US EPA (1976) advises that the lowest TDS water quality limit for livestock and poultry (those exposed to highly alkaline waters containing sodium and calcium carbonates) be 5,000 mg/L. This is also consistent with NRC (1974, 2005) recommendations of 5,000 mg/L TDS for all livestock.

Sulfate can also dominate TDS concentrations, but criterion for this constituent is already addressed. Thus, the 500 ppm TDS criterion is not supportable, either by the references provided in the livestock report or by the general literature.

3.2 Toxicological Relevance

Toxicological endpoints are explicit statements of an environmental value that is to be protected. Toxicological endpoints should be developed following consideration of the structure and function of the system that is to be protected, policy goals and other societal values (USEPA 1998). Endpoints are vaguely described in the proposed ruling as "ensur[ing] that water quality is not acutely toxic to livestock or does not contain pollutants in concentrations that would affect growth or reproduction. (section b.i., p. H-2)."

To more precisely define toxicological endpoints, adverse growth effects should be specifically defined as weight loss measured over a chronic (i.e., long term) time period. Indirect indices of growth, including feed or water intake rates and digestibility should not considered adequate endpoints in themselves to evaluate the potential effects on growth of livestock species, because research has shown that there is considerable individual variation in feed and water intake above and below that expected or predicted on the basis of size and growth (e.g., Zinn 1994, Hickman 2002, Schwartzkopf-Genswein 2004). Individuals of the same body weight often require widely different amounts of feed for the same level of production (NRC 2000). In addition, some early studies considered microorganism changes in the ruminant gut, or other types of biochemical changes in the body, as an indicator of adverse effects (NRC 1980), but these effects have not been clearly correlated with growth impairment. Thus, only studies or risk assessments which measure the effect on weight loss or gain in addition to intake rates or other performance parameters such as digestibility should be used to form the basis of livestock water quality limits under consideration by the EQC.

Similarly, adverse reproductive effects should be defined as declines in calving rates, or milk production rates. Other measures of reproduction which are not relevant to the livestock industry should not be considered in the context of the proposed ruling.

Finally, the term "acutely toxic" should refer to the mortality or adverse effects clearly linked to death or loss of livestock marketability on organisms following soon after a brief exposure (less than 2 weeks; Hodgson and Levi 1987) to a chemical agent. Symptoms affecting marketability would include polioencephalomalacia (PEM), dyspnea, blindness, ataxia, hemorrhage, seizures, paralysis, cardiac arrest or coma. Conversely, symptoms such as diarrhea, dehydration, gut microbial changes, or mild behavioral changes are sometimes cited as "effects" in toxicological studies but should have no consequences to a livestock's potential marketability.

3.2.1 Fluoride

The UW report stated that the recommended water quality criterion for fluoride (F) was based on dental and osteal (skeletal) effects. The report concluded that a water quality criterion of 2 mg/L F should protect livestock from fluorosis, which generally consists of tooth discoloration and mottling. Except in extreme cases, this endpoint is neither a toxicologically nor an economically significant adverse effect. The U.S. Center for Disease Control and Prevention considers this a cosmetic effect harmless to the health of humans and Phillips et al. (1960) noted that there was no instance where tooth mottling decreased the economic value of livestock. In all of the studies on the effects of fluoride in animals, none have shown that tooth mottling causes injury to cattle or other animals that is measurable in terms of milk production, feed consumption, weight gain, growth, reproduction, development, life span, or other effects relevant to livestock producers or toxicologists.

The National Research Council (NRC) review of fluoride toxicity in livestock identifies a criterion of 2 mg/L F for the protection of tooth mottling, but states, "At least a several-fold increase [from 2 mg/L] seems, however, required to produce other injurious effects." In fact, NRC (2005) recommends a limit of 40 ppm F for cattle, and higher limits for other types of livestock.

Of the studies reviewed in NRC (1980) that measured F effects on livestock growth and reproductive effects (Table 3), a minimum of 49 ppm F is identified to result in decreased milk production in dairy cows as reported by Stoddard et al. (1963). The current fluoride criterion for the protection of livestock is 4 mg/L; fluoride levels in Wyoming forage are low, about 25 mg/kg (Newman 1984), and hence there is no essentially no risk of additive dosing from forage content. The range of NOAELs identified from the studies on all types of livestock effects on growth or reproductive was 25 ppm F to over 200 ppm F. These findings are not consistent with a recommended fluoride criterion of 2 mg/L.

3.2.2 Sulfate

The sulfate (SO_4) review of effects on cattle was the most comprehensive compared to the other constituents (Table 4). "Acute" effects (PEM, death) from exposure to 2,000 mg/L SO_4 were stated in the UW report (but not referenced; p.54-55) but the references reviewed in earlier paragraphs provided do not support this statement. In fact, cattle exposed to at least 3,780 mg/L SO_4 (S content in dry matter not reported) resulted in suspected but unconfirmed cases of PEM (Ward and Patterson 2004). Other references indicate higher sulfate doses required to produce acute effects. Furthermore, in the Ward and Patterson (2004) study, death rates between groups given 390 mg/L SO_4 or 3,780 mg/L SO_4 were not statistically different. It should also be noted that the Ward and Patterson (2004) study occurred over a subchronic time period, not an acute timeframe. In fact, studies which met acute conditions reported PEM and other effects at much higher sulfate concentrations (>5,500 ppm SO_4 equivalent).

Although chronic water quality criteria were supposedly derived from growth endpoints, the chronic criteria were more consistent with feed efficiency and feed intake endpoints. The UW report stated that sulfate levels between 500 and 1,500 mg/L can result in adverse effects on growth, but none of the references provided support this statement. The provided references show that growth appeared not to be significantly affected at much greater sulfate exposures. Patterson et al. (2002) showed growth effects on cattle in a feedlot environment occurred at 8,780 ppm sulfate equivalent; if Wyoming's cattle are routinely exposed to 0.2% S in open range grasses (Raisbeck et al. 2007), the resulting water exposure would have to be ~2,700 mg/L sulfate to match the LOAEL identified by Patterson et al. (2002). Feedlot environments are relatively more stressful to cattle than open range; Johnson and Patterson (2004) demonstrated that the stressful conditions in feedlots resulted in reduced sulfate toxicity thresholds to growing cattle compared to conditions in open rangeland environments. In fact, on the open range, Johnson and Patterson (2004) found that 3,000 mg/L sulfate in drinking water did not affect growth. The findings in Johnson and Patterson (2004) match anecdotal accounts from Wyoming livestock owners, who have indicated that their cattle do not appear to be negatively affected by sulfate levels as high as 3,100 mg/L (Geomega 2007).

The form of S administered to livestock should be considered in a toxicology review. Sadler et al. showed negative growth effects at 7,200 ppm sulfate equivalent, but S supplements were administered in a magnesium-potassium compound, and growth effects have been found to occur and lower dosages from these constituents (Grout et al. 2006, Embry et al. 1959). Although Albert et al. (1956) reported a LOAEL of 500 ppm sulfur (S), the form administered was methionine, an organic form of S; it is well known (NRC 2005) that toxicity of sulfur depends heavily on the form of S administered, with sulfate being one of the least toxic forms of S. The water quality criterion under consideration is an inorganic S form (sulfate); thus, only inorganic forms of S should be considered in any toxicity review relating to this criterion.

The chronic sulfate limit identified in the UW report is consistent with the studies referencing effects on dry matter and water intake rates. As reported by Harper et al. (1997), dry matter intake rates of cattle exposed to 1,000 mg/L SO_4 were statistically lower when on a low nutritional diet. Sulfate content of the dry matter consumed was not reported, so at a minimum of 0.01% sulfate in dry matter, this would result in an equivalent LOAEL of 1,200 mg/L SO_4.

4 Balancing Criteria

It is not enough to identify a statistically significant and toxicologically relevant effect; the effect must be put into context of relevancy to Wyoming's citizens and their livestock industry. As mandated by the state (W.S. 35-11-302), the EQC must consider a range of effects on the people, animals, and plants, as well as social and economic values. An acceptable threshold of effect should be determined for each constituent that incorporates the values of the Wyoming livestock industry and the state's citizens, and balances the benefits and costs to all affected parties.

It is beyond the scope of this report to address all risk management considerations, however this paper will address the fundamental basis of the proposed ruling, which is defining unacceptable harm to livestock from chemical exposure to surface water bodies in Wyoming. The data presented in the UW report were evaluated within the larger risk management process by considering three types of balancing criteria relevant to Wyoming's citizens and their livestock industry: practicability, natural industry variability and incremental risk.

4.1 Practicability

Practicability of meeting the recommended water quality criteria is a fundamental issue in risk management evaluations, and a criteria listed in the Wyoming statute (W.S. 35-11-302(vi)D).

Many of the current discharges in Wyoming from coal bed natural gas (CBNG) and conventional oil and gas producers will not meet the UW report's recommended criteria. Available outfall data from conventional oil and gas producers in the Bighorn and Platte River basins show exceedences of proposed criteria for sulfate (Table 5). Most, though not all, CBNG producers in the Powder River basin will meet recommended criteria (Table 5), however CBNG water quality is less pristine elsewhere in Wyoming (Bensen et al. 2005), with concentrations regularly exceeding 500 mg/L TDS (Jackson and Reddy 2007). Many current producers do not monitor sodium water quality at all; if the alternative TDS benchmark of 500 mg/L were employed in these cases, nearly all basins everywhere would exceed the recommended limit.

It is not practicable for surface water producers to treat water to meet the recommended criteria. Many producers have indicated that re-injection will be a likely alternative if faced with unnecessarily stringent water quality standards, resulting in lost water availability to Wyoming citizens and their livestock.

Moreover, it is of questionable practicability for industry to meet the recommended water quality criteria for sulfate, sodium and fluoride when the reality in Wyoming is that natural background water quality alone does not meet these criteria in many cases. In the Powder River Basin, an estimated 30% of livestock ground water sources, 23% of non-stock ground water sources, and half of surface water bodies sampled in and around the Powder River, exceed the chronic sulfate, fluoride and/or sodium criteria recommended in the UW report (Table 6). Available data on natural ambient surface water quality in the Bighorn and Platte River basins suggests a similar trend in these areas. Statewide, 15% or more of ground water sources do not meet the criteria for either sulfate or fluoride (Table 6).

Statewide application of water quality criteria to Wyoming's surface water bodies may impact livestock managers who would have to treat their water sources to meet State-sanctioned livestock water quality criteria. Changes in statewide application of water quality criteria could also have ramifications for multiple industries that affect surface water bodies, requiring new management practices and additional State regulation.

4.2 Natural Livestock Industry Variability

An index of natural livestock industry variability was compared to the magnitude of effect identified from the literature to understand the ramifications of "effects" identified in the literature when applied to the Wyoming livestock industry. Establishing baseline variability within the livestock industry is complex; one source of available data includes USDA livestock production data. Methods and results are presented below. The metadata analysis was performed for growth effects of sulfate. Sufficient data was not available to evaluate fluoride or sodium.

Cattle production (expressed as average daily gain or ADG), compared to control populations, varied between -5% and +5% due to sulfate exposure in water between 1,200 and ~3,000 mg/L. This variability, however, is almost half the natural variability in cattle production (adults, per farm) according to the USDA cattle data set, which is 8.5%. The analyses suggest that potential variability in cattle production exposed to the current sulfate limit is within the natural variability of cattle production in Wyoming.

4.2.1 Data Analysis of Livestock Production

The entire livestock sulfate database from Raisbeck et al. (2007) and additional literature were considered for a metadata analysis of livestock production effects from sulfate exposure. Studies that were used in the metadata analysis were limited to those with exposure durations of at least 30 days, where cattle were exposed to sulfate in drinking water and the amount of S in dry matter was within the average S concentration (0.2% S) for Wyoming grasses (Raisbeck et al. 2007). Studies which met these criteria are shown in Table 7. Production rates of test groups in each study were calculated from ADG data and compared to ADG of control groups in the same study. The metadata analysis shows that that cattle drinking between 1,200 mg/L and 3,000 mg/L sulfate in water could result in a variation in production between -5% and +5% compared to within-study controls (Figure 3). Studies which found significant differences between test and control groups are distinguished from other data.

The metadata results were compared to Wyoming livestock production data. Variability in livestock production (measured in pounds) was calculated from ten-years' worth of USDA data (Table 8). The years used for the calculation were between 1990 and 1999, representing a relatively stable cattle production cycle (Mathews et al. 1999) as well as the most recent trends in production before the drought began in 2000. Precipitation affects forage quality and therefore livestock production (Clawson 1979), thus data after 1999 was not used to compute baseline variability. Precipitation records over this time period are stable and normal (Table 8). The variation in production was calculated by taking the standard deviation over the average (expressed as a percent). Between 1990 and 1999, production per head of cattle and calves varied by 8.7%. Production per farm varied by 8.5%.

The analyses shows that that the potential production variability in cattle exposed to concentrations of sulfate meeting current water quality criteria (and within the range of background water quality in Wyoming) is within normal industry variability in Wyoming's cattle production (Figure 3).

4.3 Incremental Risk

Wyoming statute W.S. 35-11-302(vi) states that "the degree of injury or interference with the health and well-being of people [and] animals" must be considered in the risk management evaluation. In Wyoming, where natural water quality is already less than ideal in many areas, the "degree of injury" or incremental risk to livestock is a key concept to consider. Incremental risk is defined here as the added risk from exposure to a new mass of a constituent compared to the baseline risk of the natural environment.

The literature review did not identify a statistical risk to cattle growth, reproduction or acute effects at levels lower than at least 2,800 mg/L sulfate, 5,000 TDS (~2,000 mg/L Na equivalent) or 4 mg/L fluoride. The incremental risk of cattle exposed to current limits for sulfate and TDS is practically zero compared to the natural environment, where cattle could potentially be exposed to concentrations as high or higher than current limits. The metadata analysis also showed that the variability in cattle weights from exposure to sulfate concentrations between 1,200 and 3,000 mg/L sulfate would not be larger than normal industry variability. Thus, there would be no reduction in the "degree of injury" to animals if the water quality limits were changed because there is no present injury to livestock from current limits.

Conversely, the degree of injury to livestock and Wyoming's citizens may be greater under the UW-recommended water quality criteria compared to current limits because the potential costs of treating current water sources or obtaining additional water sources could far outweigh any additional income from increased weight gains. Water quality limits are intimately tied to water availability in Wyoming, because unnecessarily stringent effluent limits for produced water discharges would likely result in reduced discharge to surface water bodies. The economics of treating large quantities of produced water to meet stringent effluent limits are such that injection/re-injection, deep disposal and/or reduced exploration and development are likely results of additional treatment requirements.

The impact of declining water supply is already well documented in Wyoming due to the ongoing drought. Livestock owners respond to declining water availability in a number of ways, including purchasing additional land and feed, applying for government income assistance programs, or herd liquidation and early weaning. Livestock may expend more energy to reach fewer water sources, as well as lower forage quality in some cases, consequently impacting growth and milk production rates anyway. Finally, developing alternate water sources such as well installation can be well over $100,000 (Geomega 2007).

Other industries can be impacted by lost tourism from fishing and wildlife viewing, and increased costs to oil and gas industries to design alternative water management programs. These changes can negatively impact Wyoming's tax income and reserve for state assistance programs.

5 Summary and Conclusion

The Wyoming EQC is considering updating numeric chemical constituent criteria in Chapter 1 of the Wyoming Water Quality Rules and Regulations for the protection of livestock. The EQC will review a UW risk assessment before making a decision.

While the risk assessment partially fulfills the risk management evaluation that the EQC should undergo, important data gaps remain. In fact, Wyoming statute mandates that the state consider a range of criteria before recommending water quality standards (W.S. 35-11-302(vi)). In effect, the state requires a risk management evaluation before setting water quality criteria. Risk management is the process of determining which action to take when a risk assessment indicates that a probability of harm exists. The goal of the risk management process should be to determine an acceptable threshold of effect that incorporates the values of the state's citizens and balances the benefits and costs to all affected parties.

This paper reviewed the UW report in the context of a risk management framework. This review focused on three constituents: fluoride, sulfate and sodium, because these constituents are already regulated by the state and criteria recommended in the UW report appear to contradict other assessments (e.g., Geomega 2007) as well as published water quality criteria for livestock.

The UW report recommended constituent criteria based on a number of "performance" endpoints, which varied from feed efficiency and dry matter intake (sulfate) to dental hygiene (fluoride) to weight loss and decreased milk production (sodium). This paper's review found that the UW report does not contradict the current fluoride, TDS and sulfate standards for the protection of livestock as defined by the EQC. Differences between current livestock water quality limits and those recommended in the UW report were the result of differences in toxicological endpoint selection and statistical relevance.

However, it is not enough to identify a statistically significant and toxicologically relevant effect; the effect must be put into context of relevancy to Wyoming's citizens and their livestock industry. Wyoming statute (W.S. 35-11-302) mandates that the EQC must consider a range of effects on the people, animals, and plants, as well as social and economic values. An acceptable threshold of effect should be determined for each constituent that incorporates the values of the Wyoming livestock industry and the state's citizens, and balances the benefits and costs to all affected parties.

As part of the risk management evaluation, risk assessment data were considered evaluating in the context of three kinds of balancing criteria relevant to Wyoming's citizens and their livestock industry: practicability, natural industry variability, and incremental risk. The analysis found that lowering these criteria to levels recommended by the UW report is not practicable and will not result in any incremental risk reduction. The potential costs to livestock owners, other industries and the state from changing the criteria to levels recommended by the UW report will likely be greater than potential benefits to livestock.

Many of the conventional oil and gas produced water discharges in Wyoming will not meet the UW report's recommended water quality criteria, as well as some coal bed methane gas producers. It is not practicable for these surface water producers to treat water to meet the proposed criteria. Many producers have indicated that re-injection will be a likely alternative if faced with unnecessarily stringent water quality standards, resulting in lost water availability to Wyoming citizens and their livestock. The ramifications of lost water quantity will far outweigh the potential benefits to livestock identified in the UW report. Moreover, it is of questionable practicability for industry to meet the UW-recommended criteria for sulfate, sodium and fluoride when the reality in Wyoming is that natural background water quality alone does not meet these criteria in many cases.

Natural industry variability in cattle production was calculated from USDA data sets and compared to a metadata analysis of literature data on sulfate exposure to cattle (there was not enough data to run a similar analysis for fluoride or sodium). The metadata analysis shows that variability in cattle production as much as 5% may occur if cattle are exposed to sulfate levels between 1,200 mg/L and 3,000 mg/L. However, this potential variability in cattle production is within natural industry variability for Wyoming, suggesting that there is no added degree of injury to livestock from exposure to current sulfate limits.

The incremental risk to livestock growth, reproduction or acute effects from exposures to current water quality limits is essentially zero compared to natural background water quality. This is because cattle are already exposed in many cases to sulfate, sodium or fluoride concentrations near current limits. Thus, there would be no reduction in the "degree of injury" to animals if the water quality limits were changed.

In conclusion, this paper found that the UW report (Raisbeck et al. 2007) does not contradict the current fluoride, TDS and sulfate standards for the protection of livestock as defined by the EQC. Moreover, lowering these criteria to levels recommended by the livestock water quality study does not balance the potential positive effects on livestock compared to negative effects on ranchers, other industries, and the state.

6 Literature Cited

Albert W.W., Garrigus U.S., Forbes R.M. and Norton H.W. (1956). The sulfur requirement of growing-fattening lambs in terms of methionine, sodium sulfate and elemental sulfur. J Anim Sci 15:559-569.

Amaral D.M., Croom J. WJ, Rakes A.H., Leonard E.S. and Linnerud A.C. (1985). Increased concentration of sodium chloride on milk production of cows fed low fiber diets. J Dairy Sci 68:2940-2947.

ASTM 2002. Annual Book of Standards. Vol. 11.05 Biological Effects and Environmental Fate; Biotechnology; Pesticides. ASTM International, West Conshohocken, PA: E 1847-96 Standard Guide for Statistical Analysis of Toxicity Tests Conducted Under ASTM Guidelines.

Aurelich, R.J., R.K. Ringer M.R. Bleavins and A. Napolitano. 1982. Effects of supplementary dietary copper on growth, reproductive performance and kit survival of standard dark mink and the acute toxicity of copper to mink. Journal of Animal Science 55:337-343.

Baird A.C. (1969). Salt poisoning in the dog. Vet Rec 85:756.

Barr J.M., Kahn S.A., McCullough S.M. and Volmer P.A. (2004). Hypernatremia secondary to homemade play dough ingestion in dogs: A review of 14 cases from 1998 to 2001. J Vet Emerg Crit Care 14:196-202.

Beke G.J. and Hironaka R. (1991). Toxicity to beef cattle of sulfur in saline well water: A case study. Sci Total Environ 101:281-290.

Bensen, M., H. Bergman, A. Boelter, R. Coupal, N. Hoffer, D. Hulme, N. Korfanta, S. Lieske, J. Lovato, S. Miller, L. Munn, K. Reddy.. 2005. Water production from coalbed methane development in Wyoming: a summary of quantity, quality and management options. Online at: www.uwyo.edu/enr/ienr/CBMWaterFinalReportDec2005.pdf

Berg R.T. and Bowland J.P. (1960). Salt water tolerance of growing-finishing swine. Feeder's Day Report - Univ. of Albert, Edmonton 39:14-16.

Bouchard R. and Conrad H.R. (1974). Sulfur metabolism and nutritional changes in lactating cows associated with supplemental sulfate and methionine hydroxy analog. Can J Anim Sci 54:587-593.

Boyd E.M., Abel M.M. and Knight L.M. (1966). The chronic oral toxicity of sodium chloride at the range of the LD50 (0.1L). Can J Physiol Pharmacol 44:157-172.

Bulgin M.S., Lincoln S.D. and Mather G. (1996). Elemental sulfur toxicosis in a flock of sheep. J Am Vet Med Assoc 208:1063-1065.

Cerklewski, F.L. 1997. Fluoride bioavailability: nutritional and clinical aspects. Nutrition Research 17:907.

Clawson. 1979. The western range livestock industry. Ayer publishing. 401pp.

Croom J. WJ, Harvey R.W., Amaral D.M. and Spears J.W. (1983). Growth, carcass, ruminal and metabolic parameters of fattening steers fed elevated levels of sodium chloride and limestone. J Anim Sci 57 (S1):11-12.

Croom J. WJ, Harvey R.W., Linnerud A.C. and Froetschel M. (1982). High levels of sodium chloride in beef cattle diets. Can J Anim Sci 62:217-227.

Dean, H.T. The investigation of physiological effects by the epidemiological method. In: Moulton, FR, ed. Fluorine and Dental Health. Washington, DC: American Association for the Advancement of Science 1942:23-31.

Digesti R.D. and Weeth H.J. (1976). A defensible maximum for inorganic sulfate in drinking water of cattle. J Anim Sci 42:1498-1502.

Digesti, R.D. and H.J. Weeth. 1976. A defensible maximum for inorganic sulfate in drinking water of cattle. J. Anim. Sci. 42:1498-1502.

Embry, L.B., M.A. Hoelscher and R.C. Wahlstrom. 1959. Salinity and livestock water quality. SD. Agric. Expt. St. Bull. 481:5.

Fountaine J.H., Gasche J. DG and Oehme F.W. (1975). Experimental salt poisoning (water deprivation syndrome) in swine. Vet Toxicol 17:5-8.

Geomega. 2007. Water Quality Effects and Beneficial Uses of Wyoming Produced Water Surface Discharges. Geomega, Inc: Boulder, CO.

Gooneratne S.R., Olkowski A.A., Klemmer R.G., Kessler G.A. and Christensen D.A. (1989). High sulfur related thiamine deficiency in cattle: A field study. Can Vet J 30:139-146.

Grout, A.S., D.M. Veira, D.M. Weary, M.A.G. von Keyserlingk and D. Fraser. 2006. Differential effects of sodium and magnesium sulfate on water consumption by beef cattle. J. Anim. Sci. 84:1252-1258.

Gudmundson J. and Meagher D.M. (1961). Sodium salt poisoning in swine. Can Vet J 2:115-116.

Hamilton J.A. and Webster M.E.D. (1987). Food intake, water intake, urine output, growth rate and wool growth of lambs accustomed to high or low intake of sodium chloride. Aust J Agric Res 38:187-194.

Hamlen H., Clark E. and Janzen E. (1993). Polioencephalomalacia in cattle consuming water with elevated sodium sulfate levels: A herd investigation. Can Vet J 34:153-158.

Harper G.S., King T.J., Hill B.D., Harper C.M.L. and Hunter R.A. (1997). Effect of coal mine pit water on the productivity of cattle. II. Effect of increasing concentrations of pit water on feed intake and health. Aust J Agric Res 48:155-164.

Harries W.N. (1987). Polioencephalomalacia in feedlot cattle drinking water high in sodium sulfate. Can Vet J 28:717.

Harris, L.E., R.J. Raleigh, M.A. Madsen, J.L. Shupe, J.E. Butcher, and D.A. Greenwood. 1963. Effects of various levels of Fluorine, Stilbestrol, and oxytetracycline, in the fattening ration of lambs. Journal of Animal Science 22:51-55

Harvey R.W., Croom J. WJ, Pond K.R., Hogarth B.W. and Leonard E.S. (1986). High levels of sodium chloride in supplements for growing cattle. Can J Anim Sci 66:423-429

Haydock D. (2003). Sulfur-induced polioencephalomalacia in a herd of rotationally grazed beef cattle. Can Vet J 44:828-829.

Heller V.G. (1932). Saline and alkaline drinking waters. J Nutr 5:421-429.

Heller V.G. (1933). The effect of saline and alkaline waters on domestic animals. Oklahoma Agric Exp Sta Bull 217:4-23.

Heller V.G. and Larwood C.H. (1930). Saline drinking water. Science 71:223-224.

Hickman, D.D., T.A. McAllister, K.S. Schwartzkopf-Genswein, D.H. Crews, Jr., C.R. Krehbiel, and R. Silasi. 2002. Relationship between feeding behavior and performance of feedlot steers. J. Anim. Sci. 80(Suppl. 1):15.

Hodge, H.C. and F.A. Smith. 1968. Fluorides and man. Annual Review of Pharmacology 8:395-408.

Hodgson and Levi. 1987. A textbook of modern toxicology. Appleton & Lange. New York, NY.

Hughes D.E. and Sokolowski J.H. (1978). Sodium chloride poisoning in the dog. Canine Pract 5:28-31.

Jaster E.H., Schuh J.D. and Wegner T.N. (1978). Physiological effects of saline drinking water on high producing dairy cows. J Dairy Sci 61:66-71.

Johnson W.H., Meiske J.C. and Goodrich R.D. (1968). Influence of high levels of two forms of sulfate on lambs. J Anim Sci 27:1166.

Johnson, P.S. and H.H. Patterson. 2004. Effects of sulfates in water on performance of steers grazing rangeland. Proc. Western Section, Am. Soc. Anim. Sci. 55:261.

Khan A.A., Lovejoy D., Sharma A.K., Sharma R.M., Prior M.G. and Lillie L.E. (1987). Effects of high dietary sulphur on enzyme activities, selenium concentrations and body weight of cattle. Can J Vet Res 51:174-180.

Khanna C., Boermans H.J. and Wilcock B. (1997). Fatal hypernatremia in a dog from salt ingestion. J Am Anim Hosp Assoc 33:113-117.

Koletsky S. (1958). Hypertensive vascular disease produced by salt. Lab Invest 7:377- 386

Koletsky S. (1959). Role of salt and renal mass in experimental hypertension. Arch Pathol 68:11-22.

Lames H.S. (1968). Salt poisoning in swine (water deprivation syndrome). Vet Med Small Anim Clin 63:882-883.

Loneragan G.H., Gould D.H., Wagner J.J., Garry F.B. and Thoren M. (1997). The effect of varying water sulfate content on H2S generation and health of feedlot cattle. J Anim Sci 75 (Supplement 1):272.

Loneragan G.H., Wagner J.J., Gould D.H., Garry F.B. and Thoren M.A. (2001). Effects of water sulfate concentration on performance, water intake, and carcass characteristics of feedlot steers. J Anim Sci 79:2941-2948.

Loneragan, G.H., J.J. Wagner, D.H. Gould, F.B. Garry and M.A. Thorens. 2001. Effects of water sulfate concentration on performance, water intake, and carcass characteristics of feedlot steers. J. Anim. Sci. 79:2941-2948.

Mathews, K.H. Jr., W.F. Hahn, K.E. Nelson, L.A. Duewer, and R.A. Gustafson. 1999. U.S. Beef Industry: Cattle Cycles, Price Spreads, and Packer Concentration. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1874.

McAllister M.M., Gould D.H., Raisbeck M.F., Cummings B.A. and Loneragan G.H. (1997). Evaluation of ruminal sulfide concentrations and seasonal outbreaks of polioencephalomalacia in beef cattle in a feedlot. J Am Vet Med Assoc 211:1275-1279.

Medway W. and Kare M.R. (1959). The mechanism of toxicity associated with an excessive intake of sodium chloride. Cornell Vet 49:241-251.

Meyer J.H. and Weir W.C. (1954). The tolerance of sheep to high intakes of sodium chloride. J Anim Sci 13:443-449.

Murphy, M. R., C. L. Davis and G. C. McCoy. 1983. Factors affecting water consump by Holstein cows in early lactation. Journal of Dairy Science 66:35.

National Research Council (2005). Sulfur. pp. 372-385 in Mineral Tolerance of Animals. National Academies Press, Washington, DC.

Nestor K.E., Hemken R.W. and Harmon R.J. (1988). Influence of sodium chloride and potassium bicarbonate on udder edema and selected blood parameters. J Dairy Sci 71:366-372.

Newman, J.R. 1984. Fluoride standards and predicting wildlife effects. Fluoride: Journal of the International Society of Fluoride Research 17:41-47.

Niles G.A., Morgan S., Edwards W.C. and Lalman D. (2002). Effects of dietary sulfur concentrations on the incidence and pathology of polioencephalomalacia in weaned beef calves. Vet Hum Toxicol 44:70-72.

NRC. 1974. Nutrients and Toxic Substances in Water for Livestock. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 1980. Mineral Tolerances of Domestic Animals. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 2000. Nutrient Requirements of Beef Cattle. 7th revised edition update. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 2005. Mineral Tolerances of Animals. National Academy of Sciences, Washington, D.C. National Research Council.

Ohman A.F.S. (1939). Poisoning of cattle by saline bore water. Aust Vet J 15:37-38.

Olkowski A.A., Rousseaux C.G. and Christensen D.A. (1991). Association of sulfatewater and blood thiamine concentration in beef cattle: Field studies. Can J Anim Sci 71:825-832.

Pattee, O.H., S.N. Wiemeyer and D.M. Swineford. 1988. Effects of dietary fluoride on reproduction in eastern screech-owls. Archives of Environmental Contamination and Toxicology 17:213-218.

Patterson H.H., Johnson P.S. and Epperson W.B. (2003). Effect of total dissolved solids and sulfates in drinking water for growing steers. Proceedings, Western Section, American Society of Animal Science 54:.

Patterson H.H., Johnson P.S., Patterson T.R., Young D.B. and Haigh R. (2002). Effects of water quality on performance and health of growing steers. Proceedings, Western Section, American Society of Animal Science 53:217-220.

Patterson, H.H., P.S. Johnson and W.B. Epperson. 2003. Effect of total dissolved solids and sulfates in drinking water for growing steers. Proc. Western Section, Am. Soc. Anim. Sci. 54:378.

Patterson, H.H., P.S. Johnson, E.H. Ward and R.N. Gates. 2004. Effects of sulfates in water on performance of cow-calf pairs. Proc. Western Section, Am. Soc. Anim. Sci. 55:265.

Patterson, H.H., P.S. Johnson, T.R. Patterson, D.B. Young and R. Haigh. 2002. Effects of water quality on performance and health of growing steers. Proc. Western Section, Am. Soc. Anim. Sci. 53:217.

Peirce A.W. (1957). Studies of salt tolerance of sheep. I. The tolerance of sheep for sodium chloride in the drinking water. Aust J Agric Res 8:711-722.

Peirce A.W. (1959). Studies on salt tolerance of sheep. II. The tolerance of sheep for mixtures of sodium chloride and magnesium chloride in the drinking water. Aust J Agric Res 10:725-735.

Peirce A.W. (1960). Studies on salt tolerance of sheep. III. The tolerance of sheep for mixtures of sodium chloride and sodium sulfate in the drinking water. Aust J Agric Res 11:548-556.

Peirce A.W. (1962). Studies on salt tolerance of sheep. IV. The tolerance of sheep for mixtures of sodium chloride and calcium chloride in the drinking water. Aust J Agric Res 13:479-486.

Peirce A.W. (1963). Studies on salt tolerance of sheep. V. The tolerance of sheep for mixtures of sodium chloride, sodium carbonate, and sodium bicarbonate in the drinking water. Aust J Agric Res 14:815-823.

Peirce A.W. (1966). Studies on salt tolerance of sheep. VI. The tolerance of wethers in pens for drinking waters of the types obtained from underground sources in Australia. Aust J Agric Res 17:209-218.

Peirce, A.W. 1959. Studies on Fluorosis of sheep. III. The toxicity of water-borne fluoride for the grazing sheep throughout its life. The Australian Journal of Agricultural and Resource Economics 10:186-199

Pendlum L.C., Boling J.A. and Bradley N.W. (1976). Plasma and ruminal constituents and performance of steers fed different nitrogen sources and levels of sulfur. J Anim Sci 43:1307-1314.

Phillips, P.H., D.A. Greenwood, C.S. Hobbs, C.F. Huffman, and G.R. Spencer. 1960. The fluorosis problem in livestock production. Pub No. 824. National Academy of Sciences—National Research Council. Washington D.C.

Potter B.J. and McIntosh G.H. (1974). Effect of salt water ingestion on pregnancy in the ewe and on lamb survival. Aust J Agric Res 25:909-917.

Potter B.J., Walker D.J. and Forrest W.W. (1972). Changes in intraruminal function of sheep when drinking saline water. Br J Nutr 27:75-83.

Pretzer S.D. (2000). Diarrhea in gilts caused by excessive dietary sodium chloride. Swine Health Prod 8:181-183.

Qi K., Lu C.D. and Owens F.N. (1993). Sulfate supplementation of growing goats: Effects on performance, acid-base balance, and nutrient digestibilities. J Anim Sci 71:1579-1587.

Raisbeck M.F. (1982). Is polioencephalomalacia associated with high-sulfate diets? J Am Vet Med Assoc 180:1303-1305.

Raisbeck, M.F., S.L. Riker, C.M. Tate, R. Jackson, M.A. Smith, K.J. Reddy and J.R. Zygmunt. 2007. Water quality for Wyoming livestock and wildlife. Online at: http://deq.state.wy.us/wqd/WQD_home/Announcements/final%20draft_1.pdf

Rich, C. and E. Feist. 1970. The action of fluoride on the bone. In: Fluoride in Medicine. T.C. Vischer, ed. Switzerland: Hans Huber. Pp 70-87.

Rosen, D., I. Gedalia, J. Anaise, A. Simkin and M. Arcan. 1975. The effect of fluoride alone or fluoride followed by calcium and vitamin D on discus osteoporosis of the rat tail vertebrae. Calcified Tissue Research 19:9-15.

Rossi R., Del Prete E., Rokitzky J. and Scharrer E. (1998). Effects of a high NaCl diet on eating and drinking patterns in pygmy goats. Physiol Behav 63:601-604.

Rumsey T.S. (1978). Effects of dietary sulfur addition and synovex-s ear implants on feedlot steers fed an all-concentrate finishing diet. J Anim Sci 46:463-477.

Sadler W.C., Mahoney J.H., Puch H.C., Williams D.L. and Hodge D.E. (1983). Relationship between sulfate and polioencephalomalacia in cattle. J Anim Sci 57 (Supplement 1):467.

Sandals W.C.D. (1978). Acute salt poisoning in cattle. Can Vet J 19:136-137.

Sapirstein L.A., Brandt W.L. and Drury D.R. (1950). Production of hypertension in the rat by substituting hypertonic sodium chloride solutions for drinking water. Proc Soc Exp Biol Med 73:82-85.

Sautter J.H., Sorenson D.K. and Clark J.J. (1957). Symposium on poisoning - Part I. Case 1 - Salt poisoning in swine. J Am Vet Med Assoc 130:12-13.

Schmidt, H.J. and B.S. Rand. 1952. A critical study of the literature on fluoride toxicology with respect to cattle damage. Journal of the American Veterinary Medical Association 13:38-49

Schwartzkopf-Genswein, K. S., K. A. Beauchemin, T. A. McAllister, D. J. Gibb, M. Streeter, and A.D. Kennedy. 2004. Effect of feed delivery fluctuations and feeding time on ruminal acidosis, growth performance, and feeding behavior of feedlot cattle. J. Anim. Sci. 82: 3357-3365.

Shupe, J.L. and A.E. Olson. 1969. Clinical aspects of fluorsis in horses. Journal of the American Veterinary Medical Association 15:167-174.

Shupe, J.L., L.E. Harris, D.A. Greenwood, J.E. Butcher, and H.M. Nielsen. 1963b. The effect of fluorine on dairy cattle. V. Fluorine in the urine as estimator of fluorine intake. Journal of the American Veterinary Medical Association 24:300-306

Shupe, J.L., M.L. Miner, and D.A. Greenwood. 1964. Clinical and Pathological aspects of Fluorine Toxicosis in cattle. Ann. N.Y. Acad. Sci. 111:618-637.

Shupe, J.L., M.L. Miner, D.A. Greenwood, L.E. Harris, and G.E. Stoddard. 1963a. The effect of fluorine on dairy cattle. II. Clinical and Pathological effects. Am. J. Vet Res. 24:964-979.

Smart M.E., Cohen R., Christensen D.A. and Williams C.M. (1986). The effects of sulphate removal from the drinking water on the plasma and liver and copper and zinc concentrations of beef cows and their calves. Can J Anim Sci 66:669-680.

Stoddard, G.E. 1963. Effects of Fluorine on Dairy Cattle IV Milk Production. Journal of Dairy Science 46: 720-726

Suttie, J.W., J.R. Carlson and E.C. Faltin. 1972. Effects of alternating periods of high- and low-louoride ingestion on dairy cattle. Journal of Dairy Science 55:790-796.

Suttie, J.W., R. Gesteland, and P.H. Phillips. 1961. Effects of dietary sodium fluoride on dairy cows. VI. In young Heifers. Journal of Dairy Science 44:2250-2258.

Suttie, J.W., R.F. Miller and P.H. Phillips. 1957a. Effects of dietary sodium fluoride on dairy cows. I. The physiological effects and the development symptoms of fluorosis. Journal of Nutrition 63:211.

Suttie, J.W., R.F. Miller and P.H. Phillips. 1957b. Studies of the effects of dietary sodium fluoride on dairy cows. II. Effects on milk production. Journal of Dairy Science 40:1485.

Suttie, J.W., R.J. Hamilton, A.C. Clay, M.L. Tobin, and W.G. Moore. 1985. Effects of Fluoride ingestion on white-tailed deer. Journal of Wildlife Diseases. 21(3):283-288

Tao, S. and J.W. Suttie. 1976. Evidence for a lack of an effect of dietary fluoride level on reproduction in mice. Journal of Nutrition 106:1115-1122.

Tomas F.M., Jones G.B., Potter B.J. and Langsford G.L. (1973). Influence of saline drinking water on mineral balances in sheep. Aust J Agric Res 24:377-386.

Trueman K.F. and Clague D.C. (1978). Sodium chloride poisoning in cattle. Aust Vet J 54:89-91.

US EPA. 1998. Guidelines for ecological risk assessment. USEPA EPA/630/R095/002F. 01 Apr 1998. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, 175 pp.

US EPA. 1976. Quality criteria for water. Office of Water and Hazardous Materials, Washington, D.C. July.

Wagner J.J., Loneragan G.H., Gould D.H. and Thoren M. (1997). The effect of varying water sulfate concentration on feedyard performance and water intake of steers. J Anim Sci 75 (Supplement 1):272.

Ward E.H. and Patterson H.H. (2004). Effects of thiamin supplementation on performance and health of growing steers consuming high sulfate water. Proceedings, Western Section, American Society of Animal Science 55:375-378.

Ward, E.H. and H.H. Patterson. 2004. Effects of thiamin supplementation on performance and health of growing steers consuming high sulfate water. Proc. Western Section, Am. Soc. Anim. Sci. 55:375.

Weeth H.J. and Capps D.L. (1972). Tolerance of growing cattle for sulfate-water. J Anim Sci 34:256-260.

Weeth H.J. and Haverland L.H. (1961). Tolerance of growing cattle for drinking water containing sodium chloride. J Anim Sci 20:518-521.

Weeth H.J. and Hunter J.E. (1971). Drinking of sulfate-water by cattle. J Anim Sci 32:277-281.

Weeth H.J. and Lesperance A.L. (1965). Renal function of cattle under various water and salt loads. J Anim Sci 24:441-447.

Weeth H.J., Lesperance A.L. and Bohman V.R. (1968). Intermittent saline watering of growing beef heifers. J Anim Sci 27:739-744.

Weeth, H.J. and D.L. Caps. 1972. Tolerance of cattle for sulfate water. J. Anim. Sci. 34:256-260.

Weeth, H.J. and J.E. Hunter. 1971. Drinking of sulfate-water by cattle. Journal of Animal Science 32:277-281.

Whitford, G.M. 1996. The metabolism and toxicity of fluoride. Monographs in Oral Science. Vol 16. S. Karger, AG, Switzerland.

Wilson A.D. (1966). The tolerance of sheep to sodium chloride in food or drinking water. Aust J Agric Res 17:503-514.

Wilson A.D. (1967). Observations on the adaptation by sheep to saline drinking water. Aust J Exper Agric Anim Husbandry 7:321-324.

Wobeser G. and Runge W. (1979). Polioencephalomalacia in white-tailed deer (*Odocoileus virginianus*) in Saskatchewan. Can Vet J 20:323-325.

Wobeser G., Daoust P.Y. and Hunt H.M. (1983). Polioencephalomalacia-like disease in pronghorns (Antilocapra americana). J Wildl Dis 19:248-252.

Zimmerman, A.S., D.M. Veira, D.M. Weary, M.A.G. von Keyserlingk, and D. Fraser. 2003. Sodium and magnesium sulphates reduce water consumption by beef cattle. J. Anim. Sci. 81:336 (Abstr.)

Zinn R.A., Alvarez E., Mendez M., Montano M., Ramirez E. and Shen Y. (1997). Influence of dietary sulfur level on growth performance and digestive function in feedlot cattle. J Anim Sci 75:1723-1728.

Zinn, R. A. 1994. Influence of fluctuating feed intake on feedlot cattle growth-performance and digestive function. In: Southwest Nutr. and Manage. Conf. Proc., Phoenix, AZ. p 77-83

Table 1. Sodium toxicity studies reviewed in the UW report.

UW Report Ref. No.	Reference	Chemical Form Admin-istered	NOAEL Na intake, ppm	NOAEL Equiv. NaCl intake, ppm	LOAEL Na intake, ppm	LOAEL Equiv. NaCl intake, ppm	Endpoint	Study Duration	Duration classifi-cation	Receptor	Statistically Id'd N/LOAEL?	Notes
575-580	Peirce 1959, 1960, 1962, 1963, 1966, 1972	NaCl	5,114	13,000	5,114	13,000	growth, DMI, WI	15 months	chronic	sheep	N	WI affected but not growth, DMI
546	Perice 1957	NaCl			5,900	15,000	DMI, BW, WI	460 days	chronic	sheep	N	
562	Potter and McIntosh 1974	NaCl			5,114	13,000	neonatal distress, death	80 days	chronic	sheep	N	
580	Potter et al. 1972	NaCl	5,114	13,000			WI	<24 hrs	acute	sheep	Y	Sheep already accustomed to drinking 1.3% NaCl for 6-12 months.
553	Pretzer 2000	NaCl			4,720	12,000	diarrhea	<96 hrs	acute	gilts	N	vet clinical report; uncontrolled experiment
570	Rossi et al. 1998	NaCl			11,801	30,000	DMI, WI	30 days	subchronic	goats	Y	
538	Sandals 1978	NaCl			19,668	50,000	CNS disruption	<24 hrs	acute	cattle	N	vet clinical report; uncontrolled experiment
566-568	Sapirstein et al. 1950, Koletsky 1959, Koletsky 1958	NaCl			3,934	10,000	hypertension	6 months+	chronic	rats	Y	
552	Sautter et al. 1957	NaCl	unknown	unknown	unknown	unknown	death	6 days	acute	pigs	N	vet clinical report; uncontrolled experiment
540	Tomas et al. 1973	NaCl	5,114	13,000			mineral balance		chronic	sheep	N	
543	Trueman and Clague 1978	NaCl			229,888	584,416	death, blindness, disorientation	1 day after dehydratin g the animal	acute	cattle	N	vet clinical report; uncontrolled experiment
558	Weeth and Haverland 1961	NaCl			4,720	12,000	DMI, WI, diarrhea	30 days	subchronic	cattle	Y	
574	Weeth and Hunter 1971	NaCl	1,617	4,110			growth, WI, related effects	30 days	subchronic	cattle	Y	
550	Weeth and Lesperance 1965	NaCl			5,900	15,000	DMI, WI, renal function	<24 hrs	acute	cattle	N	
539	Weeth et al. 1968 (exp. 1)	NaCl	2,557	6,500			WI, diuresis, related effects	30 days	subchronic	cattle	Y	
542	Wilson 1966	NaCl	19,668	50,000	39,336	100,000	DMI	21 days	subchronic	sheep	Y	
563	Wilson 1967 (exp. 1)	NaCl	7,867	20,000	7,867	20,000	DMI	3-5 days	subchronic	sheep	N	no control group; DMI affected at 3 days but recovered by 5 days.

Notes:
DMI = dry matter intake
WI = water intake
If not otherwise reported, assumed a 273 lb cow feeding at a rate of 6.8 kg/day for cattle studies.
NOAEL and LOAEL concentrations represent reported daily exposure rates.

Table 1. Sodium toxicity studies reviewed in the UW report.

UW Report Ref. No.	Reference	Chemical Form Admin-istered	NOAEL Na intake, ppm	NOAEL Equiv. NaCl intake, ppm	LOAEL Na intake, ppm	LOAEL Equiv. NaCl intake, ppm	Endpoint	Study Duration	Duration classifi-cation	Receptor	Statistically Id'd N/LOAEL?	Notes
560	Amaral et al. 1985	NaCl			23,602	60,000	DMI, WI, digestion patterns	28 days	subchronic	cattle	Y	
544	Baird 1969	unknown	unknown	unknown	unknown	unknown	blindness, convulstions	<24 hrs	acute	dogs	N	vet clinical report; uncontrolled experiment
556	Barr et al. 2004	NaCl			3,421	8,696	acidosis, seizure, hyperthermia, related effects	<1 day	acute	dogs	N	vet clinical report; uncontrolled experiment
582	Berg and Bowland 1960	NaCl			2,026	5,150	WI	unknown	unknown (assume chronic)	pigs	N	
569	Boyd et al. 1966	NaCl			3,035	7,714	LC-50	100 days	chronic	rats	N	
551/559	Croom et al. 1983, Croom et al. 1985 (exp 1)	NaCl			27,536	70,000	growth, feed eff. (weight gain + carcass weight)	126 days	chronic	cattle	Y	7% did not affect gains, only carcass weight.
554	Fountaine et al. 1975	NaCl			420,000	1,067,712	death	<1 day	acute	pigs	N	vet clinical report; uncontrolled experiment
573	Gudmundson and Meagher 1961	unknown	unknown	unknown	unknown	unknown	convulsions, death	unknown	unknown (assume acute)	pigs	N	vet clinical report; uncontrolled experiment
564	Hamilton and Webster 1987	NaCl			19,668	50,000	growth, DMI, diarrhea	lifetime	chronic	lambs	Y	
532	Harvey et al. 1986 (Trial 1)	NaCl	18,445	46,891			growth, feed eff.	84 days	chronic	cattle	Y	roughage diet
532	Harvey et al. 1986 (Trial 1)	NaCl	21,291	54,127			growth, feed eff.	84 days	chronic	cattle	Y	corn silage diet
565	Heller 1932	NaCl			5,900	15,000	behavior, WI	30 days	subchronic	pigs	N	
557	Heller 1933 (exp. 1)	NaCl			4,917	12,500	growth, death	10 weeks	chronic	rats	N	Specific threshold not reported by Raisbeck.
205	Hibbs and Thilsted 1983	unknown			4,370	11,109	PEM, death	< 24 hrs per dose	acute	cattle	N	well water contam. With multiple constituents, organo-S chief among them; vet clinical report, no controls.
555	Hughes and Sokolowski 1978	NaCl			39,336	100,000	death	< 24 hrs	acute	dogs	N	vet clinical report; uncontrolled experiment
547	Jaster et al. 1978	NaCl			4,958	12,604	milk production, WI, diarrhea	28 days	subchronic	cattle	Y	stat significance marginal (0.05<p<0.08)
548	Khanna et al. 1997	NaCl	unknown	unknown	unknown	unknown	death	<1 day	acute	dogs	N	vet clinical report; uncontrolled experiment
572	Lames 1968	unknown	unknown	unknown	unknown	unknown	death	unknown	acute	pigs	N	vet clinical report; uncontrolled experiment
571	Medway and Kare 1959 (exp 1)	NaCl			52,868	134,400	death	<1 day	acute	pigs	N	
581	Meyer and Weir 1954	NaCl	35,796	91,000			reproductive and wool production	253 days	chronic	sheep	Y	
561	Nestor et al. 1988 (NaCl exp.)	NaCl			53,498	136,000	udder edema	52 days	chronic	cattle	Y	
551	Ohman 1939	NaCl			6,726	17,099	body condition, death	<96 hrs	acute	cattle	N	vet clinical report; uncontrolled experiment

Table 2. Sodium toxicity studies specific to livestock that are not referenced in the UW report.

Reference	Chemical Form Administered	Receptor	Endpoints	Study Duration	Duration classifi-cation	NOAEL NaCl (ppm)	LOAEL NaCl (ppm)
Bahman et al. (1993)	brackish water well, total TDS measured.	dairy cows	milk production, growth	196 days	chronic	3574	not identified
Ballantyne (1957)	NaCl	growing & adult cattle	mortality	not reported	subchronic	861	not identified
Ballantyne (1957)	NaSO4	growing & adult cattle	mortality	not reported	subchronic	1721	not identified
Challis et al. (1987)	well water (NaCl measured)	dairy cows	milk production	unknown	subchronic	448	4387
Embry et al. (1959)	NaCl	growing cattle	food/water intake, growth	112 days	chronic	7000	10000
Frens (1946)	NaCl	dairy cows	milk production		chronic	10000	not identified
Heller (1933)	NaCl	dairy cows and steers	milk production, reproduction, weight gain	21 weeks	chronic	17500	not identified
Lassiter and Cook (1963)	NaHCO3	growing cattle (yearlings)	food/water intake, digestibility	21 days	chronic	5000	not identified
Patterson et al. (2003)	NaCl	growing cattle	food/water intake, weight gain	3 months	chronic	not identified	not identified
Ramsey (1924)	NaCl	cattle	water intake, weight gain, survival	3 mo - 2 yrs	chronic	17,190	not identified
Ray (1989)	CaCl, NaSO4, NaHCO3, NaCl (all added together).	growing cattle	food/water intake, efficiency of growth	112 days	chronic	1300	6000
Solomon et al. (1995)[1]	natural water sources	dairy cows	milk production, water intake	4 months	chronic	35	867
Spafford (1941)	NaCl	cattle	water intake, survival	unknown	subchronic	14250	18500
Weeth and Haverland (1961) (exp 1)	NaCl	growing cattle	food/water intake, growth	30 days	subchronic	100	10000
Weeth and Haverland (1961) (exp 2)	NaCl	growing cattle	food/water intake, growth	30 days	subchronic	15000	17500
Weeth et al. (1960)	NaCl	growing cattle	food/water intake, growth	30 days	subchronic	10100	20100

Notes:

Sodium dose calculated only from water intake; additional sulfate intake from food not factored in.

1 Cows were sodium deficient during study.

All references have statistically identified a NOAEL and/or a LOAEL.

NOAEL and LOAEL concentrations represent reported daily exposure rates.

Table 3. Fluoride literature data pertaining to growth, reproductive and other effects in livestock from chronic exposure.

Reference	Receptor	NOAEL (mg/kg in diet)	LOAEL (mg/kg in diet)	Effect Noted
Shupe et al. (1963a,b), Shupe et al. (1964)	Dairy cows	27	49	Decreased milk production
Schmidt and Rand (1952) [1]	Cattle	1 mg per kg BW	n/a	
Suttie et al. (1972), Suttie et al. (1957a,b)	Dairy cows	35		
Suttie et al. (1961)	Dairy cows		128	dental fluorosis
Shupe and Olson (1969) [2]	Dairy cows	30	n/a	
	Beef cows	40	n/a	
	Sheep	50	n/a	
	Horses	60	n/a	
Phillips et al. (1960)	Cattle	30 to 50	n/a	various[3]
Harris et al. (1963)	Lambs	200		
Suttie et al. (1985)	Deer	25		

Notes:
BW = body weight.
n/a = not applicable.
ND = not determinable
[1]Schmidt and Rand (1952) provided a review of studies and recommended a “safe” forage concentration for cattle.
[2]Shupe and Olson (1969) recommended ranges of fluorine tolerances in domestic animals for breeding/lactating animals.
3 The Phillips et al. (1960) citation is a literature review. Safe daily intake level for fluorine from a soluble source was cited between 30 and 50 ppm. Phillips et al. (1960) also reported that other animal species were able to tolerate much higher levels of fluorine in the diet.

Table 4. Sulfate toxicity studies reviewed in the UW report.

UW Report Ref. No.	Reference	Chemical Form Administered	S intake, total (%)	Endpoint	NOAEL SO4 equiv. intake, total (ppm)	LOAEL SO4 equiv. intake, total (ppm)	Study Duration	Duration classification	Receptor	Statistically Id'd N/LOAEL?	Notes
606	Smart et al. 1986	S	0.21 / 0.4	growth, Cu and Zn uptake	6,285	11,913	2 years	chronic	cattle and calves	Y	
640	Wagner et al. 1997	S	0.14	growth, DMI, WI	not identified	not identified	84 days	chronic	steers	N	Non-peer reviewed data (abstract only); trend analysis conducted only; no NOAEL, LOAEL id'd.
629	Ward and Patterson 2004	SO4	0.13	PEM		3,780	84 days	chronic	steers	Y	
617	Weeth and Caps 1972	SO4	0.28	DMI		8,314	30 days	subchronic	heifers	Y	
574	Weeth and Hunter 1971	Na2SO4	0.33	growth, DMI, WI		9,862	30 days	subchronic	cattle	Y	LOAEL concentration id'd in study as 3493ppm sulfate
635	Wobeser and Runge 1979	organosulfate	0.56	PEM		16,814	unknown	unknown	deer	Y	
636	Wobeser et al. 1983	not reported	unknown	blood thiamine levels due to PEM		unknown	unknown	acute	deer	N	vet clinical report; uncontrolled experiment
616	Zinn et al. 1997	NH4SO4	0.25	growth, feed eff.	not identified	not identified	76 days	chronic	heifers	N	Trend analysis conducted only; no NOAEL, LOAEL id'd.

Notes:

DMI = dry matter intake

WI = water intake

If not otherwise reported, assumed a 273 lb cow feeding at a rate of 6.8 kg/day for cattle studies.

NOAEL and LOAEL concentrations represent reported daily exposure rates.

Sodium dose calculated only from water intake; additional sodium intake from food not factored in.

Table 4. Sulfate toxicity studies reviewed in the UW report.

UW Report Ref. No.	Reference	Chemical Form Administered	S intake, total (%)	Endpoint	NOAEL SO_4 equiv. intake, total (ppm)	LOAEL SO_4 equiv. intake, total (ppm)	Study Duration	Duration classification	Receptor	Statistically Id'd N/LOAEL?	Notes
594	Albert et al. 1956	elemental S	0.4 / 0.55	growth	11,985	16,479	56 days	chronic	lambs	N	Not a clean study- study objective included N and S effects together, specifically measuring effects of urea N supplements.
594	Albert et al. 1956	methionine	0.05	growth		1,498	56 days	chronic	lambs	N	Not a clean study- study objective included N and S effects together, specifically measuring effects of urea N supplements.
594	Albert et al. 1956	Na_2SO_4	0.40	growth	11,903	16,366*	56 days	chronic	lambs	N	Not a clean study- study objective included N and S effects together, specifically measuring effects of urea N supplements; *authors claim that 2.42 should not be a LOAEL, should result in max gains.
631	Beke and Hironaka 1991	SO_4	0.47	PEM		13,935	< 96 hrs	acute	cattle	N	vet clinical report; uncontrolled experiment
591	Bouchard and Conrad 1974	unknown	0.35	DMI		10,487	unknown	acute	dairy cow	Y	
625	Bulgin et al. 1996	elemental S	unknown	PEM, death		unknown	< 1 day	acute	sheep	N	vet clinical report; uncontrolled experiment
585	Digesti and Weeth (1976)	Na_2SO_4	0.26	growth, DMI, WI	7,691		90 days	chronic	growing cattle	Y	
602	Gooneratne et al. 1989	S	0.04	Cu and B1 intake		1,328	3 weeks	subchronic	calf	Y	
627	Hamlen et al. 1993	Na_2SO_4	0.16	PEM		4,869	3 days	acute	cattle and calves	N	vet clinical report; uncontrolled experiment
630	Haries 1987	SO_4	0.17	PEM		5,203	<96 hrs	acute	steers	N	vet clinical report; uncontrolled experiment
619	Harper et al. 1997	SO_4	0.03	DMI		1,000	unknown	chronic	cattle	Y	
619	Harper et al. 1997	SO_4	0.07	DMI		2,000	unknown	chronic	cattle	Y	
634	Haydock 2003	SO_4	0.77	PEM		23,175	unknown	acute	cattle	N	vet clinical report; uncontrolled experiment
620	Johnson et al. 1968	Na_2SO_4	0.50	growth, DMI, feed eff.		15,014	67 days	chronic	lambs	Y/N**	Non-peer reviewed data (abstract only) **no stats for weight gain, only feed eff. and DMI.
621	Khan et al. 1987	$CaSO_4$	0.75	growth	22,471		85 days	chronic	beef calves	Y	
597/Not R	Loneragan et al. 1997 /Loneragan et al. 2005	SO_4	0.24	blood thiamine, ruminal gas cap H_2S		7,154	113 days	chronic	yearling steer	Y	1 case of PEM noted but incidence frequency close to norm at .11% vs .07%
614	Loneragan et al. 2001	SO_4	0.20	DMI		6,013	112 days	chronic	cattle	Y	
633	McAllister et al. 1997	SO_4	0.67	blood thiamine levels due to PEM		20,074	3 weeks	subchronic	beef cow	N	vet clinical report; uncontrolled experiment
632	Niles et al. 2002	SO_4	0.18	PEM		5,540	<96 hrs	acute	beef calves	N	vet clinical report; uncontrolled experiment
632	Niles et al. 2002	SO_4	0.23	PEM		7,010	<96 hrs	acute	beef calves	N	vet clinical report; uncontrolled experiment
589	NRC 2005	S	0.50	PEM, Max tolerable dose to prevent	14,981		chronic	chronic	cattle	N	Recommended max for range cattle
589	NRC 2005	S	0.30	PEM, Max tolerable dose to prevent	8,989		chronic	chronic	cattle	N	Recommended max for feedlotted cattle
639	Olkowski et al. 1991	SO_4	0.03	blood thiamine levels		1,000	varies	unknown	beef cattle	Y	not a controlled study; metadata analysis.
618	Patterson et al. 2002	SO_4	0.29	growth, DMI, WI		8,780	84 days	chronic	steers	Y	PEM noted
626	Patterson et al. 2003	SO_4	0.32	PEM, death		9,658	3 months	chronic	growing steers	Y	
624	Pendlum et al. 1976	elemental S	0.30	growth, DMI, feed eff.	8,989		140 days	chronic	steers	N	Not a clean study- study objective included N and S effects together, specifically measuring effects of non-natural protein N supplements.
623	Qi et al. 1993	$CaSO_4$	0.28	growth, DMI	8,389		8 weeks	chronic	goats	N	Interaction between N (added at 2.28%) and S.
628	Raisbeck 1982	gypsum, KSO_4 or $MgSO_4$	0.67	PEM		20,000	varies	acute	cattle	Y	vet clinical report; uncontrolled experiment
622	Rumsey 1978 (Trial 1)	sublimed S	0.56	growth, DMI	16,779		28 weeks	chronic	steers	Y	Not a clean study- cattle implanted with DES. Purpose of study was to gauge implant performance on varying levels of S, not a tox study on S.
622	Rumsey 1978 (Trial 1)	sublimed S	1.12	growth, DMI		33,557	10 weeks	chronic	steers	N	Not a clean study- cattle implanted with DES. Purpose of study was to gauge implant performance on varying levels of S, not a tox study on S.
615	Sadler et al. 1983 (Trial 1)	$MgKSO_4$	0.24	growth, PEM		7,200	14 days	subchronic	steers	not stated	Non-peer reviewed data (abstract only); ingredient type and source was different than trial 1, producing the effects. Differences not elaborated on.
615	Sadler et al. 1983 (Trial 2)	$MgKSO_4$	0.24	growth, PEM	7,200 (growth)	7,200 (PEM)	56 days	chronic	steers	not stated	Non-peer reviewed data (abstract only)

Table 5. Produced water quality in some Wyoming area basins.

	|-Groundwater dataset--|	|---------------------------Surface water dataset-----------------------------------|			
Data	Powder River Basin, groundwater data	Bighorn Basin, at outfall	Platte River Basin, at and below discharge area	Powder River Basin, at discharge area	Powder River Basin, outfall data
% samples > 2 fluoride	1%	66%	25%	96%	3%
% > samples 1000 sodium	1%	8%	5%	87%	0%
% samples > 1000 sulfate	2%	55%	45%	30%	<1%
% samples > 500 TDS	n/a	88%	50%	100%	100%
Average of fluoride	1.0	2.6	1.5	2.7	1
Average of sodium	312	516	323	1115	442
Average of sulfate	61	1278	1305	1094	8
Average of TDS	n/a	2640	2917	4338	1545
Max of fluoride	4.1	4.1	3.8	3.41	4
Max of sodium	1470	1620	1700	1400	910
Max of sulfate	3870	3270	8500	1680	1790
Max of TDS	n/a	7320	5430	7320	4980
Min of fluoride	0.1	0.9	0.3	1.96	0
Min of sodium	11	27	35	895	137
Min of sulfate	1	58.6	130	368	0
Min of TDS	n/a	310	351	2810	674
# Samples - Fluoride	11332	17	14	23	260
# Samples - Sodium	21705	86	14	23	2106
# Samples -Sulfate	2284	136	19	13	627
# Samples - TDS	n/a	122	11	23	87

Notes:
All results in mg/L
n/a = not applicable. Data not available for this constituent.
Data sources: CBMA; Cottonwood, Salt and Poison Spider UAAs; WY NPDES data for select areas in Powder River and Bighorn basins; additional monitoring data courtesy of Marathon oil, Fidelity.
Data collected "at discharge area" in the Powder River basin reflects a mixture of natural background and produced water. Water was collected in vicinity of discharges.
Yellow-highlighted boxes are > 10%
Orange-highlighted boxes are > or = 25%

Table 6. Natural background water quality at some areas in Wyoming.

Data	Groundwater dataset: State-wide USGS groundwater (mostly background)	Groundwater dataset: Powder River Basin background groundwater stock use	Groundwater dataset: Powder River Basin background groundwater non-stock	Surface water dataset: Bighorn Basin, Background	Surface water dataset: Platte River Basin, Background	Surface water dataset: Powder River Basin, Background
% samples > 2 fluoride	16%	5%	4%	25%	100%	42%
% > samples 1000 sodium	7%	1%	1%	0%		65%
% samples > 1000 sulfate	15%	32%	24%	25%	100%	45%
% samples > 500 TDS	n/a	n/a	n/a	50%	100%	100%
Average of fluoride	2.3	0.8	0.8	1.5	2.9	0.6
Average of sodium	627	276	239	257		1195
Average of sulfate	554	881	691	508	1708	2792
Average of TDS	n/a	n/a	n/a	1235	3157	5449
Max of fluoride	130	30.2	9.3	4.12	3.88	2.2
Max of sodium	75700	1980	2510	692		6000
Max of sulfate	68000	7250	18300	1180	1746	12000
Max of TDS	n/a	n/a	n/a	2310	3430	25100
Min of fluoride	0	0.1	0.1	0.39	2.3	0.22
Min of sodium	0.3	2	2	51		73
Min of sulfate	0	1	1	109	1633	252
Min of TDS	n/a	n/a	n/a	260	2990	590
# Samples - Fluoride	3526	2422	1115	4	3	69
# Samples - Sodium	3547	2816	1285	4	0	69
# Samples -Sulfate	3993	2026	814	4	3	43
# Samples - TDS	n/a	n/a	n/a	4	3	69

Notes:
All results in mg/L
n/a = not applicable. Data not available for this constituent.

Data sources: CBMA; Cottonwood, Salt and Poison Spider UAAs; WY NPDES data for select areas in Powder River and Bighorn basins; additional monitoring data courtesy of Marathon oil, Fidelity.
Data collected "at discharge area" in the Powder River basin reflects a mixture of natural background and produced water. Water was collected in vicinity of discharges.
Yellow-highlighted boxes are > 10%
Orange-highlighted boxes are > or = 25%

Table 7. Sulfate literature used for the metadata analysis.

Reference	% S in Dry Matter	Water SO4 intake (mg/L)	Weight loss (% ADG) compared to control	ADG (kg/day)	Significantly different than control?
Digesti & Weeth 1976	0.2	1250	3.7%	0.8	N
Digesti & Weeth 1976	0.2	2500	3.7%	0.8	N
Embry et al. 1959	0.2	4733	0.1%	1.14	N
Embry et al. 1959	0.2	4775	1.7%	1.04	N
Embry et al. 1959	0.2	6762	10.7%	1.24	Y
Embry et al. 1959	0.2	6817	7.3%	0.82	N
Embry et al. 1959	0.2	10000	27.8%	-0.18	Y
Johnson & Patterson 2004 yr 1	0.1	3947	1.7%	0.75	N
Johnson & Patterson 2004 yr 2	0.1	4654	5.2%	0.81	N
Lonergan et al. 2001	0.16	291	0.6%	2.13	N/A
Lonergan et al. 2001	0.16	583	0.0%	2.16	N/A
Lonergan et al. 2001	0.16	1219	0.8%	2.12	N/A
Lonergan et al. 2001	0.16	2360	2.1%	2.06	N/A
Patterson et al. 2002	0.19	3087	4.1%	0.46	Y
Patterson et al. 2002	0.19	3947	3.8%	0.46	Y
Patterson et al. 2003	0.17	1725	1.9%	0.75	N/A
Patterson et al. 2003	0.17	2919	4.0%	0.67	N/A
Patterson et al. 2003	0.17	4654	14.1%	0.28	N/A
Patterson et al. 2004	0.1	2608	-3.6%	1.08	N
Patterson et al. 2004	0.1	2608	3.9%	-0.19	N
Wagner et al. 1997	0.14	150	1.9%	2.11	N/A
Wagner et al. 1997	0.14	500	0.5%	2.14	N/A
Wagner et al. 1997	0.14	1000	2.3%	2.1	N/A
Wagner et al. 1997	0.14	2000	5.1%	2.04	N/A
Ward & Patterson 2004	0.17	3786	5.9%	0.49	Y
Weeth and Caps 1972	0.18	2814	4.6%	0.33	Y
Weeth and Hunter 1971	0.25	5000	12.4%	-0.5	N

Notes:

N/A - not applicable. No statistical analysis was performed that identified a NOAEL or LOAEL.

All study durations were 30 days or longer. Receptor was cattle in all cases.

Table 8. USDA livestock production data for Wyoming, 1990-1999.

Year	Inventory - cattle/calves all (1,000 head)	Production (1,000 lbs) 1/	Annual rainfall (in)	Number of Farms	Production per Head (lbs)	Production per Farm (lbs)
1990	1220	468,490	12.75	5900	384.0	79.4
1991	1190	548,200	14.80	5400	460.7	101.5
1992	1290	552,870	12.59	5800	428.6	95.3
1993	1350	618,186	13.67	6000	457.9	103.0
1994	1480	557,334	15.66	5900	376.6	94.5
1995	1470	590,465	18.27	5700	401.7	103.6
1996	1490	631,483	14.22	5700	423.8	110.8
1997	1580	580,909	10.22	5700	367.7	101.9
1998	1660	604,007	12.09	6400	363.9	94.4
1999	1560	613,065	16.27	6300	393.0	97.3

	Production per Head (lbs)	Production per Farm (lbs)
Std. Deviation	35.4	8.3
Average	406	98.2
Variability (%)	8.7%	8.5%

Notes:

1/ Adjustments made for changes in inventory and for inshipments.

Annual rainfall periods are between Sept-Dec of the previous year and Jan-August of the current year.

Avg size of farm has not changed between 1993-1999

Inventory and production data calculated January of each year.

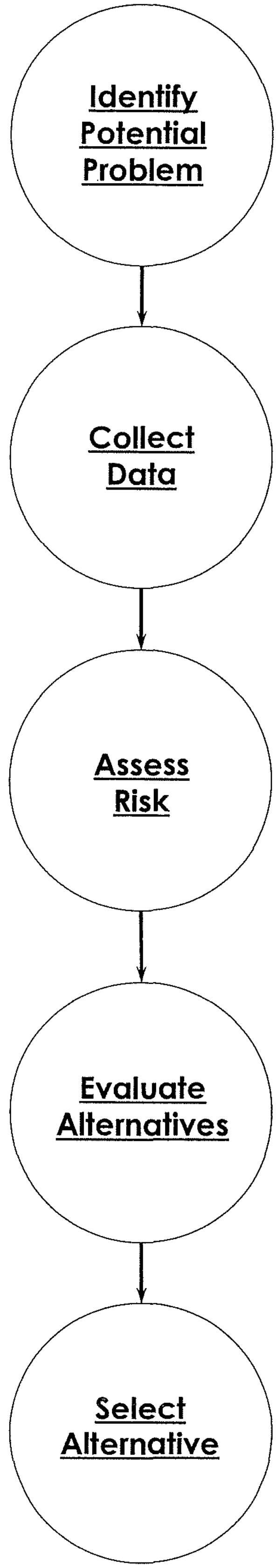


Figure 1. General Risk Management Evaluation Process

PJH Environmental, Inc. • Environmental, Inc.

Date: 9/12/2007

C:\Flow Diagram figures_portrait.p

Identify Potential Problem: Anecdotal, Report

- Anecdotal Information
- Report
- Public input

↓

Collect Data: Toxicological Review

- Evaluate anecdotal info
- Toxicological literature collection
- Identify:
  - background water quality (surface / stock wells)
  - water source availability
  - forage type & quality
  - production per species
  - impact on production from breed & genetics
  - impacts on production from climate, drought, predation
  - supplemental feed type & amount
- Collect data on actual impacts due to each constituent
- Public input

↓

Assess Risk: Numeric Risk Assessment

- Rigorous protocol followed
- Consideration of background
- Determine appropriate toxicological endpoints (define "measurable decrease")
- Determine statistical relevance of toxicity data
- Calculate probability of risk
- Public input

↓

Evaluate Alternatives: Feasibility Study

- Identify risk management alternatives
- Evaluate alternatives considering balancing criteria W.S. §35-11-302(a)(vi):
  - character & degree of injury to or interference with the health & well being of people, livestock, wildlife, plants
  - social & economic value of oil & gas production
  - priority of location in the area involved
  - technical practicability of reducing or eliminating produced water discharges
  - economic reasonableness of reducing or eliminating produced water discharges
  - effect upon the environment of reducing or eliminating produced water discharges
- Evaluate a no action alternative
- Public input

↓

Select Alternative: Select Standard

- Describe selected alternative
- Explain
  - Scientific & technical basis
  - Evaluation of balancing criteria

Figure 2. Example of the Risk Management Evaluation Process Applied to the Agricultural Use Ruling Proposal

PJH Environmental, Inc.

Date: 9/12/2007

C:\Flow Diagram figures_portrait.p

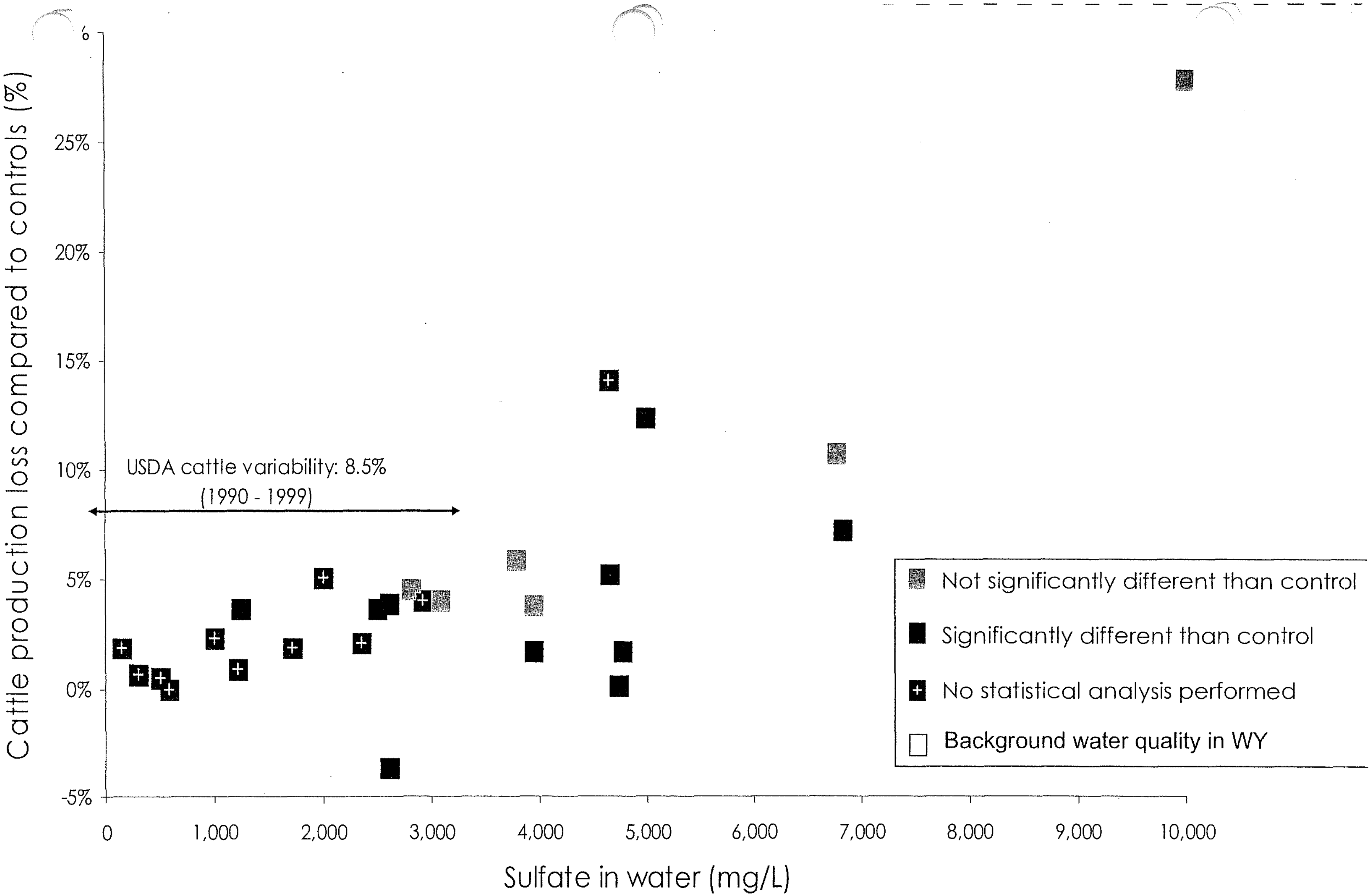


Figure 3. Metadata showing relationship between sulfate in water to loss of cattle production in test groups compared to controls.

Date: 9/12/200

Identify Potential Problem → **Collect Data** → **Assess Risk** → **Evaluate Alternatives** → **Select Alternative**

Example 1: Voluntary remediation of a contaminated site

Identify Potential Problem: Anecdotal or Report → **Collect Data:** Site Characterization → **Assess Risk:** Numeric Risk Assessment → **Evaluate Alternatives:** Feasibility Study → **Select Alternative:** Corrective Action Plan

Identify Potential Problem:
- Anecdotal Info
- Spill Report or Phase 1
- Public input or Public Participation Plan

Collect Data:
- Evaluate anecdotal info
- Identify background air, water, soil quality
- Collect site air, water, soil data
- Public input

Assess Risk:
- Rigorous protocol followed
- Consideration of background, site specific factors
- Public input

Evaluate Alternatives:
- Evaluate alternatives considering balancing criteria W.S. §35-11-1601:
  - long term effectiveness
  - reduction in risk of harm from source (toxicity, mobility & volume)
  - short term effectiveness
  - impacts caused by the alternative
  - practical capability of treatment technology
  - expected land use (risk of exposure)
  - consistency or predictability of alternative
  - cost of remedy
- No action alternative
- Public input

Select Alternative:
- Describe selected alternative
- Explain
  - Scientific & technical basis
  - Evaluation of balancing criteria

Risk Management Process

Identify Potential Problem: Anecdotal Report

- Anecdotal Info
- Report
- Public input

Collect Data: Toxicological Review

- Evaluate anecdotal info
- Toxicological literature collection
- Identify:
  - background water quality (surface / stock wells)
  - water source availability
  - forage type & quality
  - production per species
    - adult weight
    - offspring birth/wean weight
    - pregnancy rate
  - impact on production from breed & genetics
  - impacts on production from climate, drought, predation
  - supplemental feed type & amount
- Collect data on actual impacts due to each constituent
- Public input

Assess Risk: Numeric Risk Assessment

- Rigorous protocol followed
- Consideration of background
  - Identify quality of natural water:
    - a) for potential agricultural use
    - b) for non-agricultural use
- Determine appropriate toxicological endpoints
  - Define "measurable decrease"
  - Define "potential for agricultural use"
  - Define "measurable decrease" in livestock production
- Determine statistical relevance of toxicity data
- Calculate probability of risk
- Public input

Evaluate Alternatives: Feasibility Study

- Identify risk management alternatives
- Evaluate alternatives considering balancing criteria W.S. §35-11-302(a)(vi):
  - character & degree of injury to or interference with the health & well being of people, livestock, wildlife, plants
  - social & economic value of oil & gas production
  - priority of location in the area involved
  - technical practicability of reducing or eliminating produced water discharges
  - economic reasonableness of reducing or eliminating produced water discharges
  - effect upon the environment of reducing or eliminating produced water discharges
- Evaluate a no action alternative
- Public input

Select Alternative: Select Standard

- Prepare report to WWAB
- Describe selected alternative
- Explain
  - Scientific & technical basis
  - Evaluation of balancing criteria

Example 2: Agricultural Use Livestock Standards Decision Process

TESTIMONY – SEPTEMBER 14, 2007

PAW & Member Companies

Waste & Water Advisory Board Meeting

CHAPTER 1 WATER QUALITY RULES AND REGULATIONS

Resubmitted by

PETROLEUM ASSOCIATION OF WYOMING

August 26, 2008

right now. And part of that is due, I think, to the escalated cost of diesel fuel. One operator told me this morning that his diesel fuel bill went from 20,000 to 76,000 or 77,000 this year, from $1 to $3.48 or something. And that operation is for sale. That's on one side of us. And another operation to the west of us is also for sale.

So I guess what I'm saying is, it doesn't take much to upset the precarious balance for a lot of people in this business. And you need to take that into consideration.

MR. SUGANO: Thank you, Mr. Flitner.

Questions? Joe?

MR. OLSON: No, I'm fine. Thanks, Glenn.

MR. SUGANO: Looked like you were just getting ready.

Thank you, sir.

Dave Applegate?

MR. APPLEGATE: Hello. My name is Dave Applegate, and I live in Casper, Wyoming at 1360 Bretton Drive. I work for Anadarko Petroleum Corporation in their environmental and regulatory group. And I'm testifying today on behalf of the Petroleum Association of Wyoming, of which Anadarko is a member.

Anadarko has a keen interest in the proposed agriculture use rule, as we have both conventional and coal bed methane projects that could be affected by new rules that are being developed and that may be developed in the future for produced water discharges.

I should point out the PAW comes here today, and rather than having all of the operators testify, we've kind of organized our presentation. There's four of us. So I'm going to kind of frame up our presentation in terms of some of the thoughts that we have on the livestock watering standards, and then Penny Hunter will follow us on thoughts on risk assessment. Marvin Blakesley with Marathon will talk a little bit, and then Margo Sabec will talk, as well. I have probably about a ten-minute presentation here.

I hope to frame up for you today why the members of PAW believe that more needs to be done before new rules requiring more stringent water quality discharge standards for produced water are adopted.

To that end, we have put together several poster boards that represents what we believe is the typical process for making risk management decisions. I would like to walk through several of these diagrams with you in a general sense. The testimony today from several industry members will connect back in many cases to this risk management process.

So I have an example of that up here. And I've handed it out to the audience, as well.

The risk management process is generally the same, whether it is for cleaning up hazardous waste sites, implementing safety standards for motor vehicles or children's toys or setting new water quality standards. The process includes, as a first step, the identification of a potential problem.

I'll use as an example today a project for which I have some detailed experience, the old Amoco Refinery cleanup project in Casper. I worked on that project for about seven years, the last three as the engineering manager responsible for implementing the selected risk management alternatives. I might note that it was a project that generated nearly the same level of emotional investment and controversy that we see with the ag use rule -- or the proposed ag use rule.

So I'm going to walk through this example in a different context and relate that back to the water quality standards.

For that old refinery, the presence of off-site groundwater contamination, tar-like sludges on off-site properties and oil seeps in the North Platte River were strong indicators that a potential problem involving an environmental risk existed.

So that's the first box in our double chart. Something indicates to us there's a problem.

Once a potential problem is identified, data is most often collected to better understand the nature and extent of the problem. The refinery example is illustrative of a risk management problem that involved a large degree of data collection. Groundwater, soil, air and surface water samples were selected for a long list of chemical constituents resulting in literally tens of thousands of pieces of data.

That would be under the second box here.

Keeping with the refinery cleanup example, we now go to Box 3 in our risk management process and conduct a detailed risk assessment. The Environmental Protection Agency has strict protocols on how this type of risk assessment is performed for hazardous waste sites. Suffice it to say, it includes conceptual models describing the various risks associated with the soil and groundwater contamination identified by the collected data, a review of background chemical concentrations, the toxicology of chemicals that have been identified to be present and the duration of potential exposures.

One note on background, which has been brought up a couple times today and which I think is just really critical to this discussion, there are natural levels of arsenic in the soil around Casper that exceed the target cleanup levels that EPA would often establish for a hazardous waste site. Radon and arsenic from soil, benzene from forest fires, they are natural carcinogens in the environment. The natural environment is not risk-free. If the risks identified in Step 3 are determined to exceed a certain threshold -- I might add that in the world of hazardous waste, where I spent much of my career, the threshold is quite low -- then the next step is to evaluate alternatives for managing the risk.

This takes us to the fourth box in our process, where different alternatives for managing the risk are developed and evaluated against a set of balancing criteria. The balancing criteria are imposed by statutory language. And in Wyoming, cleanup alternatives, including the no-action alternative, are compared against each other in terms of their implementability, risk reduction and cost, to name just a few of the balancing criteria.

Finally, we get to the last box in the risk management process, which is selection of an alternative. In deciding what to do at the old refinery, WDEQ used a rigorous, detailed and thoroughly documented analysis of the alternatives and public input as a process for negotiated cleanup agreement.

I might note this advisory board saw the fruits of this systematic approach to risk management at their last meeting, which was held at the Wyoming Oil and Gas Conservation Commission now located on the old refinery property. Perhaps it is also worth noting that the residual risk at the former refinery site is not zero. The selected alternative did not eliminate all risk, at least not in the short term. For example, groundwater contamination remains at the old refinery and will for a very long time.

I have obviously spent some time in going through a rather detailed example of the risk management process with the purpose of illustrating that a similar process is at least very consistent with the statute outlining the establishment of new water quality standards in the state of Wyoming.

To this end, I would like us to look at another chart that illustrates these same process steps in the establishment of new agricultural use standards for produced water discharges in Wyoming. PAW believes that these steps should be completed in a systematic way in the development of the proposed ag use rule and hope to demonstrate this point in our testimony.

So those of you that have it on paper, you can just -- one of the things I'll point out here is, you'll see on this chart that we haven't colored in all of the bubbles, because we believe we're in the midst of this process and not yet to a point where recommendations are ready to be made in terms of risk.

I should say at this point that the fact that we're recommending some additional detailed steps is not meant to distract from the work that has been completed to date by WDEQ and Dr. Raisbeck. In fact, effort has been directed to some extent to nearly all aspects of the risk management process. But we believe more needs to be done. And I would like to provide just a few examples that will be described in more detail by others who will testify after me.

Let's start with what might be missing from the data collection aspect of the process as it pertains to the proposed ag use rule.

By the way, when I wrote this, I hadn't seen some of the background data that WDEQ was going to present today. So some of these questions they've already started to answer.

What are background surface water and groundwater conditions in the geographic areas where these new rules will most likely apply?

We saw some presentation on surface waters. We didn't see any presentation today on groundwater, for example, of what might be typical stock water from groundwater sources.

And I say that here. What is the quality of water, for example, from groundwater wells permitted for stock use, and how does that data compare to potential new livestock standards for produced water discharges? What harm is being incurred at this time by produced water with the existing water quality rules?

For example, anecdotal evidence is sometimes presented at these hearings, suggesting agricultural harm from produced water. Have we systematically investigated and categorized the nature and extent of this harm such that the benefits of the new rules can in some sense be quantified?

Again, I'm reminded of anecdotal evidence presented by very reliable sources during the cleanup of the old refinery, indicating that chlorinated solvents had been used and spilled at the old refinery during its operational life. Several soil borings samples were collected in locations that were suspected to have been impacted by this family of chemicals. The actual soil and groundwater data did not indicate that impacts from these solvents remained at the property.

One can speculate that the spilled amounts were not large enough to be detected or that the solvents had either evaporated or migrated away. In any case, WDEQ concluded there was no significant risk associated with this particular anecdotal testimony.

In a similar manner, the anecdotal evidence that may be out there suggesting produced water has adversely affected -- or "caused" really may be a more appropriate statutory term -- a measurable decrease in livestock production should be thoroughly investigated and documented by WDEQ.

Moving to the third bubble, assess risk. WDEQ commissioned a study to understand the toxicology of water quality parameters as it relates to livestock. That is the particular focus of today's meeting. Risk assessment as a specialized science, however, is more than a review of literature, as Dr. Raisbeck mentioned in his own testimony, regardless of how comprehensive that review may be.

Questions that arise, has WDEQ defined what a measurable decrease in crop or livestock production means? What does the term "production" mean in the context of this proposed rule? If it is weight gain in livestock, then what are the baseline conditions to which the metric of measurable decrease is compared? Is the comparison to baseline feedlot conditions, or is it to range conditions as they might exist in the absence of produced water or stock well water, or is it to some other baseline condition?

What are the statistical parameters surrounding the current risk under baseline conditions and under the proposed -- what could be a proposed set of new standards? In other words, will the benefits of the proposed rule be measurable? Are the benefits of the new rule statistically significant?

These risk assessment questions are quite technical in nature, and Penny Hunter will be testifying today to further clarify our input on the potential livestock standards as presented in Dr. Raisbeck's draft report.

Finally, moving to the fourth bubble, evaluate alternatives. Under the heading of "evaluate alternates," we believe Wyoming Statute 35-11-302 requires a systematic and transparent evaluation of new water quality standards using a set of balancing criteria. We are not suggesting that WDEQ necessarily produce the quantity of work that was associated with the risk management process at the old refinery.

I brought some notebooks today to illustrate the comprehensive nature of that risk management process. That's what I hauled up here. There were ten three-inch binders. Again, we're talking about one project, 300 acres in the middle of Casper. Ten binders had the data. This was the risk assessment which was performed following a literature review. Here is the corrective measures study which is the evaluation of alternatives. I'm quite familiar with that document because I was the lead author on it.

And then finally, after that balancing of alternatives, there was an established set of standards for that particular property. So what we're suggesting is some level of documentation, some level of evaluation that tied together these balancing criteria be conducted as the fourth step in this box.

While the Casper refinery project involved different circumstances than we are talking about today, the process of data collection, risk assessment and the identification and evaluation of alternates is similar when setting water quality standards that apply statewide and affect two major industries of a state, that being agriculture and oil and gas.

Hence, PAW is suggesting that a document be developed that provides a degree of transparency on how the competing interests that will be visible today are balanced. Those competing -- or those balancing criteria listed on the chart, I'll go through a couple of them.

What are the social and economic values of the produced water discharges as currently allowed under existing water quality standards? We certainly heard some input on that just now from Mr. Flitner. What is the benefit to the environment, animals and plants of reducing pollution from current levels to the proposed levels?

I think this next question is critical. Are these benefits statistically significant and measurable? Is the reduction in discharge standards technically achievable? Do we anticipate that less water will be discharged if the new standards are imposed? If yes, how much less water, and do we have any sense where the geographic location of reduced discharges may be?

Well, due to the work that WDEQ has already started, we might have an indication of where those locations might be.

What of legal challenges -- what of legal questions and challenges? Currently WDEQ indicates the application of these new standards only for discharges permitted after 1997. That's the current date exemption in the ag use rule as it's currently written.

This provision will necessarily be challenged. Is this provision for historic discharges technically defendable? How was this date determined? If surface discharges need to meet these more stringent livestock standards, then what about future challenges to stock well water quality?

I have obviously raised a number of difficult questions. Other representatives of PAW will now testify to further clarify our input on the risk management process and provide our input as it relates to answering some of the questions that I have raised.

Thank you for your time today.

MR. SUGANO: Thank you, David.

Any questions?

(No response.)

MR. SUGANO: Do we want Penny Hunter next?

MS. HUNTER: My presentation today is on risk management considerations for Wyoming livestock water quality criteria. The agenda today is to discuss the proposed ruling which aims to update the water quality criteria for livestock protection. And the EQC indicated in their last triennial review that they'll be reviewing the UW report by Raisbeck, et al., before the final ruling.

Our question is, how will the EQC integrate the report into the ruling? And this goes back to the risk management process.

I'm going to be focussing my presentation today on review of three constituents, fluoride, sulfate and standards, then what about future challenges to stock well water quality?

I have obviously raised a number of difficult questions. Other representatives of PAW will now testify to further clarify our input on the risk management process and provide our input as it relates to answering some of the questions that I have raised.

Thank you for your time today.

MR. SUGANO: Thank you, David.

Any questions?

(No response.)

MR. SUGANO: Do we want Penny Hunter next?

MS. HUNTER: My presentation today is on risk management considerations for Wyoming livestock water quality criteria. The agenda today is to discuss the proposed ruling which aims to update the water quality criteria for livestock protection. And the EQC indicated in their last triennial review that they'll be reviewing the UW report by Raisbeck, et al., before the final ruling.

Our question is, how will the EQC integrate the report into the ruling? And this goes back to the risk management process.

I'm going to be focussing my presentation today on review of three constituents, fluoride, sulfate and sodium, because these constituents have existing water quality criteria or they're related to sustained water quality criteria.

Just to reiterate some of what Dave already talked about, risk management is the process of determining which action to take when a risk assessment indicates that the probability of harm exists. Risk managers consider factors outside just what a risk assessment would predict. For instance, the Wyoming statute asks that we consider effects on people, animals and economic and social aspects, practicability and environmental effects.

The UW report by Raisbeck, et al., partially fulfills the risk management process, but a number of important data gaps remain. Perhaps the most important is to understand, what are we trying to protect? And the draft agriculture use protection ruling proposal states that it wants to prevent a measurable decrease in livestock reduction. And it explains further that the concept behind the statement is to ensure that water quality is not acutely toxic to livestock or does not contain pollutants and concentrations that would affect growth or reproduction.

So I think this pretty much defines what we are trying to protect in general terms. Overall, it's a measurable decrease. But more specifically, it's protecting growth, reproduction and acute effects. And I would offer that these are the gist of what the EQC goals are.

But in order to interpret the UW report, some more concise definitions of what these values mean, I think, are needed, keeping in mind, first of all, that livestock is a commodity, and therefore, effects should have livestock industry values in mind.

A measurable decrease can be defined as a statistically significant effect. In fact, statistical analysis provides an objective means to determine the relationship between two variables, like sodium exposure in water and the effects on milk production. In effect, statistical relevance is the essence of a measurable effect.

The second basic concept is to determine relevant toxicological end points; or in other words, relevant goals to protect. We've already identified growth as a relevant goal to protect. But what are we really talking about? And I would offer that we really mean we want to protect weight gain in cattle or the prevention of weight loss. And to do that, we need to rely on studies that have measured growth directly.

Some of the toxicology literature has measured intake rates, like water or food intake rates. But these are not adequate measures in and of themselves to measure growth because, first of all, a number of studies have shown that intake rates will not predict growth.

Now, there is individual variation that occurs in intake groups, regardless of what the constituent intake is. And, in fact, a lot of the literature quoted -- or referenced in the UW report, as well as our additional literature search, shows that, in many cases, intake rates would vary significantly, but growth was not affected. And even in some cases, intake rates didn't vary, but growth was affected. And so we need to go back to studies that have measured weight gain or weight loss directly.

Same with reproduction. We are trying to measure relevant indices, which I think include things like milk production and calving rates. Indirect measures are not clear. Dr. Raisbeck indicated that he was looking at copper deficiency, and that was a measure of -- that could indicate infertility. Copper deficiency alone is not enough. We need to understand what that ramification means for reproductive effects.

And finally, acute effects, in a toxicological sense, it generally means a short-term effect, so less than 96 hours or less than four days. And the types of effects we're talking about here are those that affect marketability, so things like disease, blindness, death and body condition. Again, we need to go towards effects that have some value for the livestock owners. Dr. Raisbeck, again, indicated that diarrhea was an important effect. Livestock get the runs for many reasons. And it doesn't all result in death. And so when we're talking about effects, we need to focus on those effects that have clear and meaningful end points.

So with those two concepts together, the toxicological relevance and the statistical relevance, we reviewed the UW report, went through all of the information and the references provided, and we actually re-created the database that the UW report, I think, was using. What we did was go back through with the references and identify what the end points were that they were measuring, what the thresholds of the effects were, what the statistical analysis was. And in some cases, we did additional literature review because there were some gaps that were remaining.

And our overall findings for the three constituents that we're focussing on here are that, first of all, the UW report recommendations don't contradict current limits for sulfate or fluoride or sodium-dominated TDS. First of all, for sulfate, the current limit is 3,000 milligrams per liter. The literature in the UW report, as well as our additional literature search, shows that 3,000 milligrams per liter will meet the EQC goals of protection of growth, reproduction and acute effects. The references in the UW report show growth effects starting at over 8,000 PPM, and PEM effects, which is the disease, over 5,500 PPM.

Same with fluoride. The current limit is four milligrams per liter. And, in fact, those will meet the EQC goals of protection of growth, reproduction and acute effects. There were actually no references in the UW report addressing growth or reproductive effects. But our additional literature search shows that these kinds of effects begin to occur above 30 PPM fluoride. Actually, 35 PPM fluoride.

And TDS, which is the measure of cations and anions, can sometimes be dominated by one or two constituents. In fact, we did a little bit of a water quality analysis on the TDS and determined that, in some cases, when we're talking about TDS in the water of Wyoming, it's often dominated by a sodium fluoride signature. So if TDS was a sodium chloride dominant signature, then we can discuss the sodium recommendations in the context of TDS limits.

And the references in the UW report, as well as our additional literature, show that the sodium criteria of 2,000 PPM or the equivalent criteria of 5,000 PPM sodium chloride will meet those EQC goals of growth, reproduction and acute effects. The references in the UW report show that reproductive effects begin to occur above 5,000 PPM or 12,000 PPM sodium fluoride equivalent. And, in fact, there weren't any statistically significant effects on growth below 21,000 PPM sodium.

We did some additional references which show growth and reproductive effects lower than what was shown in the UW report. But those additional references also support a 5,000 milligram per liter sodium chloride limit. What if TDS is dominated by other constituents, excluding sulfate? Because we've already addressed all these separately. The EPA and NRC reviews of available literature indicate that no effects will occur to livestock below 6,000 milligrams per liter.

The UW report had a note in the recommendations that a TDS limit of 500 should be safe. But this is very conservative, considering the EPA and NRC has recommended that below 6,000 milligrams per liter for other constituents will be safe.

But we're really talking about lab data here. And the issue has come up a couple times in previous presentations about what really happens in the real world. The lab data that we're referring to is of these feedlot conditions which are very stressful environments, not necessarily the kind of forage quality that cattle will encounter in the open space in Wyoming. And so I think that it is important to gather Wyoming ranchers' experience about how they have seen the water quality affect their cattle.

And earlier this year, we conducted some phone interviews with some of the ranchers in Wyoming and found that, from these interviews, they indicated no adverse effects on livestock that drank water containing up to 3,100 milligrams per liter of sulfate, 1,700 milligrams per liter sodium and close to four milligrams per liter fluoride. Where they did find effects apparent were when the cattle were drinking over 4,000 milligrams per liter sulfate and the total TDS over 7,000 milligrams per liter.

Specifically, Dave Flitner testified to his weaning rate data. But his seven-year weaning rate averages were as good or better on land with produced water containing sulfates up to 2,700 milligrams per liter and TDS of 5,000 milligrams per liter.

And Mr. McCarty also reported no adverse effects on land with produced water with sulfates up to 3,100 milligrams per liter and sodium of 1,700 milligrams per liter. The data he was looking at were things like body condition, mortality, weaning rates. And a number of other ranchers and some organizations have also recorded no effects from produced water with these types of sulfate, sodium and fluoride concentrations.

So why is there such a difference in numbers between what the UW report recommendations are and what we're saying here in this presentation? It really comes down to the fact that the toxicological end points or the values worth protecting are different. The UW report recommends sulfate criteria that's more in line with protection of feed and water intake rates. But as I've indicated previously, this is not necessarily related to growth.

Similarly, the UW report recommendations for fluoride will protect against fluorosis, which is a dental effect. In effect, this is tooth mottling. And this does not necessarily lead to other effects. In fact, the NRC conducted a similar literature review and found that, indeed, two milligrams per liter will protect against dental effects. But they say, quote, at least a severalfold increase from this criteria seems required to produce other injurious effects other than these dental effects that they were talking about.

Phillips, et al., did a review of fluoride effects and livestock and also indicated there was no instance where tooth mottling decreased the economic value of livestock.

Another difference why the UW recommendations are different from what we're saying here is that statistical criteria differ, especially for sodium. A lot of the criteria seem to be based on nonstatistically significant effects. But this really is all a balancing act. The question is, can we live with tooth mottling? Do we really care about statistics, or are ranchers going to care about any variation in cattle weight gains? And so, really, the probability of risk must be put into context of relevancy to the Wyoming citizens and their livestock industries. So this is going back again to the risk management process.

We considered the data presented in the UW report and our own literature search in terms of three types of balancing criteria, which includes practicability, incremental risk and a natural livestock industry variation. So some of this data has been shown before, so I'll try to go briefly through it.

The first issue is practicability. This is showing some data that we collected from produced water. The source of data differs a little bit from what Jennifer was presenting, but the results were very similar, that in the Powder River -- in the Powder River Basin here, the groundwater data set, which is indicative of what produced water outfalls will look like, 2 percent or less will not meet the criteria for either sulfate, sodium or fluoride. And we collected other surface water data sets for the Big Horn Basin and the Platte River Basin. And we show that 50 percent or more are not going to meet the proposed criteria in the UW report.

And interestingly, this last column here is Powder River Basin surface water data set. It was water collected just downstream of the discharge area. So it includes natural background, plus the produced water outfall. And in this case, much of the surface water is not going to meet the proposed criteria in the UW report.

And it's a questionable practicability for industry to try to meet these standards when natural background water quality already does not meet these standards. So, again, our data sets differ a little bit from what Jeremy was presenting. We collected most of our data from monitoring wells. Some of the data is private. Some of it was USGS, probably a subset of what Jeremy was considering. We also collected the data presented in the UAAs and other WYPDES permits.

And so what we can start to see here is, we have background groundwater across the state. The USGS data indicates that about 15 percent on average won't meet the sulfate criteria. But in the Powder River Basin specifically, water already used for stock water and other purposes is not going to meet that sulfate standard by at least 24 percent or more. And in the Big Horn and Platte River basins, we have much less data, but it suggests that we could have the same issue, where natural background quality is not going to meet these proposed criteria.

And this last column here is surface water in the Powder River Basin. And, again, the natural background surface water quality does not meet the proposed recommendations.

Producers have already indicated that it wouldn't be practicable for them to meet very stringent standards and that, in these cases, reinjection is the likely alternative. We have heard before that the effects of limiting produced water surface discharge include some major impacts on the livestock industry, including loss of cattle herds, up to 50 percent in some cases. And loss of cattle can have impacts on the state in terms of decreased economic output and lost jobs and labor income.

There's additional costs to ranchers who develop alternate water sources when produced water sources aren't available. And those costs trickle down to the livestock themselves, who must go farther for the water sources that are available. There's also lost revenue from tourism and hunting and access in some cases to federal funding, such as at Loch Katrine, which we see as produced water.

The data that we've collected so far suggests that the UW recommendations are not practicable for multiple industries, the producers as well as the livestock industry. And that can have ramifications for the state. And at a minimum, a review of all the water quality data is needed to evaluate the ramifications on the UW recommendations.

The second balancing criteria is a concept of, what does this toxicology literature mean in the real world? And we thought we had enough data on sulfate effects on growth, because it's been studied the most extensively, to look at what that would mean in terms of in the context of natural industry variability.

What we did was conduct a joint literature metadata analysis. We used the data presented in the UW report, as well as additional data from the literature we uncovered. So just looking at growth effects from the sulfate, over 40 studies were considered. But we narrowed it down to studies with similar parameters, baseline parameters, so we could compare apples to apples. We looked at long-term exposures. We limited it to the sulfate exposure. We looked at just sulfate exposure in water. And we assumed a baseline -- we chose studies with a dry matter sulfate intake that was similar to what was expected in Wyoming, so that .2 percent sulfur. And the receptor we're considering here is cattle.

Our question is, what is the effect on cattle production from sulfate exposure up to current limits, up to this 3,000 milligrams per liter? And this graph shows all the data that met the criteria. On the X axis here, is sulfate in water. This was the sulfate dose given to the cattle. And on the Y axis is cattle production loss compared to the control populations in the same studies. And it's expressed as a percent.

And I've also distinguished those studies that measured a statistically significant difference, which you'll see doesn't begin until about 3,000 milligrams per liter, from earlier studies which either did not do any statistical analysis or do not show any statistical difference.

And so what we can start to see from this range here, from zero up to 3,000, and even beyond, that the effects on cattle production vary by, plus or minus, 5 percent. In some cases, the addition of sulfate resulted in greater production than the controls. So this is why the result was plus or minus. So there is my result there.

And what we did was compare the metadata analysis to a USDA cattle data set. So we took about ten years of production data in Wyoming. We limited that data collection to the time period 1990 through 1999, because it represented a stable participation in market period. And what we found is that the production in this case varied by a minimum of 8.5 percent. So going back to the graph, our literature effects, even from the statistically significant, vary maybe by 5 percent. But this is less than natural industry variability in Wyoming. That is about 8.5 percent.

So our conclusion here is that potential growth effects from sulfate, by at least 3,000 milligrams per liter, are within that natural variability of the livestock industry.

The third concept is incremental risk. And this goes back to the Wyoming balancing criteria that states the character and degree of injury, with the health and well-being of people and animals, need to be considered. So the degree of injury can be interpreted a number of ways. And one interpretation of that is this concept of incremental risk. And changing the criteria to the levels recommended in the UW report is not going to result in any incremental risk reduction to livestock, because the current limits do not result in growth, reproduction or acute effects. Are we talking here about zero risk or even negative risk, considering that background water quality would not meet the UW recommendations in many cases?

Just to wrap this up, our conclusions overall from the review show that the UW report recommendations do not contradict current livestock criteria for sulfate, fluoride and TDS. And adopting the UW report recommendations for these constituents is not practicable for industries, will not result in reduction of risk and may result in greater cost to livestock owners, possibly the State and definitely other industries, compared to potential benefits.

Thank you.

MR. SUGANO: Thank you, Penny.

Any questions?

(No response.)

MR. SUGANO: I think this would be a good time for us to take a break. I hope it doesn't break the rhythm of what PAW is trying to do. But I think there are a lot of people in town right now, and we need to

COMMENTS – JUNE 15, 2007

PAW & Member Companies

Waste & Water Advisory Board Meeting

CHAPTER 1 WATER QUALITY RULES AND REGULATIONS

Resubmitted by

PETROLEUM ASSOCIATION OF WYOMING

August 26, 2008

devon

Devon Energy Production Company, L.P.
20 N. Broadway, Suite 1500
Oklahoma City, OK 73102

June 15, 2007

Wyoming Department of Environmental Quality
Water and Waste Advisory Board
Herschler Building - 4W
122 West 25th Street
Cheyenne, Wyoming 82002

RE: Comments, Water Quality Rules, Chapter 1, Appendix H, Agricultural Use Protection

We at Devon Energy Production Company, L.P. (Devon) appreciate the opportunity to comment on the the Department of Environmental Quality's latest draft of Chapter 1, Appendix H, Agricultural Use Protection. Devon produces oil and natural gas throughout the state of Wyoming, including coal bed natural gas (CBNG) in the Powder River Basin. We hold a number of WYPDES permits for the surface discharge of water produced in association with our production and we will be directly affected by the proposed rule, if implemented.

Devon hereby incorporates the comments it has previously submitted to the Advisory Board and to the Environmental Quality Council (EQC) regarding the various drafts of the Agricultural Use Protection standard, as they were published in policy and rule forms. In addition, we ask the Department of Environmental Quality (DEQ) to consider the following comments.

ENVIRONMENTAL QUALITY COUNCIL'S REMAND

The current draft proposed by DEQ does not meet the parameters of the remand ordered by the EQC at its February 16, 2007 meeting. At that time, the EQC found that the format and language of Appendix H was not appropriate for a rule, that it would not clarify the way in which DEQ administers Chapter 1, Section 20. (*See* Excerpts from Transcript of February 16, 2007, EQC Meeting, attached as Appendix A). The EQC directed DEQ to remove the livestock and wildlife watering issues from the policy, and start from scratch, writing a rule limited to the protection of irrigation and agricultural lands, and obtaining this Board's input. At a minimum, the EQC instructed, the rule should clarify historical definitions, clarify irrigation, and clarify the default effluent limits for irrigation. Furthermore, the EQC requested that DEQ provide more supporting evidence for the scientific basis of the default effluent limits. (*See*, App. A, p. 15, l. 7-11). In summary, Council Member Boal, who made the motion to remand, stated, "So we ought to be able to come back with a tight, focused regulation and one that is supported by good science."

DEQ has not followed the EQC's order. Instead, DEQ started with the policy that was presented to the EQC in February, and made minor modifications. It has not clarified any previous provisions; in fact, the modifications only introduce more uncertainty and confusion as to how the rule would be applied.

DEQ has not provided any scientific evidence to support the default effluent limits for irrigation, and failed to remove the water quality standards for livestock and wildlife.

DEQ has further failed to provide any scientific basis or any other justification for applying different irrigation protection standards to discharges based on whether they began after January 1, 1997. It is well known that, in Wyoming's semi-arid climate, many and varied uses develop quickly around new water sources. By establishing a date more than ten (10) years in the past, DEQ fails to protect the livestock watering, irrigation, and other agricultural uses that have developed in areas where water discharges commenced during the past ten (10) years. This is an obvious attempt to regulate CBNG produced water discharges in the Powder River Basin differently from other discharges. However, this rule would apply statewide and DEQ has provided no justification for such an arbitrary and capricious standard exclusion of the agricultural uses that have developed around produced water.

NATURALLY IRRIGATED LANDS

We disagree with the provisions in the proposed rule that include "naturally irrigated lands" as protected agricultural uses. The restrictions on water discharges contemplated for the protection of such lands necessarily involve the regulation of the quantity of water discharged, regardless of quality. In addition, such restrictions fail to account for the state's easement in all watercourses, thereby limiting the ability of downstream landowners to utilize the water for its highest preferred use under Wyoming law: drinking water for both man and beast. *See*, WYO. STAT. § 41-3-102(b)(i).

The state has a watercourse easement across private and governmental lands in the state for the purpose of flowing and managing the waters of the state. The state's right of way for its water to flow through watercourses is essential to our water law system of prior appropriation. The scope of the watercourse easement includes waters augmenting natural flow, whether it comes from oil and gas development or otherwise. The easement extends to all seasons and it is only because the state has the easement that water users can count on water flowing down the watercourse. *The PeeGee Ranch v. Devon Energy Production Co., L.P.*, 6^{th} Judicial District, Civil Case No. 26607, 4/13/07.

Because the surface estate is burdened by the state's easement to flow waters of the state, a landowner does not have exclusive possession of the land or rights to its physical condition. Therefore, the landowner has no claim for trespass, interference, or damages associated with the flow of the state's waters. The land is also burdened by an easement held by downstream water users. A valid appropriation of water from a natural stream constitutes an easement in the stream; therefore, when a person acquires the right to a certain amount of water in a stream, he also acquired the right to have that water flow in the natural stream and over the lands of others to the point of diversion. *The PeeGee Ranch v. Devon Energy Production Co., L.P.*, 6^{th} Judicial District, Civil Case No. 26607, 4/13/07.

To say that an ephemeral stream or a stream having stretches without a defined channel, bed and banks is not a natural watercourse would call into question the administration and enforcement of water rights throughout the entire state, and would be directly contrary to the Constitution, statutes, and established case law precedent. Further, it would invalidate all adjudicated water rights and deny downstream users the right to call flows through upstream lands to their points of diversion. *The PeeGee Ranch v. Devon Energy Production Co., L.P.*, 6th Judicial District, Civil Case No. 26607, 4/13/07.

Water that is subject to appropriation is water of the state. The State Engineer has designated the production of water for purposes of producing coalbed natural gas a beneficial use of groundwater, for which a permit to appropriate groundwater is required and a water right is appropriated. When produced water is legally discharged into the watercourse, it is the property of the state, not the discharger, and is subject to the state's watercourse easement to flow such water through and across downstream lands. *The PeeGee Ranch v. Devon Energy Production Co., L.P.*, 6th Judicial District, Civil Case No. 26607, 4/13/07.

Wyoming law defines the preferred uses of water, and establishes an order of preference for them. The highest preferred use of water in the state is "water for drinking purposes for both man and beast". Water rights that are not preferred may be condemned to supply water for preferred uses. WYO. STAT. § 41-3-102(b)(i). The surface discharge of groundwater that meets water quality standards for livestock and wildlife is a preferred use of the water. Therefore, neither DEQ nor a landowner have the right to prevent the flow of drinking water for livestock and wildlife in the state's easement through and across downstream lands, nor does a landowner have a claim for trespass, interference, or damages—including a potential decrease in crop production—associated with the flow of such water.

Section (a) of DEQ's proposed rule defines "irrigation" as "a substantial acreage of naturally sub-irrigated pasture within a stream floodplain." The stream floodplain is within the state's watercourse easement and is used for the flow of the waters of the state. Therefore, any rights of a landowner to produce crops in the floodplain are subordinate to the state's right to flow water through and across the land. DEQ defines "naturally irrigated lands" as those "along stream channels". Again, these lands are within, and burdened by, the state's watercourse easement. The landowner does not have exclusive possession of the land or its physical condition. Were that not the case, landowners whose land and improvements are damaged by floods would have valid claims against the state for compensation.

Water rights to underground water are administered through permits on wells withdrawing the water for beneficial purposes. The law protects rights to the volume of groundwater withdrawn by a well only if the well was adequately developed. WYO. STAT. § 41-3-911(a). To acquire a water right to spring water, a landowner must apply for a groundwater permit. WYO. STAT. § 41-3-902. The use of groundwater in sub-irrigation is opportunistic, is not recognized as a beneficial use of water, and no water rights are granted for such a use. Even if the state did grant water rights for the passive use of groundwater in sub-irrigation, it would not be a preferred use of water and, as such, may be condemned and changed to a preferred use. WYO. STAT. § 41-3-906.

DEQ must recognize the state's watercourse easement and that the highest preferred use of the state's water is drinking water for livestock and wildlife. Where produced water meets quality standards for livestock and wildlife use, DEQ must allow it to flow through and across the lands within the state's watercourse easement to supply drinking water for livestock and wildlife. The naturally irrigated lands DEQ seeks to protect are within and burdened by the watercourse easement. The use and management of the watercourse easement lies within the jurisdiction of the State Engineer, and the law expressly prohibits DEQ from taking any action which would limit or interfere with the jurisdiction, duties, and authority of the State Engineer and Board of Control. WYO. STAT. § 35-11-1104(a)(iii). Therefore, the provisions in Appendix H related to naturally sub-irrigated pasture and naturally irrigated lands exceed DEQ's authority, frustrate the highest preferred use of water in the state, and should be deleted.

Recognizing the highest preferred use of water is drinking water for livestock and wildlife and the state's watercourse easement for the flow of such water, the State Engineer recently proposed new legislation for consideration by the CBM Water Task Force. The State Engineer's draft bill limits the discharge of produced water from coalbed natural gas operations to the downstream carrying capacity of the channel and provides that, where the carrying capacity of the channel is diminished, the State Engineer may order the channel capacity to be restored. While we believe the State Engineer already has the authority to require the channel capacity to be restored, this legislation would lay to rest any doubt that the state has an easement where the carrying capacity of the channel is diminished for any reason. The provisions in Appendix H related to naturally sub-irrigated pasture and naturally irrigated lands conflict with the State Engineer's authority and proposed legislation, and should be deleted.

<u>RULEMAKING STANDARDS</u>

The Advisory Board should not vote on or recommend the proposed rule because neither DEQ nor the Advisory Board has conducted the balancing review required by the Environmental Quality Act (EQA). Recognizing that environmental rules, standards, and permit systems can significantly and adversely impact other interests in the state, the Wyoming Legislature expressly required consideration of the *reasonableness* and all of the intended—as well as unintended—consequences. The law requires a "reasonableness" test, or a balancing of interests and values, and the Legislature prescribed some of the facts and circumstances that must be evaluated and considered. Clearly, the Legislature intended the reasonableness test to apply in a situation such as this, where a statewide rule is being considered that has the potential of significantly and adversely affecting many other interests in the state.

DEQ has not identified, evaluated, or presented evidence of any facts or circumstances that bear upon the reasonableness of the proposed rule. The first balancing criterion DEQ and the Advisory Board must evaluate and consider is "...the character and degree of injury to or interference with the health and well being of the people, animals, wildlife, aquatic life and plant life affected[.]" WYO. STAT. ANN. §35-11-302(a)(vi)(A) (Lexis 2005). While the Advisory Board previously heard some testimony and will take comments from people who might be positively or negatively affected by the proposed rule, nothing has been done to compile this information to adequately evaluate, analyze, or quantify the true character and degree of alleged injuries. DEQ has not adequately considered the impacts to wildlife and its habitat, nor has it considered, quantified, or otherwise evaluated the environmental <u>*loss*</u> that would result from implementation of the proposed rule. Clearly, prohibiting the flow of water that is suitable for wildlife in ephemeral drainages will result in an injury to wildlife health. Similarly, DEQ has not quantified or otherwise evaluated the degree of injury to or interference with the wellbeing of livestock that depend upon the flow of produced water in ephemeral streams for survival. Also, the flow and use of produced water in ephemeral drainages is critical to the economic viability of many ranching operations across the state, and DEQ must quantify and evaluate the character and degree of injury to or interference with the wellbeing of those people. The testimony received in previous hearings from ranchers confirms that they highly value the flow of water for livestock and wildlife through their properties, and that the benefits from such flows far outweigh any potential negative impacts.

According to the Wyoming Department of Agriculture, many landowners want to use produced water and have acquired water rights in it. By July 2006, landowners in the Powder River Basin had acquired 13,741 stock water permits, 3,491 stock reservoir permits, and 61 irrigation permits to use CBNG water. *See*, Presentation to CBM Task Force, Grant Stumbough, Dept. Agriculture, July 2006 at http://cbm.moose.wy.gov/Information_Presented_to_the_Task_Force.htm. Landowners benefit from the installation of water pipelines, stock tanks, and reservoirs that improve the distribution of livestock over range lands and increase stock productivity. Produced water improves the health of livestock as well as wildlife, and improves habitat by increasing forage production, reducing overgrazing, and enhancing riparian areas and wetlands. If this analysis were performed, DEQ would find that the surface discharge of oil and gas produced water results in a net environmental benefit.

Other potential injuries and adverse consequences that must be identified, evaluated, and considered include:

- ***Injury to and interference with*** landowners' existing water rights in wells, reservoirs, and stock tanks; landowners' need for the flow of produced water in the channel for stock and wildlife; the needs of downstream landowners to use the flow of produced water for stock water and irrigation; and the state's right to flow waters of the state down its watercourse easements.

- ***Injury*** to mineral owners resulting from increased oil and gas production costs that reduce royalties and may render leases uneconomic. This includes the state of Wyoming, which receives mineral royalties from state and federal mineral lands.

- ***Injury*** to oil and gas operators resulting from increased production costs and the loss of capital investments.

The second balancing criterion requires the evaluation and consideration of "the social and economic value of the source of pollution", which includes social values associated with jobs, agriculture, and wildlife, and economic values of state and private royalties, state and local taxes, salaries, and increases in agriculture production. WYO. STAT. ANN. §35-11-302(a)(vi)(B) (Lexis 2005). In the recent EQC rulemaking, a report was provided that describes some of these factors, including the impact on agricultural producers if produced water could no longer be discharged to the surface from oil and gas operations and, thus, cease to be, or never becomes, available for agricultural use. *See* Water Quality Effects and Beneficial Uses of Wyoming Coal Bed Natural Gas Produced Water Surface Discharges, by

Geomega Inc., (Submitted to EQC January 17, 2007). Additionally, mineral taxes and royalty payments provide unique socioeconomic benefits to the state which will not be realized if development of oil and gas is curtailed by the implementation of Appendix H. Mineral taxes and royalties allow Wyoming to rank first in the nation in federal revenues, first in non-property tax revenues, second in general revenue and interest income, fourth in tax revenues, and fourth in sales tax revenues. Were it not for the taxes paid on minerals, Wyoming would rank 48th in property tax revenues; instead, it ranks tenth. Wyoming Taxpayers Association, *How Wyoming Compares*, 2006 ed., FY2004.

Oil and gas production provides tremendous benefits to counties. For example, in 2006 coalbed natural gas producers paid 62% of the property taxes in Johnson and Sheridan Counties, while agriculture accounted for only 3% of the taxable valuation in Johnson County, and 1% in Sheridan County. The taxable value of minerals increased by 1559% in Sheridan County since 1999, and by 1329% in Johnson County since 1998. Also, oil and gas producers paid an average of nearly half (48.26 %) of the property taxes paid in 2005 in the counties where CBNG is produced. Kerns, *Coalbed Natural Gas*, presentation to EQC, January 18, 2006. The proposed rule has the potential to adversely affect oil and gas operations throughout the state, and DEQ should consider and evaluate the beneficial socioeconomic impacts of the oil and gas industry as a whole. Oil and gas production provides tremendous social and economic value to the state, as well as to counties and local production areas:

- In 2005, Wyoming ranked third in the nation in natural gas production (2 trillion cubic feet) and seventh in crude oil production (51.6 million barrels). Campbell County led the state in crude oil production, followed by Park County. Campbell County was the second highest in natural gas production. Petroleum Association of Wyoming, *Oil & Gas Facts,* 2006 ed.

- There are 523 companies engaged in the production of crude oil and natural gas in the state, and 48 companies operating petroleum pipelines. In 2005, there were 45 operating gas plants and four crude oil refineries. Oil and gas companies in the state directly employ approximately 20,000 people with an annual payroll of over $950 million. Petroleum Association of Wyoming, *Oil & Gas Facts,* 2006 ed.

- In 2005, the total taxes and royalties paid by oil and gas producers in the state was $1.693 billion, which constitutes a direct payment of nearly $3,257 for each person living in Wyoming. Oil and gas producers pay royalties and lease bonuses to the state and federal government, and the state receives half of the royalties paid to the federal government. In 2005, oil and gas producers paid $422 million in federal royalties and $101 million in state royalties. In 2004, the state received approximately $554 million in federal mineral royalties and lease bonus payments. Petroleum Association of Wyoming, *Oil & Gas Facts,* 2006 ed.

- In 2004, oil and gas companies paid over $540 million in property tax revenues to the state, of which nearly $434 million was paid on natural gas. Oil and gas producers paid over 52% of the total property taxes paid in the state (more than 79% of the property taxes paid on all minerals). Minerals are the only class of property in the state that is taxed at 100% of their value, as well as the only class that is required to pay two direct taxes (property and severance). In contrast, only 4% of the state's revenue was paid by other property taxpayers, including agriculture and residential and commercial property owners. Also, oil and gas producers paid $497 million in severance taxes, of which $408 million was paid on natural gas. And, in addition to property and severance taxes, oil and gas companies paid $129 million in sales and use taxes, and $5 million under the conservation mill levy, in 2005. Petroleum Association of Wyoming, *Oil & Gas Facts,* 2006 ed.

- In the counties where conventional oil and gas operators produce water that is discharged under WYPDES permits, oil and gas producers paid an average of 58.4% of the property taxes paid in 2005 (Petroleum Association of Wyoming, *Oil & Gas Facts,* 2006 ed.):

  - Big Horn 46.73%
  - Fremont 79.82%
  - Hot Springs 78.23%
  - Natrona 48.10%
  - Park 57.20%
  - Washakie 40.56%

The third balancing criterion requires DEQ to evaluate and consider "the priority of location of the area involved[.]" WYO. STAT. ANN. §35-11-302(a)(vi)(C) (Lexis 2005). The proposed rule will affect the discharge of produced water in all areas of the state, including existing and future discharges of water produced in association with oil and gas operations statewide, including the Big Horn Basin. The Advisory Board should not recommend a rule for the entire state based on the complaints from a few landowners in the Powder River Basin.

The fourth balancing criterion requires DEQ to evaluate and consider "the technical practicability and economic reasonableness of reducing or eliminating the source of pollution[.]" WYO. STAT. ANN. §35-11-302(a)(vi)(D) (Lexis 2005). DEQ has not submitted relevant or reliable scientific evidence to demonstrate that the proposed rule is necessary, let alone technically practical or economically reasonable. The natural water quality in most ephemeral drainages does not meet the default effluent limits proposed by DEQ, particularly in gaining stretches where water from the shallow water table pools and stagnates, and in low-flow runoff events. Also, DEQ should consider comments and data it has received regarding the technical impracticability of alternative means of water disposal, including the geological impracticability of reinjection in most areas of the Powder River Basin, the prohibitive costs of water treatment, and the additional environmental costs of alternative measures. *See, e.g.*, Comments submitted by Merit Energy Company (February 14, 2006), Presentation by Williams Production RMT Company (February 16, 2006), Presentation by Anadarko Petroleum Company (February 16, 2006).

The fifth balancing criterion requires DEQ to evaluate and consider "the effect upon the environment." WYO. STAT. ANN. §35-11-302(a)(vi)(E) (Lexis 2005). Appendix H will have a negative effect upon the environment because it will limit the amount of water that would otherwise be available to livestock and wildlife and other agricultural uses. DEQ has received numerous comments explaining that the surface discharge of water produced in association with oil and gas operations results in a net environmental gain and provides a vital resource to wildlife, livestock, and other agricultural uses. *See, e.g.*, Comments submitted by Hot Springs County Commissioners (February 14, 2006), Benefits to Wildlife from the Application of Water Produced by Coal Bed Natural Gas Development, by Larry Hayden-Wing, Ph.D., submitted by Yates Petroleum (February 13, 2006), Presentation by Larry Hayden-Wing, Ph.D. and Benjamin Parkhurst, Ph.D. (February 16, 2006), Presentation by Bjorn Bjorkman (February 16, 2006). The discharge of produced water suitable for wildlife sustains populations and enhances habitat, including endangered and threatened species, big game, birds, rodents, etc. In high plains, semi-arid desert areas where surface water sources and supplies are very scarce, produced water is extremely beneficial to the environment, sustains livestock, and reduces overgrazing of riparian areas and rangeland. Reducing the availability of produced water will harm wildlife and livestock, and promote overgrazing. The potential harm from prohibiting the flow of produced water down ephemeral drainages is exacerbated by a prolonged drought. DEQ and the Advisory Board must consider and quantify these facts before moving forward with a statewide rule that would deprive the environment of these benefits. Therefore, the Advisory Board should not recommend the rule until all of the balancing criteria have been fully identified, evaluated and made available for public comment.

CONCLUSION

Again, thank you for the opportunity to submit our comments. We request that the Board carefully consider all comments and advise DEQ to issue another draft of the rule, in compliance with the EQC's order, for public review and comment. If you have any questions regarding our comments, please feel free to contact me.

Sincerely,

RW Maxey

Randall W. Maxey MWB
Regulatory Advisor

BEFORE THE ENVIRONMENTAL QUALITY COUNCIL

STATE OF WYOMING

Docket No. 06-3819

CHAPTER 1, SURFACE WATER STANDARDS FOR RULEMAKING

TRANSCRIPT OF MEETING PROCEEDINGS

PURSUANT TO NOTICE duly given to all parties in interest, this matter came on for meeting on the 16th day of February, 2007, at the hour of 10:03 a.m., at the Bighorn Meeting Room, Holiday Inn, 204 West Fox Farm Road, Cheyenne, Wyoming, before the Wyoming Environmental Quality Council, Chairman Mark Gordon presiding, with Mr. John Morris, Ms. Wendy Hutchinson, Mr. Jon Brady, Mr. Richard Moore, Ms. Sara Flitner and Mr. Dennis Boal, Council Members.

Ms. Terri Lorenzon, Executive Director to the Council and Bridget Hill, Assistant Attorney General, also in attendance.

6321f729-209d-43e5-bad9-8933c296ce13

PROCEEDINGS

(Meeting proceedings commenced
10:03 a.m., February 16, 2007.)

CHAIRMAN GORDON: It is a long process and I understand it's a complicated one. I want to thank everybody again.

I'm going to call our meeting to order. We're running about an hour late. It's 10:00 by my watch. I'm going to suggest that we move the election of officers further down so that we can get straight to -- straight to the business at hand.

Does that sit with the Council?

MS. HUTCHINSON: Yes.

MR. BRADY: Yes.

CHAIRMAN GORDON: Okay. So the next item of business would be the decision on Chapter 2, Appendix H.

MR. MOORE: Mr. Chairman, I think we need to decide how we're going to proceed on Chapter 1 first.

MR. BRADY: Okay.

MR. MOORE: Whether we're to try to make a decision today or make a decision at a future meeting is the first question, so I ask the pleasure of Council on that question.

CHAIRMAN GORDON: Is that the pleasure of the Council?

MS. HUTCHINSON: I think this would be a good idea to determine which way we're going to go right now.

CHAIRMAN GORDON: Okay. I hear a decided consensus to do that, so we will do that.

I will open the floor to the Council to make comments.

MS. HUTCHINSON: I think our first decision I would recommend we discuss the rule versus policy issue, because I think if we choose to move forward as a rule, then I am not prepared to make a decision today.

MR. MORRIS: Mr. Chairman, I'd like to make a motion.

MS. HUTCHINSON: Hang on a minute, I'm talking.

And otherwise if we're going to move forward as a policy, then I think I'm prepared to make a decision on remaining part of the Chapter today.

Go ahead, John. Your turn.

MR. MORRIS: I'd like to make a motion that we make this a rule instead of a policy, then we can open it up for discussion.

CHAIRMAN GORDON: Okay.

MR. BRADY: I'll second it.

CHAIRMAN GORDON: It's been moved and

seconded. To put the proposed rule Chapter 1 -- I'm working off the December 2005 draft; is that the correct one?

MS. HUTCHINSON: Yes.

CHAIRMAN GORDON: All in favor?

MR. MOORE: Wait a minute.

MS. HUTCHINSON: Open it for discussion.

CHAIRMAN GORDON: I just wanted to make sure we were putting it on the table.

MR. MOORE: You have a motion on the table, which is to consider it a rule, not a policy, as I understood it.

MS. HUTCHINSON: Yes.

MR. MOORE: I think first we need to decide whether we're going to decide today or not.

CHAIRMAN GORDON: Right. That's the discussion item, the motion was to put these --

MR. MOORE: The motion --

CHAIRMAN GORDON: The motion Mr. Morris made moved to package rules, and seconded by Jon. Now we have discussion about the rule versus policy.

MS. HUTCHINSON: John's motion was essentially to keep Appendix H.

MR. MOORE: I think we're talking about two different motions.

MS. HUTCHINSON: I don't think we are.

MR. MOORE: I think John's motion was to make Appendix H a rule, not a policy. And I think Mark was understanding it was a motion to consider it as a -- consider whether or not we act on the rule package today in its entirety.

MS. HUTCHINSON: No, I don't think so. I think John is starting the discussion on is it a rule or policy.

MS. FLITNER: How about John tells us --

CHAIRMAN GORDON: Yeah, would you clarify your motion? I took it to mean you were moving the whole package as is.

MR. MORRIS: That we devote this is -- or have a discussion whether this will be a rule or a policy.

MS. FLITNER: As is?

MS. HUTCHINSON: As it is.

CHAIRMAN GORDON: The whole package as it is as --

MS. HUTCHINSON: No, Appendix H --

THE REPORTER: You're going to have to go one at a time, please.

CHAIRMAN GORDON: What John has proposed, if I'm understanding correctly, is that he would like to move Appendix H --

MR. MORRIS: H.
CHAIRMAN GORDON: -- as a rule.
It's been seconded by Jon Brady. I'm going to ask if that is correct.
MR. MORRIS: That is correct.
MR. MOORE: Thank you.
CHAIRMAN GORDON: So just for clarification purposes, we could vote down Chapter 1 and have a rule of Appendix H; is that --
MS. HUTCHINSON: No. All John is saying let's have the discussion we want Appendix H to be the rule or policy. And then if that -- he's saying make it a rule. If that fails, then we need another motion to discuss the rest of Chapter 1.
CHAIRMAN GORDON: Okay. Is that clear to everyone?
Okay. Thank you.
MR. MORRIS: Is there an opinion from the Attorney General's Office?
MS. HUTCHINSON: Yes, that would be great.
Bridget, go ahead.
MS. HILL: An opinion as to what? John just likes to give me a hard time. I don't have an opinion at this time.
MS. FLITNER: I think that what we need to

decide is whether or not we want the policy specific to the last conversation to be a rule or not. We further need to decide if we go forward with rulemaking instead of the less formal policy, how we treat the concerns about public notice, you know, we thought we were responding to a policy, we don't -- you know, we've heard comments on specific considerations, if this became a rule, not a policy.
So for purposes of clarification, including my own, I want to know how we can move forward with that discussion. I am not prepared to say -- you know, I like the predictability. I don't like the idea of lots more contested cases.
MS. HUTCHINSON: Here's what I think --
MS. FLITNER: Yes.
MR. CORRA: Mr. Chairman, may I be allowed to --
CHAIRMAN GORDON: I'm going to make a recommendation. It's going to be called a consideration as a rule, does that help clarify this? So comments in our discussion at this point --
MR. MORRIS: No, there's a motion out there. Let's vote on it.
CHAIRMAN GORDON: All right. Go ahead.
MS. HUTCHINSON: Okay. John Corra would

like to speak. Should we let him?
MR. CORRA: Mr. Chairman, may -- I know you're in deliberation. May I offer a suggestion?
MR. GIRARDIN: You need to get closer to the mike.
CHAIRMAN GORDON: Yes, John, go ahead.
MR. CORRA: It may or may not be helpful, and by no means attempt to interfere with the motion or anything else of that sort. It has been presented to you as a rule, the whole thing, Chapter 1, in its entirety. You may -- and follow your own instincts -- you may want to entertain a motion to pass the entire rule and discussion -- amend that motion to decide whether or not you want to include the Appendix H as a rule or a policy.
CHAIRMAN GORDON: That was where I was trying to go, John, and I appreciate that.
MR. CORRA: I thought that might be it, but I just wanted to offer that as an alternative, but thank you for your allowing me to do that.
CHAIRMAN GORDON: That's not what we have before us.
Mr. Moore.
MR. MOORE: Let me follow up on Mr. Corra's comment. And that's exactly where I was trying to get to when I was questioning what Mr. Morris' motion is.

And it seems to me what we need to do is put the entire rule package on the table with a motion to approve or disapprove. We can then consider, for example, as the First Amendment to that motion, whether or not Appendix H should be considered as a rule or a policy. If the Appendix H is determined that we're going to have to receive that as a policy, rather than a rule, then we could go ahead with discussion of other components of the rule package and attempt to adopt the entire rule package today.
If we decided Appendix H should be a part of the rulemaking, I think Miss Hutchinson's comment that she thinks we need a little more time should be taken into consideration, and at that point a member of the Council could move to postpone consideration to a later date. And that would keep us, in my mind, very straight procedurally. Put the motion -- put the whole rule package on the table to start with, deal with the question of Appendix H. Once we've dealt with that, whether it's a rule or policy, then we can decide whether we want to postpone action on the entire package to a later date or move forward at this time. I think that would be the cleanest way to deal with it.
MS. HUTCHINSON: I don't like that. I like John's way to do it, but whatever the Council wants to do.
CHAIRMAN GORDON: I'm struggling with this,

because there are so many wise people on this Council, but I'm going to rule the motion out of order.

MS. HUTCHINSON: Wise guys?

CHAIRMAN GORDON: Wise people.

So I'm going to rule the motion out of order. I would entertain a substitute.

MR. MOORE: Mr. Chairman, I move that we adopt Chapter 1 Surface Water Standards, Docket Number 06-3819, as proposed in the December 2005 EQC draft from the Department of Environmental Quality.

CHAIRMAN GORDON: Is there a second?

MR. BRADY: I'll second it.

CHAIRMAN GORDON: It's been seconded.

Is there discussion?

MR. MOORE: Mr. Chairman, I would yield to Mr. Morris to make a motion about Appendix H.

MS. HUTCHINSON: Well, don't -- okay. Now I'm confused. We don't have to because John's motion was to make it part of the rule, which you just did.

MR. MOORE: Now he can make it a motion to make it policy or keep it as a rule.

MS. HUTCHINSON: Do we want that --

THE REPORTER: One at a time, please.

MR. MOORE: If someone wanted to rule -- I'll take care of it.

MS. HUTCHINSON: Go ahead.

CHAIRMAN GORDON: Hold on, what I'm going to do is start recognizing people one at time.

I've got Rick, I've got Wendy, then I've got Sara.

MR. MOORE: Mr. Chairman, I move we remove Appendix H from the rule package and leave it as a policy.

MS. HUTCHINSON: I'll second that.

CHAIRMAN GORDON: It's been seconded.

MS. HUTCHINSON: So now we're voting on -- if you vote yes, you're making it a policy. If you vote no, you're making it a rule.

CHAIRMAN GORDON: We're now at a point of discussion about whether it's a policy.

MR. MOORE: Thank you. Mr. Chairman, speaking in favor of my motion, I would say that I respect Mr. Corra's recommendation that we leave it as a policy for now. And if we leave it as a policy, I would expect Mr. Corra to look seriously at problems that have been identified, including the uncertainty that a policy provides, and decide whether to bring it back to us in a revised form of a rule at a future date.

CHAIRMAN GORDON: Thank you.

Wendy, I have you recognized.

MS. HUTCHINSON: I guess I would actually

also speak in favor of the motion for the same reasons. I think that -- I wish that it was ready to go to rule, but at this point in time, I understand why some of the language is as it is, because it was policy. I do think that -- I think everybody has stated very clearly that what they would like is certainty, and I think there are some elements in the ag use section here that make a lot of uncertainty, especially for those people who are current permit holders. That needs to definitely be clarified.

CHAIRMAN GORDON: Sara, I have you recognized.

MS. FLITNER: It's the only time you recognized me when I didn't actually raise my hand, but I can think of something.

I'm not prepared to -- I don't know what I'm going to do yet. I have heard a desire for certainty and I don't think a policy provides certainty. I do think that this policy has substance that does provide clarity, which was lacking before. So, you know, I'm just struggling with how we're putting off a decision sort of with this -- I mean, I don't -- I'm grappling with that. If this doesn't work because of the additional clarity, then where are we as opposed -- are we going to have this conversation again a year from now?

CHAIRMAN GORDON: John Morris.

MR. MORRIS: Go ahead, Jon Brady.

CHAIRMAN GORDON: Brady.

MR. BRADY: I want certainty and I would vote against having Appendix H go as a policy. And by focusing upon this rule package as it has come to us, proceed posthaste and come back 10 -- 10 to 30 days, and not later than that, with the revised and clarified rules before the Council.

CHAIRMAN GORDON: So you're speaking against?

MR. BRADY: I'm against.

CHAIRMAN GORDON: Okay. Thank you.

Did you want to, Dennis?

MR. BOAL: I've been -- you know, this has been an interesting one for us, because -- and you've heard me say it a couple of times -- it's a policy that everybody hates, but nobody wants to -- nobody wants to do the work to make it a rule. And so what I would like to do, Mr. Chairman, is I want to make it a rule, but I recognize that it needs some work.

The criticisms about not having appropriate definitions are correct; the observations that it actually refers to itself as a policy is correct; some of the other language that it uses, you know, really isn't appropriate for a policy, so I don't see how we can adopt it as a rule

6321f729-209d-43e5-bad9-8933c296ce13

today. But I believe it's better for everyone if we have a rule that is based on good science, which gives everybody a chance to talk about it in open forum and debate it, and the problem with the policy is those things don't happen. They happen within the confines of DEQ and within the offices of maybe the license holder, the permittee, and other affected landowners find out about it after it's too late.

So I -- and then we get the litigation, and, you know, litigation is fun for lawyers. We love it. But I think most people would say that that's not an efficient way for society to deal with problems, particularly problems that can be prevented beforehand with a rule. So I would like a rule.

And, you know, one of the things Miss Fox said at the end kind of rang a bell with me, is I don't need -- I don't think we need to deal with the livestock watering part of the policy at this point in time. We're going to do this study, which looks at the appropriate -- which looks at the appropriate levels of those kinds of constituents for livestock. And so, you know, so when somebody says to me don't make that a rule yet because those things may change, that makes sense to me. So what I've been toying with is some sort of motion which remands this to DEQ, with input from the advisory board, to take

that part of this proposed policy which deals with protection of irrigation and agricultural lands and put it in a rule form, ask that they look at the comments we receive from a lot of folks as to what appropriate definitions should be and add those to the policy and put it in rule form.

And then it would be good to have another hearing and it would be nice to actually hear testimony about the science supporting the default rate for SAR and you know, the formulation of the EC value. That would -- that would be -- that would be helpful for me.

I just think, as hard as it is for us -- and I know this is as much fun for you guys as it is for me -- I just think we need to go forward through the hard work of hammering out a rule, and if there are some parts of it that are just too amorphous -- that's become a word -- for us to deal with, then let's take them out, but at least we ought to nail down in a rule the default, the default SAR cap and how we're going to develop the default EC value. At the very least we ought to do that. That's my feeling.

And the science is out there, which I -- sounds to me like would enable us to do that. So that would have been my preferred approach is to remand it to DEQ, to put the policy in a -- in a rule form, to address the definitions that need to be addressed and then we hear it

as a rule. That's how I would have liked to have proceeded. And so I think that means I vote against this motion.

CHAIRMAN GORDON: Okay. John.

MR. MORRIS: Well, I concur with Mr. Boal. I definitely think it should be a rule. I think everyone should know where they stand. A rule can be changed, too. Policies can be changed much, much easier. It can be changed at a whim or political pressure or whatever, but a rule, when a rule is changed, everyone knows about it. You have to have a hearing, so everyone will know about a rule.

It was stated earlier a policy can change, no one will know about it until it affects them. So I think it's -- I think this is one of the reasons that we're here today is because of some policies. So I would like to see this a rule.

And that doesn't mean the rule can't be changed. They can be. That's the only way it will ever get to this Council if it is a rule. If it's policies, we'll probably never know about it. So I think for everyone's protection and for the state, good of the state, this should be put into a rule. So I oppose the motion.

CHAIRMAN GORDON: Wendy.

MS. HUTCHINSON: I'd just like to ask some clarifying things about Dennis's proposal procedurally. So

let's pretend for a second everybody wants to do what Dennis just said, and I'm just wondering how that would work through. So would that mean we have to vote no on the motion -- let me go forward for a second, Rick, and you help me. We would then be voting no on the motion, which means we want to keep it a rule, but then that Dennis would have to propose another motion to remand this part of the rule to DEQ?

Go ahead, Rick, if you --

MR. MOORE: Mr. Chairman.

CHAIRMAN GORDON: Yes.

MR. MOORE: Miss Hutchinson, that's exactly correct. Let me state one thing, maybe out there in the open and clear. I made my motion because I want specific guidance from this Council on whether it's a policy or a rule. With that question settled, if my motion fails, then I would request that Mr. Boal make his motion to remove Section H from the rule package today and remand it back to DEQ for rulemaking for the expectation it comes back to us at a time certain.

MS. HUTCHINSON: Okay.

MR. MOORE: That's my intended approach if my motion fails.

MS. HUTCHINSON: I just wanted to make sure it's clear where we're going.

MR. MOORE: Key thing is I want it clear on record that this Council makes it clear to DEQ and all the parties whether we're looking at this being a rule or a policy.

MS. HUTCHINSON: I'm going to make one more argument in favor of the motion. And that is I do think that there are issues that come up as you go along with working with a new policy, or whatever it is, that it's useful to have it in policy for a certain amount of time, one year perhaps, perhaps two, that the DEQ and the regulated community can work through and say now that we're really actually using it, this is not working or this is working, and in a policy they can make those changes and then ultimately bring us a better rule.

So in my mind I would prefer that it stay a policy so that those sort of kinks can get worked out. So that being said, have at it.

CHAIRMAN GORDON: Are there any further comments from the Council? Would you like to proceed to vote on the amendment?

MR. MOORE: Go for it.

CHAIRMAN GORDON: My count showed I'll have to probably vote on this, so I'm just going to go with a roll call. And I'm going to start with --

MR. MOORE: Refresh our memory on the yes

vote is to make Appendix H a policy and a no vote is to keep it a rule?

CHAIRMAN GORDON: That is correct.

MR. MOORE: Thank you.

CHAIRMAN GORDON: So I'm going to start from the inside out. I'm going to start with Mr. Moore.

MR. MOORE: Yes.

CHAIRMAN GORDON: Yes.

Mr. Brady.

MR. BRADY: No.

CHAIRMAN GORDON: Mr. Brady no.

Ms. Flitner.

MS. FLITNER: No.

CHAIRMAN GORDON: Ms. Hutchinson.

MS. HUTCHINSON: Yes.

CHAIRMAN GORDON: Mr. Boal.

MR. BOAL: I will vote no.

CHAIRMAN GORDON: Mr. Morris.

MR. MORRIS: I vote no on the motion.

CHAIRMAN GORDON: Okay. Motion fails.

MS. HUTCHINSON: Well, you vote anyway.

MR. MOORE: He doesn't have to.

CHAIRMAN GORDON: For this -- I am torn by this. This -- you know, everyone's comments are quite correct. This is not ready for rule form. I'm amused that

what I used to hear about policies being altogether too flexible and nobody having any idea what they meant now seems to be a benefit, but that's just for irony, I guess.

I do think it makes sense to have a rule, but this is not -- this is not -- to quote my good friend Keith, not this rule -- or Mr. Isaac (sic), I guess. So I will vote -- I will vote yes.

MS. HUTCHINSON: All right.

CHAIRMAN GORDON: Okay. Now, I will entertain any other motions. I would particularly entertain a motion that had something to do with the default values.

MS. HUTCHINSON: I would like Mr. Boal to make a motion.

MR. BOAL: Your Honor, if I may. I would move that Appendix H to Section 20 be remanded to DEQ and that they be requested to place this rule -- or this policy in rule form and that at a minimum the rule deal with the protection of irrigation uses, and at a minimum the rule sets forth some sort of default standard with regard to SAR and EC. There are a number of other things in the rule that I think recommend themselves and should be seriously considered, but at a minimum, that's what I would request the revised rule deal with. And then I would ask that --

CHAIRMAN GORDON: You got --

MR. BOAL: -- the proposed rule be shared with the advisory board --

CHAIRMAN GORDON: Use the microphone.

MR. BOAL: -- be shared with the advisory board and we receive their input.

And, Your Honor, I was thinking of asking that we set some sort of time line to get at least a status report on the progress on this so that we don't lose track of it. And so I would ask that we get a status report within 90 days.

MS. FLITNER: We need a second, correct?

CHAIRMAN GORDON: Yes, I do.

MS. FLITNER: I will second that motion and I will speak my piece now.

I am in favor of the motion for -- I think it -- it grabs what we want to make clear clear. I was conferring with Dennis to see if a longer time period -- you know, at first it was suggested 10 to 30 days or something. I am interested in what Wendy said and agree with trying to bring some flexibility into this so that we can see what's working and have the benefit of that. It's here we go again with splitting up the baby, but, you know, there are -- we heard a lot of testimony in agreement about where people wanted certainty. That's what we heard.

And we're struggling to also not throw away the flexibility when it can result in better decisions by the Department that consider the input as people learn more, so I think that should be obvious, but I wanted you to know why I just did what I did.

MR. WAGNER: Mr. Chairman, can we speak just --

MR. MORRIS: No, I think we better finish.

CHAIRMAN GORDON: I think we better finish.

MS. HUTCHINSON: So you seconded the motion and we're discussing it now?

MR. FLITNER: Yeah. And I already discussed mine.

CHAIRMAN GORDON: Okay.

MS. HUTCHINSON: I think the only thing I wanted to comment on is the time frame, and I guess I think it would be best if we didn't get a status report until after the next advisory board meeting, which I imagine isn't going to be for another 90 days, so I don't know how you guys --

MS. LORENZON: They meet four times a year.

MS. HUTCHINSON: Right. They just met last week, so that would be, you know, if they're meeting quarterly.

May I ask -- may I ask John Wagner when he imagines the next advisory board meeting's going to be?

CHAIRMAN GORDON: Go ahead.

MS. HUTCHINSON: John.

MR. WAGNER: Mr. Chairman, Miss Hutchinson, that's what -- I did want to speak to that issue. The conversation I was hearing gave me some concern as far as the time frames go.

We would have to first of all go through all the comments that have been received so far, glean out of those what changes need to be made to the -- to the document, go to the advisory board, public notice the advisory board, get the decision of the advisory board, consider all the comments that were made to the advisory board, put together the rule, come back to you.

The time frames that I heard like 90 days are not realistic. It takes time to go through all those processes. So --

MS. HUTCHINSON: But he's only asking for a status report in 90 days.

So I guess my question is, Mr. Boal, do you want the status report before or after they've met with the advisory board or does it matter to you, you just want to know what they're doing 90 days from now?

MR. BOAL: Both of those things, Wendy. You know, 90 days, I came out of the air with that. We can go 120. I just don't want it -- I just don't want it to

get lost. And the status report would be for the purpose of telling us where it's at and why it's not moving or why it is moving and so if it would help, we could kick the status report for another 30 or 60 days, as far as I'm concerned.

But I -- we don't need to spend another two years on this. Let's -- and the other thing about it -- you know, how do you eat an elephant? Well, one bite at a time. And it strikes me let's take the livestock watering out of this issue, let's take the wildlife issue out of it right at this point and let's deal with protection of irrigation lands and let's deal with the default.

And if we can deal with other things at the same time, so much the better. So we ought to be able to come back with a tight, focused regulation and one that is supported by good science.

MS. HUTCHINSON: Mr. Gordon.

CHAIRMAN GORDON: Yes.

Dennis, I want a point of clarification. Are we maintaining jurisdiction on this as we remand it?

MR. BOAL: Yeah.

CHAIRMAN GORDON: Okay. Thank you.

MS. HUTCHINSON: I guess just to -- I would like the 90 days changed to 120 after we do that procedurally, but --

MS. FLITNER: Friendly amendment.

MS. HUTCHINSON: Friendly amendment there?

MS. FLITNER: Friendly amendment.

MS. HUTCHINSON: Okay. And I would also -- when we kick it back, this issue on historic discharges needs to be buttoned up tight, too.

MR. BOAL: Correct. I agree.

MS. HUTCHINSON: I want to make sure that's addressed.

CHAIRMAN GORDON: So that's the friendly amendment that's accepted by Boal?

MR. BOAL: It is, Your Honor.

CHAIRMAN GORDON: Okay.

MR. MOORE: Mr. Chairman.

CHAIRMAN GORDON: Yes, Mr. Moore.

MR. MOORE: I'm not sure if I need to do this by motion, but I'm going to, so be it. I would move that the motion --

MR. MORRIS: We've got a motion on --

MR. MOORE: I'm going to move to amend the existing motion, that while we're waiting for rulemaking, that policy be amended to reflect DEQ's recommendations for the SAR value -- default value of 10, and that the EC limits be based on the USDA Agricultural Research Service National Salinity Laboratory publication.

CHAIRMAN GORDON: Is that taken as a friendly amendment?

MR. BOAL: No.

MS. HUTCHINSON: We need vote on that.

MR. BOAL: We need to talk about that.

CHAIRMAN GORDON: Is there a second?

MR. MORRIS: I'll second it.

CHAIRMAN GORDON: John has seconded it. Thank you, John.

MR. MOORE: Mr. Chairman, speaking for my motion, I'm concerned that I have heard enough testimony, both in this hearing and other hearings, for me to feel very strongly that DEQ is correct in their interpretation that we should be applying 10 as a maximum default limit, and that we should be using the USDA ARS National Salinity Laboratory data rather than the Bridger data for default values, and, therefore, I think if we're going to not deal with those issues as a rule, we at least, as remand it back to become a rule, should at the same time say but the policy should be changed to reflect what we've heard as what we think is the best science today.

MS. HUTCHINSON: Question.

CHAIRMAN GORDON: Yes.

MS. HUTCHINSON: I have a question, not asking for a question. I have a question for Mr. Moore,

and that is clarification, really. So you're asking at this point -- in the meantime here, as we are going on these policies in use, and you're recommending to make the 16, 10, and the ES, other study, got that, okay.

My question is when they kick this -- they take this thing back through and try tightening this up as a rule, if there is further evidence that that is what advisory board comes back with and says, no, we still want it to be 16 -- I mean, have we shut the door on the changes of those numbers through the rulemaking, and I'm not comfortable with that if I think we are doing that.

MR. MOORE: It is not my intention to shut the door to whatever comes out of the rulemaking process. It's just my interpretation of what I've heard to date is that those are the appropriate values to apply as a policy in the interim, and I would hate to have other values applied because we deferred rulemaking on it today. So when it comes back as a proposed rule, if after additional research and study and testimony, either DEQ says we were wrong, it should be 16 or we were wrong, it should be 5, that's part of the rulemaking process that we would consider.

And then once we adopt it as a rule, if we do adopt it as a rule, then the policy part of it goes away but until it's a rule, I want to make sure the policy is

correct as best we know it today.

MS. HUTCHINSON: I'm going to argue against the motion. I still believe this is a policy and we are now -- and it is a policy in place. It's a policy that's gone through the vetting process in the advisory board, the advisory board recommended the 16, and I don't feel we have enough basis at this point to contradict decision of the advisory board who has sat through two years of the stuff.

MR. BOAL: Your Honor.

CHAIRMAN GORDON: Mr. Boal.

MR. BOAL: Rick, I knew -- I knew you were going to make that motion, and so I've been talking to Brenda about it --

MR. MOORE: Bridget.

MR. BOAL: Bridget about it.

MS. HILL: I have a sister named Brenda so I answer to that name.

MR. BOAL: And my concern is, you know, what is a motion directing DEQ to have a certain policy? And, you know, I pulled out the definition of rule under the APA -- actually Bridget did -- and that sounds to me like a rule. And if it's their policy, it's their policy. Okay? I think that's how it sits.

I don't think we can be taking formal action and telling them here's how your policy is going to be, unless

we're going to make a rule. That's my horse manure feeling on it. And so I'm going to vote against the motion, because I think if it's a policy, it's a policy, and we don't approve policies. We don't approve any part of them. We don't disapprove any part of them. We have nothing to do with it. So for that reason, I'm going to vote against the motion.

I agree with the sentiments that -- some of the sentiments you said, but that's my concern about it.

CHAIRMAN GORDON: I'm going to ask for a point of clarification from, I suppose, probably John Wagner. John Corra might be -- point of clarification I have really comes down to three points. One is, as I understood it, you brought the advisory board recommendations. As I understand it, you're not bound by advisory board recommendations. They don't vote on your policies. They don't -- I mean, they don't have binding votes on your policies. They don't choose the way you enforce them or deal with any of that. That sits with this board.

The question I have, you made the recommendation, if I heard you correctly, that you wanted to have default values of 10, because you thought those were more consistent with a wider range of scientific opinion, recognizing that there was some science that said 16 might be appropriate. Are you writing permits today -- so there's really three points: one is what is the advisory board, what's the purpose hearing this; the second one is how are you enforcing it; and the third one is, as you -- as you considered this -- what I'm worried about is the way this is crafted, when it goes back to the advisory board, this will have the force of a recommendation of 16, which may not be your recommendation and may not be the recommendation of this particular -- and yet may still end up in a rule, and as we've seen this other rule packages, you make a mistake, it can take a very long time to remedy those things.

MR. WAGNER: Mr. Chairman, I'll have Mr. Corra help me with all your questions, but we felt that the advisory board took a vote and voted 3 to 2 on that particular issue. We felt obligated to provide you with their recommendation, but we also felt obligated to tell you what our professional opinion was, which was different than what the advisory board said. We, today, are writing discharge permits based on our best judgment, not the advisory board's recommendation.

Then there was the third question, which escapes me.

MR. CORRA: I'm --

CHAIRMAN GORDON: Third one was are you

bound by the advisory board recommendations?

MR. CORRA: You want to take that?

MR. WAGNER: Mr. Chairman, the answer to that question is, no, we are not bound by their recommendations; however, historically, we've paid a great amount of attention and take very seriously what the advisory board says. So I don't want to give the impression that we just pro forma go through a process with them and don't pay any attention, because 95 percent of the time we take their advice and we -- that's what we pass on to you.

In this particular case we felt pretty strongly that they were incorrect, and that's why we did it the way we did it.

MR. CORRA: Mr. Chairman, may I just to add on that? And I agree with everything Mr. Wagner said. I just feel compelled to add to the last thing Mr. Wagner said.

We have high honor for the advisory board process, and we always will. It is a key ingredient in the way in which rules and regulations have been developed and it provides the citizens with a maximum amount of exposure to the process. So Mr. Wagner is correct, but that's why we went back five times, and so --

CHAIRMAN GORDON: Right.

MR. CORRA: Okay. Maybe enough said. That's probably an editorial you didn't need.

CHAIRMAN GORDON: Right.

MR. CORRA: I would like to ask, though, if I can take the opportunity very, very quick. On the 10 versus the 16, my understanding of the motion was that we would go through the rulemaking process with the advisory board, one step with the time limit, get back to you, and I thought I heard the Council tell us that they wanted special emphasis on three things: clarifying historical definitions, clarifying irrigation and clarifying the default.

Now, by necessity -- or, excuse me, by virtue of that, I would go back to the advisory board and have a full scientific discussion again on the default. I -- that's not to say I don't agree with Mr. Wagner on the Department's position about what it ought to be, but you've said, hey, this needs to be discussed as a rule and you ought to focus on that as one of the key pieces, we think that's -- we're good.

CHAIRMAN GORDON: Thank you.

You understand, Council, my concern here is that by virtue of the fact this is in what we are remanding, it has a force larger than the other number, and maybe that is a policy that we don't want to enforce, so --

MR. MOORE: Mr. Chairman, in response to Mr. Boal's comment about sounds like rulemaking, I would refer to the section of the Environmental Quality Act that talks about powers and duties of the Environmental Quality Council. And specifically it states the Council shall approve all rules, regulations, standards or orders of the Department before they become final. It seems to me we're talking about a standard, and, therefore, I'm comfortable saying we ought to approve use of default values in this policy as they go forward.

CHAIRMAN GORDON: Wendy, do you --

MS. HUTCHINSON: Yeah, I guess I still -- I think Dennis summed it up correctly, we -- the Department brings policies before us as a courtesy, because we have asked them to so that we get a fuller picture of the rule and how it's being implemented. And I have some serious difficulty stating, hey, sorry you got a policy out there, change these numbers because we think so. And although I have to honestly say I'm a little bit perplexed if -- I recognize that you respect the advisory board's opinion, which is fantastic, that's what we're trying to do here today, but I find it a little bit bizarre, quite frankly, that you feel so strongly that the advisory board is wrong, that you put their number in the policy anyway. That just seems strange to me, but -- anyway, that's a little bit off

point.
But I agree with Dennis. I don't think it's proper procedure for the Environmental Quality Council at this point in time to say we order you to change your policy. I think that's just bad politics.
MR. MOORE: Mr. Chairman, may I ask one question of Mr. Wagner for clarification?
CHAIRMAN GORDON: Yes.
MR. MOORE: Mr. Wagner, what we have before us is your draft rule package. I'm assuming that -- correct me if I'm wrong if that's a bad assumption -- that based on our action today you'll probably go ahead and publish a policy that you will implement until we come back with -- to consider rules. Is that a correct assumption?
MR. WAGNER: Mr. Chairman.
Mr. Moore, yes that's correct.
MR. MOORE: When you publish that policy, will it be in the same format, as we see it as the draft rule, with the advisory board's default value and a footnote saying what you think it ought to be, or will you put your value in there?
MR. WAGNER: Since we're using our default value, that's probably the way we would -- that we would put it out is that's the way we're writing permits. We probably wouldn't want to confuse the issue.

MR. MOORE: But you're saying probably, you don't know yet.
MR. WAGNER: Well, got to -- you hit me a little cold here, and -- but I -- just off the top of my head, I think that's probably the way we would go, yes.
MR. MOORE: Thank you.
CHAIRMAN GORDON: Mr. Boal, I have a question for you. Considering obviously the conundrum we have with this particular issue, if this policy had come with 10, would you have changed it to 16, or do you feel comfortable with the number that the policy is being implemented today?
MR. BOAL: Tell me what you're thinking. I mean, this -- just talk to me, Mark, please. Just tell me and I'll tell you my honest reaction.
CHAIRMAN GORDON: Well, I guess what I'm saying is do you -- do you have a problem with amending your motion so that this remanded document goes back with 10 as a default, with the opportunity to say if there's better science, it can be 50, it can be 70, it can be 5.
MR. BOAL: The problem I have with it is I don't think -- I don't think we have -- I don't think we should be approving or disapproving policies, you know.
CHAIRMAN GORDON: I'm not talking policy, I'm talking about what we're remanding back for

consideration.
MR. BOAL: Oh, I wasn't -- I didn't see this as remanding a specific number back to them. I thought Mr. Corra put it pretty well, we're going to come up with an agricultural protection regulation which clarifies historic uses, clarifies the definition of irrigated lands and sets a default limit based on good science, whatever that may be, and I like that approach.
CHAIRMAN GORDON: So this language does not -- is not part of that motion?
MR. BOAL: No.
CHAIRMAN GORDON: This language -- this is just --
MR. BOAL: Right.
CHAIRMAN GORDON: -- in the ether.
MR. BOAL: Right.
CHAIRMAN GORDON: We're starting from scratch?
MR. BOAL: Right, as far as I'm concerned. But we're not starting from scratch, because we have a full numbers of years of experience behind us and we already have a whole huge amount of information, so we're starting on top of a mountain and we just need to get to the submit. Shouldn't take two years. It should be, as far as rulemaking goes, an expeditious process, in my view.

That's how I see it. And so I didn't want to prescribe any number. I wanted it -- everybody to have their chance to demonstrate that their number is the right one. That's how I saw it.
CHAIRMAN GORDON: Okay. You understand my concern?
MR. BOAL: I do.
CHAIRMAN GORDON: Thank you.
John.
MR. MORRIS: I speak in favor of Mr. Moore's motion. If that's already the policy that they're working under now, so what difference is it going to make? So I speak in favor of the motion. I call for the question.
CHAIRMAN GORDON: No, don't do that. I'll just go for the question.
MR. MOORE: Call for the vote.
CHAIRMAN GORDON: Yeah, call for the vote.
Okay. John, you vote in favor?
MR. MOORE: Make sure we know what we're voting on.
MR. MORRIS: I vote in favor --
MS. FLITNER: On Rick's amendment.
CHAIRMAN GORDON: Rick's amendment.
MS. FLITNER: Or motion.

MR. MOORE: Motion to amend.
CHAIRMAN GORDON: Go ahead and read your motion to amend.
MR. MOORE: No, I'm not going to. Everybody knows -- we're moving to direct the Department to amend the policy to 10 and salinity lab values in their policy.
CHAIRMAN GORDON: Okay. John votes yes.
MR. MORRIS: Yes.
MS. HUTCHINSON: Wendy votes no.
CHAIRMAN GORDON: Wendy votes no.
Jon Brady.
MR. BRADY: Yes.
CHAIRMAN GORDON: Jon votes yes.
Rick.
MR. MOORE: Yes.
CHAIRMAN GORDON: Sara.
MS. FLITNER: No.
CHAIRMAN GORDON: No.
MR. BOAL: I vote no. Also.
CHAIRMAN GORDON: No? Thank you.
I'm going to vote -- geez, considering it's what's already been being done, I will vote yes.
MR. MOORE: Now we're back to the main motion.

MS. HUTCHINSON: So are we back to Dennis' motion now?
CHAIRMAN GORDON: Yes, we are.
MR. MOORE: Yes.
MR. MORRIS: Question.
CHAIRMAN GORDON: I'm going to say that the vote's been asked for. Is -- are we ready to go to vote?
MR. MOORE: Yes.
CHAIRMAN GORDON: Okay. Dennis.
MR. BOAL: I vote yes.
CHAIRMAN GORDON: Sara.
MS. FLITNER: I vote yes.
CHAIRMAN GORDON: Rick.
MR. MOORE: Yep.
CHAIRMAN GORDON: Jon.
MR. BRADY: Yes.
CHAIRMAN GORDON: Wendy.
MS. HUTCHINSON: Yes.
MR. MORRIS: Yes.
CHAIRMAN GORDON: Unanimous.
MS. HUTCHINSON: Okay. Now we're discussing Rick's motion to pass the rest of the rules, is that what we're doing?
MR. MOORE: Yes.
MS. HUTCHINSON: I have some comment on the rule itself.

CHAIRMAN GORDON: Okay. Wendy, I'll recognize you.
MS. HUTCHINSON: Thank you.
I guess it's pretty minor. There's a bunch of typos in the definitions, so I would like that to be fixed, whatever we got to do procedurally, but just in Chapter -- just in the definitions, there's a bunch of -- sometimes you got quotes around the whole word, sometimes you got no quotes, sometimes you got double quotes, so I would just like that sort of cleaned up and made consistent, because there's definitely some missing. So if you could just go through all the definitions and make sure the quotes are correct. It's just a typographical thing.
MR. CORRA: We can do that.
MS. HUTCHINSON: That's my only --
MR. MOORE: And Mr. Chairman.
CHAIRMAN GORDON: Yes, Mr. Moore.
MR. MOORE: Also like effluent-dependent water versus effluent-dominated water, the caps should be the same, as well as the quotes.
MS. HUTCHINSON: Correct, yeah.
MR. MOORE: And on the same type of vein, as far as typographical or structural comments, I would appreciate in the table of contents if the appendix listings include the titles for those appendices.

MS. HUTCHINSON: That would be helpful.
CHAIRMAN GORDON: Any further comments?
MS. HUTCHINSON: I'm looking.
MS. FLITNER: Ready to vote.
CHAIRMAN GORDON: Are we ready to vote?
MS. HUTCHINSON: I have one question. On page 118, which is Section 20, the added words right now say the procedures used to implement this section are described in the, quote, Agricultural Use Protection Policy. So during this interim period can we still leave the words the same that say policy, and then when they come in with a rule change, it would then change to say Appendix H?
MR. CORRA: Yeah.
MS. HUTCHINSON: Okay. Leave it alone, then.
MR. CORRA: Mr. Chairman.
CHAIRMAN GORDON: Further comments?
MR. CORRA: Mr. Chairman.
CHAIRMAN GORDON: Yeah, Mr. --
MR. CORRA: May I please -- Bill -- there is another serious typo.
MS. HUTCHINSON: Okay. Where?
MS. CORRA: Bill, do you want to --

C E R T I F I C A T E

I, KATHY J. KENDRICK, a Registered Professional Reporter, do hereby certify that I reported by machine shorthand the foregoing proceedings contained herein constituting a full, true and correct transcript.

Dated this 9th day of March, 2007.

Kathy J. Kendrick

KATHY J. KENDRICK
Registered Professional Reporter

5 public meeting

WASTE AND WATER ADVISORY BOARD

REVISIONS TO APPENDIX H
AGRICULTURAL USE PROTECTION
CHAPTER 1, SECTION 20
WATER QUALITY DIVISION RULES

HOLLAND & HART LLP

Jack D. Palma, II
Holland & Hart LLP
2515 Warren Ave., Suite 450
Cheyenne, WY 82001

June 15, 2007

DEQ AGRICULTURAL USE PROTECTION RULE

- Share DEQ's Goal of workable, reasonable program regulations
- Williams seeks rules which can be applied
  - consistently
  - fairly
  - and practically

➢ WILLIAMS' PROPOSED CHANGES

- Suggested changes within the existing framework which:
  - provide agricultural protection
  - increase certainty, enforceability, credible science
  - all within existing framework

THREE ISSUES OF CONCERN

- Need for Consistency in Application
- Historic Discharges
- Reasonable Access Requirements

➢ NEED FOR CONSISTENCY

- How Rule implemented as important as the language of the Rule itself
- Balance need for flexibility with need for consistency and predictability
- Consider Use of Fact Sheets
  - identify acceptable methodologies and protocols
  - answer key questions
  - explain fundamental processes, interpretations, and requirements

➢ HISTORIC DISCHARGES

- Exempt discharges under valid and existing permits issued prior to date of Rule
- Discharges pursuant to valid and existing permit deemed fully protective of agricultural uses when issued
- Historic discharges of record best empirical evidence of no measurable decrease

➢ NATURALLY IRRIGATED LANDS ACCESS REQUIREMENT

- Requires landowner provide the permit applicant with reasonable access to lands claimed to be naturally irrigated
- Recognizes that site-specific data, where it is available, is the most credible, reasonable data to rely on
- Since applicant bears the burden of proof, must be given access to obtain site-specific data critical to the application

➢ REASONABLE ACCESS REQUIREMENTS

- Requires a downstream landowner to provide access to the applicant to collect soil and/or water quality data
- Recognizes that the applicant bears the burden of proof of no measurable decrease to crop production and must have access to collect data to meet that burden
- Allows the process to move forward on the basis of reasonable, credible, and supportable information

LAW OFFICES
JORDEN BISCHOFF & HISER, P.L.C.

7272 E. INDIAN SCHOOL ROAD, SUITE 205
SCOTTSDALE, ARIZONA 85251
TELEPHONE: 480-505-3900
FACSIMILE: 480-505-3901

MATTHEW JOY

DIRECT LINE: 480-505-3928
e-mail: mjoy@jordenbischoff.com

June 15, 2007

Via Facsimile ((307) 777-5973) & U.S. Mail

Mr. David Waterstreet
Herschler Building – 4W
122 West 25th Street
Cheyenne, WY 82002

Re: Comments on Revisions to Appendix H, Agricultural Use Protection Policy Chapter 1 WWQRR Section 20

Dear Mr. Waterstreet:

Yates Petroleum Corporation (Yates) would like to take this opportunity to comment on the Wyoming Department of Environmental Quality's (WDEQ) proposed Chapter 1, Wyoming Water Quality Rules and Regulations (WWQRR), Appendix H – Agricultural Use Protection (Appendix H). Yates is a coalbed natural gas operator in the Powder River Basin. These comments are in addition to comments submitted by Yates on earlier drafts of Appendix H, which are incorporated herein.

As with past versions, the current version of Appendix H would prohibit the use of produced water for livestock watering and/or wildlife propagation and, in essence, cause more harm to existing uses and the environment than it would prevent. Again, Yates urges the Water Quality Division (WQD or Division) to evaluate these impacts more carefully prior to implementing Appendix H as a rule or policy.

Additionally, the proposed language in Appendix H is not suitable for implementation as a rule. The language fails to provide WQD with needed flexibility in the administration of the provisions and fails to provide both the WQD and the regulated public with notice concerning the interpretation of many aspects of the provisions.

As we have stated in previous comments, the scientific evidence demonstrates that default effluent limits for irrigation should be based on more state-specific data (such as the Bridger Plant Material Center study) and not generalized studies that do not take into account Wyoming soil characteristics. Appendix H currently relies on documents which do not take into account Wyoming soil types for developing effluent limits for EC and SAR.

In order to provide guidance to WQD, the regulated industry and the public, Appendix H should specifically define the term "naturally irrigated lands" and "agriculturally significant plants." "Naturally irrigated lands" should be limited to lands which are irrigated at least once a year and that the plants grown on "naturally irrigated lands" are cropped or otherwise managed to improve yields of desirable species. "Agriculturally significant plants" should be defined in such a manner as to protect plants which are present in such quantity to provide significant economic value or animal nutritive value.

Finally, Yates has concerns regarding the "Reasonable Access Requirement." As currently written, Appendix H provides little or no protection for regulated entities where a landowner denies access to conduct a Tier 2 or Tier 3 analysis and merely asserts that naturally irrigated lands exist near a stream. Where the applicant is denied access by the landowner, the landowner should not be able to assert that "naturally irrigated lands" exist without additional documentation that can be obtained by the *applicant* seeking access.

As always, Yates appreciates this opportunity to comment on Appendix H and looks forward to working with the Division in resolving these issues. Please contact me at (480) 505-3928 if you have any questions.

Sincerely,

Matthew Joy
Attorney for Yates Petroleum Corporation

Enclosure

LAW OFFICES

JORDEN BISCHOFF & HISER, P.L.C.

7272 E. INDIAN SCHOOL ROAD, SUITE 360
SCOTTSDALE, ARIZONA 85251
TELEPHONE: 480-505-3900
FACSIMILE: 480-505-3901

MATTHEW JOY

DIRECT LINE: 480-505-3928
e-mail: mjoy@jordenbischoff.com

February 12, 2007

Via Facsimile & U.S. Mail

Mr. Bill DiRienzo
Water Quality Division
Wyoming Department of Environmental Quality
Herschler Building, 4th Floor West
122 West 25th Street
Cheyenne, Wyoming 82002

Re: Proposed Section 20, Appendix H - Agricultural Use Protection

Dear Mr. DiRienzo:

Yates Petroleum Corporation (Yates) would like to take this opportunity to comment on the Wyoming Department of Environmental Quality's (WDEQ) proposed Chapter 1, Wyoming Water Quality Rules and Regulations (WWQRR), Appendix H – Agricultural Use Protection (Appendix H).

In brief, Appendix H would prohibit the use of produced water for livestock watering and/or wildlife propagation and, in essence, cause more harm to existing uses and the environment than it would prevent. Yates urges the Water Quality Division (WQD or Division) and the Environmental Quality Council (EQC) to evaluate these impacts more carefully prior to implementing Appendix H as a rule or policy. Additionally, the proposed language in Appendix H is not suitable for implementation as a rule. The language fails to provide WQD with needed flexibility in administration of the provisions and fails to provide both the WQD and the regulated public with notice concerning the interpretation of many aspects of the provisions. These comments are in addition to comments submitted by Yates on earlier drafts of Appendix H and those comments are incorporated herein.

Appendix H Will Eliminate a Needed Source of Water for Agriculture

As proposed, Appendix H will interfere with the livelihoods of many ranchers who currently rely on the produced water for livestock watering and adversely affect livestock and wildlife use of the water. As Appendix H will effectively prohibit the use of produced water for livestock watering, will result in a measurable decrease in production for existing uses, is *not* protective of agricultural use, and violates Section 20 in its own right, Appendix H should not be implemented.

First, the Environmental Quality Act and, more specifically, Section 20 are intended to protect *agricultural* use. The Department has extended Section 20 to include "naturally irrigated lands" which is an unallowable extension of both the Act and the regulations. Section 3(a) of the Wyoming Water Quality Rules & Regulations (WWQRR) defines agriculture uses as "irrigation or stock watering." The term "irrigate," in turn, is defined as "to supply (land) with water by means of ditches or artificial channels." (Webster's New World College Dictionary, 4th Ed.) Clearly, irrigation is intended to mean some form of active management of water more than the passive passing of water in its natural channel(s). Hence, Appendix H should only impose effluent limitations on areas that are irrigated by means of ditches or artificial channels or that are otherwise actively irrigated. As currently written, Appendix H extends agricultural protection far beyond that envisioned by the Legislature or Chapter 1 and, in effect, becomes a "native plant" protection policy that, indeed, may protect noxious weeds as much as anything else.

Second, because Appendix H extends the agricultural protection of Section 20 to non-agricultural "naturally irrigated lands," which WQD's infrared map suggests are present on most drainages, it will essentially prohibit all discharges of produced water down any drainage in which it is alleged that "naturally irrigated lands" exist. As Mr. DiRienzo candidly stated before the Water and Waste Advisory Board meeting on August 2, 2006, virtually no produced water can meet the Tier 1 effluent limitations. Prospective dischargers will be required to conduct a Tier 2 or Tier 3 evaluation and seek approval from the Division. The Division has consistently shown that it has been unable to timely administer similar tiered programs. As a result, all produced water discharges effectively will either be prohibited under Appendix H or will result in appeals that the EQC will have to resolve on a case-by-case basis. In essence, the EQC will be mandating a "permit by evidentiary hearing" procedure for all CBNG produced water discharges.

Third, because of Appendix H's extension to "naturally irrigated lands," produced water of quality suitable for livestock watering would not be allowed to discharge down such drainages *even if the downstream landowner desires the water for his use*. This situation is made worse by the fact that any person, not just a landowner on the drainage, can allege that there are "naturally irrigated lands." As a result, one landowner in the drainage or *any other third party not located on the drainage* may interfere with every other landowners' use of the water by refusing to allow such water to flow anywhere along the drainage under the pretense that the drainage may affect "naturally irrigated lands."

Fourth, by effectively prohibiting discharges of produced water down drainages where it is alleged that "naturally irrigated lands" exist, Appendix H will deprive livestock and wildlife of good quality water along these drainages. Many landowners currently rely on produced water to water livestock and for wildlife propagation. By eliminating discharge across alleged "naturally irrigated lands," Appendix H will prohibit all future discharges of water and eliminate its use for livestock watering and wildlife propagation. Appendix H will also eliminate discharges which are currently authorized under the WYPDES program in any drainages where someone alleges "naturally irrigated lands" are present once the permit is renewed. Furthermore, many landowners have already established uses of produced water for both livestock and wildlife. In the event Appendix H is implemented, no produced water will be available to continue these uses in the future. This will result in a net loss of both livestock production and wildlife propagation which is, in itself, a violation of Section 20.

Fifth, water quality in gaining stretches (areas where the shallow water table pools and stagnates) of ephemeral drainages generally does not meet Appendix H effluent limitations and is, in fact, of poorer quality than produced water. Appendix H, if implemented as currently written, will deprive landowners of good quality water which is better than water quality in gaining stretches.

The Proposed Appendix H Language is Not Suitable as a Rule

Appendix H, as currently drafted, fails to provide either the WDEQ or the regulated community with notice concerning how Appendix H will be administered. Because of its failure to provide notice, promulgation of Appendix H as a rule, rather than as a flexible policy, will likely lead to significant legal and technical challenges once WDEQ attempts to administer the proposed "rule."

Simply stated, if the proposed language is promulgated as a rule, WDEQ will have no flexibility in enforcing the standard even where the requirements of the rule are not justified. In other words, if the proposal is drafted as a policy, rather than a rule, WDEQ would have the ability to deviate from the provisions where the facts and circumstances dictate. In fact, flexibility was advocated by WQD when it originally issued the proposal as a policy. WQD's Bill DiRienzo stated that developing a numeric standard for constituents was not practicable. *See* Transcript of Hearing, Buffalo, Wyoming, August 2, 2006, pp. 20-22. Mr. DiRienzo also stated that it would be better to make decisions on a site-specific basis. *See* Transcript, p. 25. Finally, Mr. DiRienzo stated that developing a flexible policy versus a rigid rule is more advantageous given that WQD intends to "tweak" the policy from time-to-time once WQD has gained experience in implementing this policy. *See*, Transcript, p. 22. Mr. DiRienzo stated, correctly, that this would be easier if the proposal were instituted as a policy rather than as a rule. Transcript, p. 22.

An example of the inflexible nature of Appendix H, as currently written, is the fact that a Tier 2 analysis must be conducted with specific sample collection requirements (i.e., four depths at 12-inch intervals). If, for some practical reason, such sampling cannot be conducted, the Tier 2 evaluation is not available as an option. This leads to unjust results, not just to the operator, but also to landowners who may wish to use the water for stock watering or other beneficial uses.

As currently written, Appendix H fails to provide sufficient guidance and notice to both the regulators and the regulated community. It is well settled that an agency must always provide "fair notice" of its regulatory interpretations to the regulated public. *General Electric v. U.S. EPA*, 53 F.3d 1324, 1329 (D.C. Cir., 1994). However, given that Appendix H was drafted as a policy and the language has not been changed in this eleventh hour conversion to a "rule," the loose language appropriate to a policy provides no notice to the regulated community as to what it will be required to do in order to comply with the requirements of the "rule." Below are several, but not all, examples of just how the proposed language fails to provide notice to the regulated community.

1) Essentially, the proposed "rule" sets forth effluent limits for "naturally irrigated lands." The proposed language in Appendix H defines "naturally irrigated lands" as "those lands are those lands where a stream flow and channel geometry provides for enhanced productivity of agriculturally significant plants." Appendix H, H-4. Unfortunately, Appendix H fails to provide any definition or guidance concerning what the terms "channel geometry" and "agriculturally significant plants" mean. For example, does the term "naturally irrigated lands" include plants not used for livestock consumption? Does the term include exotic species?

2) The Appendix H language also provides that when calculating the 20-acre threshold, "small drainage bottoms *may* be excluded from consideration." Appendix H, H-4 (italics added). It is unclear what is meant by this provision as it provides no guidance concerning when a drainage bottom should be excluded.

3) The proposal states that "though not necessary for the estimation of background water conductivity, it is advisable to also analyze the soil samples for pH, SAR, soil texture and exchangeable sodium percentage (ESP) to avoid having to duplicate the sampling if the results indicate that a 'no harm analysis' needs to be completed." Appendix H, H-9. What does this mean if the proposal is adopted as a rule? Does the "rule" require sampling of pH, SAR, soil texture and ESP? Loose language such as "it is advisable" indicates that the current version of Appendix H is not suitable for promulgation as a rule.

4) Tier 3 allows for establishing EC and SAR limits based upon a "scientifically defensible site specific study that examines local soil characteristics, natural water quality, expected crop yield, irrigation practices and/or any other relevant factor related to crop production." Appendix H, H-9. Again, this language is too ambiguous to be used universally. Who determines whether the analysis constitutes a "scientifically defensible site specific study?" What may be defensible in one set of circumstances may not be defensible in another.

5) The language of proposed Appendix H itself warns against application as a rule. In reference to the Tier 3 analysis, Appendix H states "because of the very site-specific nature of this [the Tier 3] approach and the number and complexity of variables that may need to be considered, *it is not very useful to specify any particular type of analysis in this policy*." Appendix H, H-10 (italics added).

Because Appendix H is currently written to provide guidance and to allow flexibility is its administration, it is not suitable for use as a rule. Similarly, Appendix H does not provide notice to either the regulators or the regulated public with enough specificity to be enforceable as a rule. For these reasons, Yates respectfully requests that Appendix H not move forward in rule-making but, rather, remain as a policy. If the EQC does determine that Appendix H should be promulgated as a rule, Yates respectfully requests that the proposed language be re-drafted re-noticed for public comment period to allow fixing the many problems with the existing language before final promulgation into rule form.

Evidence Demonstrates Effluent Limits for EC of 2700 μmhos and SAR of 16

In the event the EQC decides to proceed in promulgating Appendix H as either a rule or a policy, the default limits for specific conductance (EC) and sodium adsorption ratio (SAR) should be 2700 μmhos and 16, respectively. Kevin Harvey, a soil scientist with 25 years of experience, summarized the current state of the science and Petitioners' concerns when he provided the WQD and the Water & Waste Advisory Board with an extensive scientific literature review regarding EC and SAR limits proposed in the Chapter 20 rule-making process. Mr. Harvey studied the default effluent limits (EC of 2000 and SAR cap of 10) proposed in the rule-making and compared them with soil salinity in Wyoming to determine whether the default limits were justifiable given natural conditions. Mr. Harvey concluded that the default limits were not justified and were, in fact, too low given the natural soil conditions throughout Wyoming. Based on the available science, Mr. Harvey determined that EC should be 2700 μmhos and SAR should be 16. *The Water and Waste Advisory Board accepted this suggestion and has included them in the proposed language.* DEQ/WQD has stated that they are not in favor of Mr. Harvey's limits but have failed to produce *any* evidence to support lower effluent limits. Copies of Mr. Harvey's submissions to the Water and Waste Advisory Board are attached as Exhibit "A."

WQD does not support the Tier 1 default values for EC and SAR supported by Mr. Harvey's research and accepted by the Water and Waste Advisory Board. WQD apparently believes that default levels based on the USDA Agricultural Research Service Salt Tolerance Database are appropriate. This is simply not supported by the evidence or the facts. The more appropriate levels are the values established by the Bridger Plant Material Center (the Bridger Study). The Bridger Study was conducted in soil types more similar to those found in Wyoming, and was developed for plants grown in Wyoming and Montana. Hence, the Bridger Study takes into account soil types typically found in Wyoming. The effluent limits urged by WQD reflect tolerances of plants grown in California soils which do not have characteristics representative of typical Wyoming soils. Again, the Water and Waste Advisory Board, in its October meeting, agreed with Mr. Harvey that the Bridger Study and, hence, effluent limits derived from the Bridger Study were more appropriate than relying on a study conducted in California.

There is No Legal or Factual Basis for 50-Year Containment Option

Under the requirements set forth in Appendix H, an operator must either gain downstream access and conduct extensive vegetation, soils and background water quality analysis in order to demonstrate that the default effluent limits are inappropriate or comply with the overly-conservative effluent limitations. If an operator cannot comply with either of these requirements, which is likely due to landowner reluctance to allow operators on their property and the fact that the proposed effluent limits are impossible to meet, WDEQ has established the practice of requiring an operator provide enough containment for the amount of produced water and a 50-year precipitation event.

Although WDEQ asserts that this requirement provides a viable option for those who cannot gain access or meet the limits, realistically it provides no option to operators. Under the Environmental Quality Act (EQA), "in recommending any standards, rules, regulations, or permits the administrator shall consider all the facts and circumstances bearing upon the reasonableness of the pollution involved including... the *technical practicability and economic reasonableness* of reducing or eliminating the source of the pollution." W.S. 35-11-302(a)(vi)(D) (italics added). WQD has failed to consider the technical practicability and economic reasonableness of requiring 50-year containment.

First, the 50-year containment requirements will simply render many already-permitted on-channel reservoirs useless and will unnecessarily reduce the number of reservoirs that could be constructed in the future due to constraints on the amount of land available to build the reservoirs and landowner requests. WQD has failed to consider this important fact in promulgating the permit.[1] WQD's failure to follow its own rules (here, considering the technical feasibility and economic reasonableness of the containment requirement) is arbitrary and capricious and requires remand. *See Bowen v. Wyoming Real Estate Comm'n*, 900 P.2d 1140, 1142 (Wyo. 1995).

Second, as stated above, the WQD must consider technical feasibility and economic reasonableness when promulgating conditions in a permit and WQD has failed to consider the technical feasibility of the proposed containment requirement. The 50-year containment requirement places operators in the position of having to construct overly-large reservoirs at the expense of otherwise open land. The large reservoirs would necessarily inundate otherwise ephemeral streams. Also, in many places on the watersheds, construction of reservoirs of this size simply is not possible due to characteristics of the stream in which the reservoirs are to be constructed. The WQD simply failed to weigh and properly consider the technical feasibility

---

[1] In other proceedings, WQD allegedly considered similar objections to a 50-year containment requirement and stated that the "great majority" of the reservoirs subject to the requirement were less than 20 acre-feet in size and required only an additional 5 acre feet of freeboard to contain a 50-year storm event. WQD's assertion fails to address the fact that, in most cases, reservoirs simply cannot be constructed with the additional 5 acre feet of capacity and WQD simply failed to provide any support for its conclusion.

and economic reasonableness in contravention of its rules. This requires remand. *See Bowen*, 900 F.2d at 1142.

Third, the WQD has failed to provide *any* support to justify a 50-year containment requirement or show how the requirement is related to the protection of water quality. In determining whether an agency's actions are valid, the decision must be supported in the record. *See Id.* Operators have consistently and repeatedly documented that the contribution of CBNG water is minimal when compared with even a 2-year storm event and that the characteristics of CBNG water are lost when mixed with the much larger amount of precipitation runoff from the 2-year event. This demonstration has gone unheeded and undisputed by WQD.

Comments Aimed at Improving Appendix H

As outlined above, Yates does not believe that the current draft of Appendix H is workable as either a policy statement or as a binding rule. Experience with the Tier 2 and Tier 3 approach, as presently implemented by WQD, demonstrates that the Division is rarely able to proceed in the face of a conflict between a dissenting landowner and the operator and other landowner(s) who may wish to use water. Yates hopes that the EQC will remand Appendix H back to the WDEQ and WQD for further consideration. If such remand should occur, Yates recommend the following changes:

Comment 1. The policy should address how to determine whether a discharge will "reach" irrigated lands. Unless this issue is clearly identified, it leaves WQD, landowners, operators and the public at a loss of how to evaluate when the protections stated by the proposed policy should be implemented. Yates recommends the following wording to be added to Section III.A under "Identification and Protection of Irrigation Uses":

> *For purposes of this policy, a discharge will not reach irrigated lands if it is: (a) downstream from the lands; (b) contained in an off-channel reservoir; (c) contained in an on-channel reservoir and the discharge constitutes less than 5% of the total flow during the design event that would cause overflow from the reservoir; (d) if only naturally-irrigated lands are present below the discharge, and the discharge and all other pre-existing discharges do not exceed 75% of channel capacity; or (e) if irrigated lands are present, the applicant presents letters from all downstream irrigators either agreeing that the discharge will not reach the irrigated lands or consenting to it reaching the lands.*

Clauses (a) and (b) are self-explanatory. Clause (c) addresses *de minimis* risks. At this design capacity, the total quantity of CBNG produced water will be a small part of the total volume of water flowing in the wash. Natural conditions will predominate and natural systems (e.g., flushing of higher salts at the beginning) should play their typical role. Clause (d) allows discharge where the operator can demonstrate that the water will be confined to the channel. As in the case of clasue (c), storm events should provide adequate dilution water. Clause (e) allows landowners and operators to work together cooperatively to deliver water where several landowners on the drainage desire such water.

Comment 2. Artificially irrigated lands should only include legally irrigated lands. Any other approach places the EQC and WDEQ in the position of condoning and protecting a violation of state law.

Comment 3. Naturally irrigated lands should be more concisely defined to avoid future disputes. The definition of naturally irrigated lands is important, but is essentially undefined in the proposed policy/rule. Yates recommends the following changes:

> *Naturally irrigated lands are lands (a) within the annual flood plain where the stream channel is underlain by unconsolidated material, (b) which are (i) cropped and/or (ii) actively managed by fertilization, cultivation or other mechanized means and (c) as a result have enhanced vegetative production of agriculturally significant plants over adjoining areas. Naturally irrigated lands may be identified by an evaluation of infra-red aerial photography, surficial geologic maps, wetland mapping, landowner or survey testimony, or any combination.*

The rationale for the suggested changes is simple:

- The policy/rule is supposed to protect "irrigated" lands. Land which is not, on average, irrigated at least once a year is not "irrigated" land as that term is used in the Wyoming community. Frequencies of less than once a year, on average, suggest that dry-land agriculture is actually what is being practiced.
- Irrigated lands are distinguished from livestock raising, which typically relies upon native plant species. Agriculture generally suggests that materials are cropped or otherwise managed to improve yields of agriculturally desirable species. The definition should include these concepts by requiring the lands to either be cropped or else fertilized or cultivated by mechanical means. Lands which are not managed with some degree of intensity are simply "the environment" and not agricultural use protected under the Environmental Quality Act.

Comment 4. Agriculturally significant plants should be defined. Yates recommends the following definition, after consultation with soil scientists and agronomic experts:

> *"Agriculturally significant" means typically cultivated crops (including, but not limited to alfalfa) or native and non-native forage plants (including, but not limited to wheatgrasses, bromes and wildryes) present in such quantity as to provide, in the aggregate, significant economic value if cropped or significant animal nutritive value if left in place.*

This definition is necessary to prevent an individual from seeking to protect non-significant plants under the policy. An example might be the decision to grow exotic fruits, vegetables or flowers.

Comment 5. Yates supports the 20 acre size limit. The 20 acre limit provides a good method of determining when a planting area becomes "agriculturally significant."

Comment 6. The policy/rule must address situations where background soil quality shows soil ECs higher than the default limit. The default limits are predicated upon high quality soils not typically found in Wyoming. It is inappropriate to require the default limits be met when the soils clearly demonstrate that default limit quality water has not historically been applied. Therefore, Yates recommends a new III.C.1.d, to read as follows:

> *Where soil data from areas unaffected by existing discharges show soil ECs in excess of 4 dS/m, either (i) the mean plus standard deviation of those soil data or (ii) the tier 2 or 3 approach must be used in lieu of the Tier 1 standards.*

Conclusions

As currently drafted, Appendix H would effectively eliminate a needed source of water which a great many landowners rely on for livestock watering and irrigation. In eliminating this source of water, Appendix H would ultimately have the effect of causing more damage to the agricultural community than it WQD alleges it would prevent. Because Appendix H expands protection beyond agricultural uses, in direct conflict with Chapter 1, Section 20, it would eliminate the vast majority, if not all, produced water discharges; even where produced water is of better quality than background water quality.

The language of Appendix H is not suitable for promulgation as a rule. There are simply too many provisions in Appendix H which are not specific enough to provide any meaningful guidance to either WQD or the regulated community concerning the interpretation and administration if Appendix H is promulgated as an inflexible rule.

If Appendix H is to be promulgated either as a rule or a policy, the provisions concerning effluent limits for EC of 2000 and SAR of 10 are not supported by science. If Appendix H is promulgated, it must be issued with the effluent limits recommended by the Water and Waste Advisory Board (EC of 2700 and SAR of 16). In addition, there is no support for WQD's proposed "option" of 50-year containment in lieu of the more stringent effluent limits. WQD, in developing Appendix H, has failed to consider technical and economic factors, as required under the EQA.

Based on the foregoing, Yates requests that Appendix H not be approved in any form and that it be remanded to WQD and WDEQ with instruction to redraft Appendix H accordingly. In any remand, Yates requests that the comments on improving the proposed policy/rule be given serious consideration. Again, Yates appreciates this opportunity to comment on Appendix H. Please contact me at (480) 505-3928 if you have any questions.

Sincerely,

Matthew Joy
Attorney for Yates Petroleum Corporation

Cc: Environmental Quality Council

PENNACO ENERGY

A Wholly Owned Subsidiary Of Marathon Oil Company

June 14, 2007

David Waterstreet
Herschler Building – 4W
122 West 25th Street
Cheyenne, Wyoming 82002

RE: DEQ Proposed Revisions to Appendix H, Agricultural Use Protection Standard Under Section 20 of Chapter I

Dear Mr Waterstreet:

Marathon Oil Company (Marathon) submits the following comments to the Water and Waste Advisory Board (WWAB or the Board) on the revisions to Appendix H, "Agricultural Use Protection," proposed for adoption by the Department of Environmental Quality (DEQ). Please include these comments in the record of the WWAB's consideration of the proposed rule.. We will provide a copy to the Board members at the Board's meeting on June 15, 2007

Marathon concurs in the comments submitted by Williams Production RMT Company in this matter on June 12, 2007. Marathon would like to make two additional comments and recommendations for WWAB's consideration: (1) default effluent limits for EC and for SAR under Tier I should be the same limits the Board found appropriate barely four months ago, rather than the substantially lower limits DEQ is proposing, and (2) all effluent limits in WYPDES permits that are intended to be protective of irrigation uses under Tiers I, II or III should be imposed at relevant Irrigation Compliance Points, as the Water Quality Division (WQD) has done previously in many permits, rather than as end-of-pipe limits on discharges into reservoirs that do not themselves discharge except during precipitation events.

Tier I Default Limits: On February 5, 2007, the Board recommended to DEQ that the Tier 1 default limits for EC and maximum SAR in the draft Section 20 'policy' should be, respectively, 2700 μS/cm and 16. These limits were derived from expert opinion submitted to DEQ by Mr. Kevin Harvey in two letters in May 2006.[1] Because Williams has attached Mr. Harvey's letters to its comments, we will not burden the record with duplicates

In one of the letters Mr. Harvey undertook an exhaustive survey of relevant literature and concluded that basing the default limits for EC on the soil EC levels corresponding to 100 percent yield potential values for alfalfa reported by the USDA Agricultural Research Service (ARS) Salt Tolerance Database would be scientifically unjustified. Mr. Harvey advised DEQ that the ARS data were based on research in California that used local soil, plant and environmental conditions. As a result, the California data are not reliable as a guide for evaluating effects of EC on irrigated alfalfa in Wyoming, where each of those conditions is different. Based on other research on salt tolerance of alfalfa conducted in the Northern Great Plains and on an analysis of historical alfalfa yields in Wyoming, Mr. Harvey recommended that the default limit for EC in water that is actually applied for irrigation in the Powder River Basin should be not less than 2700 μS /cm

In his second letter, Mr. Harvey explained why a SAR cap of 16 – rather than 10 – would be fully protective of soil structures in the Powder River Basin. Mr Harvey described the empirical relationship between exchangeable sodium percentage (ESP) and SAR in a

1 *See* Letter from Kevin Harvey to Bill DiRienzo, WDEQ (May 4, 2006)(Comments pertaining to the derivation of default effluent limits for EC in the Draft Section 20 Agricultural Use Policy); Letter from Kevin Harvey to Bill DiRienzo, WDEQ (May 4, 2006)(Comments pertaining to the derivation of default SAR limit cap of 10 in the Draft Section 20 Agricultural Use Policy).

large number of samples of soils in flood plains in Northeastern Wyoming, and found that the critical ESP threshold of 15 percent, above which clay swelling and dispersion occur, would not be exceeded in these soils at SAR values below 26 Mr. Harvey recommended a cap of 16, rather than 26, as a highly conservative standard that would yield ESP values that would not exceed even 10 percent. Marathon respectfully refers WWAB to Mr. Harvey's May 4, 2006 submissions and incorporates them in these comments.

Mr Harvey's findings were consistent with research at Bridger Plant Materials Center on plant salinity tolerances and the effects of sodicity on soils in Montana. Barely four months ago, WWAB agreed that Mr. Harvey's recommended EC limit in irrigation water of 2700 μS/cm as protective of alfalfa was scientifically well-founded The Board also concluded that the Bridger data suggestive of a default SAR of 16 are more reliable because the soil samples used in the Bridger study more closely approximate the soil conditions in Wyoming Indeed, DEQ incorporated these numerical limits as the default limits in the proposed rule it presented to the Board and subsequently to the EQC. DEQ has not presented any new or different scientific information that was not available in February and that would now justify a departure from the numerical limits this Board adopted a few months ago. Accordingly, Marathon respectfully submits that WWAB should reject the proposed Section 20 Agricultural Use Rule unless the default limits under Tier I are adjusted to conform with the limits the Board so recently found to be protective of crops and soils in Wyoming

End-of-Pipe Effluent Limitations on Impounded Discharges: Effluent limits on EC and SAR are important only at the nearest upstream location where irrigation occurs, and only after intervening mixing, dilution or other processes affecting water chemistry. DEQ is currently writing many WYPDES permits and renewals for CBM discharges with terms and conditions that preclude direct discharges. These permits instead require discharges to be impounded in on-channel reservoirs, and allow only precipitation-induced discharges under specified conditions, i.e., overtopping for a limited period of time. This means that even if it is assumed that the Tier I default limit of 1330 EC and associated SAR limit of 7.5 under the Hanson formula were reasonably related to protecting irrigated crops and soil characteristics at those locations where water is actually applied to land (or natural irrigation occurs), imposition of those limits on impounded discharges is unreasonably conservative. Any discharge of impounded water will occur only because enough precipitation falls on or runs into the on-channel reservoir to fill it up and then displace water out of it. All such precipitation will necessarily mix with and dilute the impounded water, and such dilution could be even more substantial if significant freeboard were present before the precipitation event.

DEQ's prior approach to WYPDES permits for CBM discharges, before WQD began applying the "policy" version of the proposed Agricultural Use Protection rule, routinely included effluents limits applicable only at Irrigation Compliance Points. In Marathon's experience monitoring at these ICPs has been an effective tool for protecting water quality at locations where discharged water may be actually diverted for irrigation. DEQ has not demonstrated why this approach is not fully protective of the Section 20 narrative standard

The proposed rule's imposition of end-of-pipe limits on discharges into impoundments – rather than at appropriate ICPs – is not consistent with WQD's duty under the Environmental Quality Act, Wyo. Stat. § 35-11-302(a)(vi) The statute directs WQD to consider, when issuing a discharge permit, "all the facts and circumstances bearing upon the reasonableness of the pollution involved," including:

(A) The character and degree of injury to or interference with the health and well being of the people, animals, wildlife, aquatic life and plant life affected;

(B) The social and economic value of the source of pollution;

(C) The priority of location in the area involved;

(D) The technical practicability and economic reasonableness of reducing or eliminating the source of pollution; and

(E) The effect upon the environment.

Wyo. Stat. § 35-11-302(a)(vi). Applying this balancing test, it makes little sense to require CBM produced water discharges that flow into impoundments to meet the Tier I, II or III standards for EC and SAR that would be protective of downstream irrigated crops and soils. Produced water discharged into on-channel reservoirs – as distinct from outflows that reach irrigation diversions – can have no adverse impact on the "health or well-being of people, animals, wildlife, aquatic life and plant life." On the other side of the statutory equation, the treatment that would be required for most CBM discharges to meet, in many cases, even appropriate Tier II or III limits – let alone Tier I limits -- at end-of-pipe is technically unproven and prohibitively costly. Requiring end-of-pipe compliance with irrigation-protective EC and SAR standards would impose a huge burden on the production of economically and socially valuable energy resources in Wyoming and is not rationally related to the protection of irrigation. In view of DEQ's failure to apply the five-part balancing test in section 35-11-302(a) when deciding whether to impose end-of-pipe limits, the Board should reject the proposed rule.

Respectfully submitted,

David T. Hill

David T. Hill, P.E.
Environmental Supervisor

Melissa Velasquez

Melissa Velasquez
HES Professional

KC HARVEY, LLC
SOIL AND WATER RESOURCE CONSULTANTS

May 4, 2006

Mr. Bill DiRienzo
Wyoming Department of Environmental Quality
Water Quality Division
Herschler Building, 4th Floor West
122 West 25th Street
Cheyenne, Wyoming 82002

Subject: Comments pertaining to the proposed default SAR effluent limit cap of 10 in the Draft Section 20 Agricultural Use Protection Policy.

Dear Mr. DiRienzo:

I respectfully submit for your consideration the following comments regarding the fourth draft of the Section 20 Agricultural Use Protection Policy as it pertains to the derivation of effluent limits for SAR, particularly the proposed SAR cap of 10. These comments are being submitted on behalf of Yates Petroleum Company, Williams Production RMT Company, Petro-Canada Resources (USA) Inc., Marathon Oil Company, Lance Oil & Gas Company, Inc., Fidelity Exploration & Production Company, Devon Energy Production Company L.P., Bill Barrett Corporation, and Anadarko Petroleum Corporation. I have submitted additional comments regarding the derivation of EC limits in a separate letter.

By way of introduction, I am a board-certified professional soil scientist having practiced as an environmental consultant in Montana and Wyoming, and throughout the world, for nearly 25 years. For the past seven years, my practice has focused on water management and soil and water salinity/sodicity issues associated with oil and gas development. I am credited as the first to research, develop, and apply managed irrigation techniques for the beneficial use of coalbed natural gas produced water. I have directed or participated in over 75 separate projects related to produced water management, WPDES permitting, soil and water chemistry investigations, and reclamation for coalbed and conventional natural gas projects in Wyoming, Colorado, and Montana. I have a M.S. degree in land rehabilitation (soil science emphasis) from Montana State University and a B.S. in Resource Conservation (soil science emphasis) from the University of Montana.

I would like to comment on the proposed changes made to the Agricultural Use Protection Policy by the WDEQ subsequent to the January 26, 2006 meeting of the Water and Waste Advisory Board. My comments will focus on the comments provided by Dr. Larry Munn in his letter to the DEQ dated December 5, 2005. It is my understanding that Dr. Munn's comments resulted in the changes made to the proposed Policy. Specifically, I comment on Dr. Munn's proposal that all WPDES default effluent limits for SAR be capped at 10 under the Tier 1 process.

233 EDELWEISS DRIVE, UNIT 11, BOZEMAN, MONTANA 59718
VOICE: 406/585-7402, FAX: 406/585-7428, EMAIL: INFO@KCHARVEY.COM

Summary of Findings

The fourth draft of the Agricultural Use Protection Policy describes a 3-tiered decision making process for deriving appropriate effluent limits for EC and SAR whenever a proposed discharge may reach irrigated lands. The Tier 1 process would be followed for deriving "default" limits, and as such, this procedure would require a minimum of background information from the applicant. The default SAR limits would be extrapolated from the Hanson et al. (1999) chart relating the established EC effluent limit to SAR, up to a maximum default value of 10. The effluent limit for SAR will be determined in conjunction with EC so that the relationship of SAR to EC remains within the "no reduction in rate of infiltration" zone of the Hanson et al. (1999) diagram.

Two key concerns arise from Dr. Munn's letter regarding sodicity and the discharge of CBNG produced water in the Powder River Basin: (1) the potential impacts on the hydraulic function of irrigated soils during produced water discharge; and (2) the potential impacts of residual adsorbed sodium on the hydraulic function of irrigated fields after produced water discharge has ceased and rainfall/snowmelt leaches salts from the upper root zone. It is assumed that these concerns led Dr. Munn and the WDEQ to propose the SAR effluent limit cap of 10 under the Tier 1 process.

In addressing these concerns, I performed a considerable amount of research, including three months searching and reviewing the relevant scientific literature, and compiling and analyzing available and relevant soil, plant, and water data. The key conclusions of the literature review and data analysis are presented below and will be substantiated by the discussion that follows.

Review of Soil Sodicity

- Plant growth problems associated with excess sodium adsorption are in response to negative changes in soil structure resulting in reduced air exchange, water infiltration and hydraulic conductivity.

- The universally applied sodic soil threshold is an exchangeable sodium percentage (ESP) greater than 15.

- SAR is a measure of the sodicity risk in irrigation water. The higher the salinity of irrigation water, the higher the SAR can be without impacting soil structure and impairing soil infiltration and permeability.

The ESP-SAR Relationship for Soils in Northeastern Wyoming

- Using regression analysis, the relationship between ESP and soil SAR was determined for the Powder River Basin (n=382, R^2=.74).

- A 1:1 relationship of soil SAR to water SAR exists for soils in equilibrium with irrigation water. This relationship is widely accepted and confirmed by recent research led by Dr.

James Bauder at Montana State University. The relationship of ESP to soil SAR is therefore equivalent to the relationship of ESP to water SAR.

- Based on the regional specific relationship of ESP and SAR, an effluent limit of SAR = 16 corresponds to an ESP of 10, and provides a 33% margin of safety against the formation of sodic conditions (i.e., exceeding an ESP of 15). The proposed default SAR cap of 10 is, therefore, unnecessarily conservative.

The Effect of Rainwater Leaching on Soils Irrigated with Produced Water

- Concern has been raised that subsequent rainfall/snowmelt leaching of residual soil salinity may lower the electrolyte concentration and naturally raise the ESP past the dispersive sodic soil threshold.

- Research demonstrates that arid land soils can release 0.3 to 0.5 dS/m of Ca and Mg to solution as a result of the dissolution of primary minerals and the inherent calcium carbonate content of surface soils. Shainberg et al. (1981) indicates that these concentrations are sufficient to counter the deleterious effects of exchangeable sodium, even when the soil is leached with rainwater.

A Review of Soil Sodicity

The physical and chemical phenomena associated with soil sodicity are complex. Therefore, a brief summary is provided regarding the soil and water chemistry associated with the physical affects of soil sodicity.

A large body of research concerning sodic, or "black alkali" soils has been generated in response to the negative effects of high sodium concentrations on soils. Toxicity effects of sodium are rarely expressed in forage and grass crops, but do cause injury to selected woody plants (Lilleand et al., 1945; Ayers et al., 1951; Brown et al., 1953). Plant growth problems associated with high concentrations of sodium are generally a response to negative changes in soil structure. Sodic soils are "nonsaline soils containing sufficient exchangeable sodium to adversely affect crop production and soil structure (Soil Science Society of America, 2001)." High levels of adsorbed sodium tend to disperse soil particles thereby sealing the soil. The result can produce clogged soil pores, hard surface crusts, reduced infiltration, reduced permeability, and reduced oxygen diffusion rates, all of which interfere with or prevent plant growth. By definition, sodic soils are those that have an exchangeable sodium percentage (ESP) greater than 15. The universally applied ESP threshold of 15 percent is acknowledged in numerous publications, including Levy et al. (1998), Abrol et al., (1988), Evangelou (1998), McNeal and Coleman (1966), Sparks (1995), Sumner et al. (1998), Shainberg et al. (1971), the Soil Improvement Committee (2002), university extension publications, etc.

Clay minerals are the most physically and chemically reactive components of the sand, silt, and clay matrix in soil. The structural arrangement of clay minerals in soil is akin to a deck of cards; the clay mineral itself can be thought of as the deck, and the cards as individual layers. The properties of the deck depend upon the arrangement of the cards and the electrochemical interlayer forces holding the cards together.

Clay minerals in soils are negatively charged and consequently attract ions with a positive charge such as calcium, magnesium, potassium, and sodium. Positively charged ions are called cations. Each cation competes with others in the soil solution for access to the bonding sites based on its valence and hydrated size. Every soil has a definite capacity to adsorb the positively charged cations. This is termed the cation exchange capacity (CEC). The various adsorbed cations (such as calcium and sodium) can be exchanged one for another and the extent of exchange depends upon their relative concentrations in the soil solution (dissolved), the ionic charge (valence), the nature and amount of other cations, etc. ESP is, accordingly, the amount of adsorbed sodium on the soil exchange complex expressed in percent of the cation exchange capacity in milliequivalents per 100 grams of soil (meq/100 g). Thus,

$$ESP = (\text{exchangeable sodium} / \text{cation exchange capacity}) \times 100.$$

Sodic soil conditions arise when greater than 15 percent of the ions bonded to the deck are sodium, which has a +1 valence and a large hydrated radius. When the ESP exceeds 15, the large hydrated sodium ions can wedge in-between the individual cards and cause "swelling" of the deck (Levy et al., 1998). This causes negative effects on the physical structure of the soil. Upon re-wetting, the individual decks may disperse and settle into soil pores, effectively clogging them and reducing the efficiency of air exchange, water infiltration, and permeability (i.e., hydraulic conductivity). In general, soils with moderately high, to high, clay contents are at higher risk.

Excessive adsorbed or exchangeable sodium can result from sustained use of irrigation water that is high in sodium and low in calcium and magnesium. Consequently, the ratio of sodium to calcium and magnesium ions in water is an important property affecting the infiltration and permeability hazard. The water quality index used to measure the hazard related to sodium abundance or sodicity in irrigation water is the sodium adsorption ratio or SAR.

The SAR is the ratio of the dissolved sodium concentration in water divided by the square root of the average calcium plus magnesium concentration. The SAR can be calculated from the sodium, calcium and magnesium concentrations via the formula:

$$SAR = [\text{sodium}] / (([\text{calcium}] + [\text{magnesium}])/2)^{1/2}$$

where the concentrations are in milliequivalents per liter (meq/L).

What is not apparent from the SAR formula is the fact that the higher the salinity of the water, the higher the SAR can be without impacting soil structure and impairing soil infiltration and permeability. Put another way, for a given SAR, infiltration rates generally increase as salinity (measured by the EC) increases. The changes in soil infiltration and permeability occur at varying SAR levels, higher if the salinity is high, and lower if the salinity is low. Therefore, in order to evaluate the sodicity risk of irrigation water, the EC must be considered. To this end, the SAR-EC guidelines presented in Ayers and Westcot (1985) and Hanson et al. (1999) are used to assess the potential sodicity risk of irrigation water.

The ESP-SAR Relationship for Soils in Northeastern Wyoming

In addition to measuring the SAR of irrigation water, one can also measure the SAR of the soil solution via a saturated paste extract (i.e., the dissolved concentrations of sodium, calcium, and magnesium are measured in a saturated paste extract and applied via the SAR formula presented above). The soil SAR was developed to serve as a rapid and relatively inexpensive index of ESP. It is widely accepted that the SAR of the soil in equilibrium with the SAR of the irrigation water is equal to the long-term average SAR of the irrigation water.

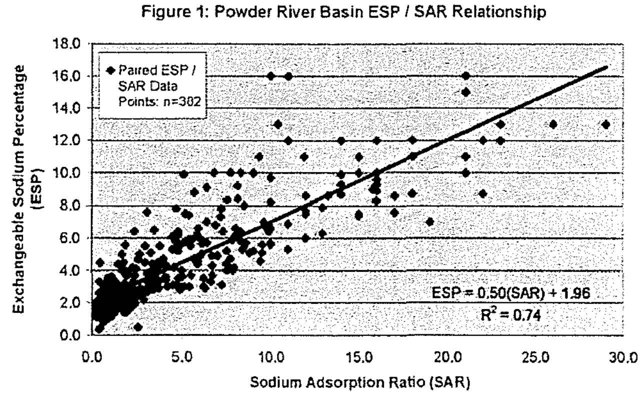
The fourth draft of the Agricultural Use Protection Policy includes a proposed SAR cap of 10 for Tier 1 default effluent limits. To evaluate the appropriateness of the proposed cap, an analysis was performed using 382 ESP-SAR data pairs generated from ongoing soils assessment work in the Powder River Basin of Wyoming (KC Harvey LLC, 2006). This database represents flood plain soils associated with tributaries to the Powder River and the Tongue River, including spreader dike irrigated fields. This database represents baseline soil chemical conditions. In no case were any of these soils irrigated with or influenced by coalbed natural gas produced water. The soil samples from which the analyses were made were collected during soil profile descriptions to five feet, and with a Giddings hydraulic probe up to eight feet in depth. The numerous soil investigations involved were required for various coalbed natural gas water management planning, permitting, and design purposes.

The ESP-SAR data pairs were graphed in Microsoft Excel using simple scatter-plot and trend line analysis. The best fit line resulted in a linear regression which yielded the equation:

$$ESP = 0.5(SAR) + 1.96, \text{ with an } R^2 \text{ value of } 0.74.$$

The regional-specific "Powder River Basin" relationship, based on 382 soil samples, is shown on Figure 1. According to the Powder River Basin equation, a soil SAR of 26 corresponds to the critical ESP threshold of 15 percent.

Figure 1: Powder River Basin ESP / SAR Relationship



It is widely accepted that the SAR of soil in equilibrium with irrigation water equals the long-term average SAR of irrigation water. Recent Department of Energy funded research directed by Dr. James Bauder at Montana State University (Robinson and Bauder, 2003) confirms this relationship. Their research, which is related to the potential effects of coalbed natural gas produced water on soils, reports that in general, soil solution SAR represents the SAR of the applied water. The 1:1 soil SAR to water SAR relationship allows one to relate the SAR of discharge water to the SAR of the soil in the Powder River Basin ESP-SAR graph and equation described above. For example, after long-term irrigation with water exhibiting an SAR of 15, the equilibrated ESP of the irrigated soil would be approximately 9.5 percent. The proposed SAR cap of 10 would equate to a corresponding ESP of 7. An ESP cap of 7 appears to be unnecessarily conservative given the regional specific relationship of ESP and SAR. While an ESP threshold of 15 is widely accepted to be the point at which clay swelling and dispersion occurs, we respectfully suggest that the WDEQ consider establishing a Tier 1 default SAR effluent limit cap of 16, which corresponds to an ESP of 10. An ESP value of 10 provides a 33 percent margin of safety.

The Effect of Rainwater Leaching on Soils Irrigated with Produced Water

In his December 5, 2005 letter, Dr. Munn indicates his concern about the potential effects of rainwater leaching of fields that had received produced water due to upstream permitted discharges. In particular, what is the effect of leaching on the sodicity status and hydraulic function of soils after discharge and irrigation with produced water ceases? Fortunately, the considerable research on this subject has been well documented in the scientific literature.

Discontinuation of produced water discharge in the Powder River Basin will effectively reduce the EC and SAR of irrigation waters from tributaries and mainstems so long as the surface water is of higher quality than the produced water. In the case of fields that are irrigated opportunistically (e.g., in response to runoff events that are captured behind spreader dike systems), there can be three sources of water supplying soil moisture: (1) meteoric water (rain and snowmelt); (2) natural runoff water; and (3) subirrigation from a shallow aquifer. In the case of rainfall and snowmelt, the EC of these waters will be similar to that of distilled water, i.e., they will exhibit very low dissolved solids. Owing to the dissolution of soluble constituents within the watershed, natural runoff EC values can range up to 5 dS/m or higher. Regarding subirrigation, shallow aquifers can be relatively saline due to the entrainment of dissolved minerals along the groundwater flowpath.

The concern arises from leaching of residual surface soil salinity with rainfall and snowmelt. Intermittent rainfall and snowmelt may lower the electrolyte concentration (i.e., EC) sufficiently to promote clay dispersion, depending on soil properties (Levy et al., 1998). Conversely, when the electrolyte concentration in the soil solution reaches a moderate level (1-2 dS/m), high sodicity levels (ESP between 10 and 30) cause only small to moderate changes in the physical and hydraulic properties of the soils, which are mostly reversible (Levy et al., 1998). Shainberg et al. (1981) showed that a major factor causing differences among various sodic soils in their susceptibility to hydraulic failure when leached with low electrolyte concentrations (i.e., a low EC) was their rate of salt release from mineral dissolution.

Arid land soils can release 0.3 to 0.5 dS/m of calcium and magnesium to solution as a result of the dissolution of plagioclase, feldspars, hornblends and other sparingly soluble minerals within the soil matrix (Rhoades et al. 1968). The solution composition of a calcareous soil at a given ESP in contact with distilled water (i.e., rainwater or snowmelt) can be calculated (Shainberg et al., 1981). As calcium carbonate ($CaCO_3$) dissolves, the EC of the soil solution increases and calcium replaces sodium on exchange sites until the solution is in equilibrium with the cation exchange system and the $CaCO_3$ solid phase. Shainberg et al. (1981) calculated that the EC values of solutions in equilibrium with soils having ESP values of 5, 10, and 20 are 0.4, 0.6, and 1.2 dS/m, respectively. Shainberg et al. (1981) indicates that these concentrations are sufficient to counter the deleterious effects of exchangeable sodium, even when the soil is leached with rainwater.

It is evident that water equilibrated with a calcareous soil can never be a very low salinity (Shainberg et al., 1981). Using the same database discussed above for evaluation of the ESP-SAR relationship in 382 soil samples from the Powder River Basin, we can compute an average percent lime ($CaCO_3$) content in surface soil samples (n=81), which is 5.1 percent. This represents a considerable reserve of calcium. Other sources of calcium include residual gypsum ($CaSO_4$) which we know to be prevalent in Wyoming soils.

Various soil SAR-EC relationships (not to be confused with irrigation water SAR-EC relationships) have been reported in the literature by introducing low electrolyte concentration waters to sodic soils. Felhendler et al. (1974) measured the hydraulic conductivity of two montmorillonitic soils as a function of the SAR and found that both were only slightly affected by the SAR of the percolating solution up to a SAR of 20 as long as the concentration of the percolating solution exceeded 1 dS/m. Shainberg et al. (1981) studied the effects of leaching a 1:1 sand-soil column with distilled water and increasing concentrations of a weak electrolyte solution. His findings concluded that an electrolyte concentration of 0.3 dS/m in the percolating solution was adequate to prevent the adverse effects of a SAR of 15 on the hydraulic conductivity of the soil-sand mixture. These findings are very similar to the conclusions of the U.S. Salinity Laboratory Staff (1954) who used electrolyte concentrations equal to or greater than 0.3 dS/m in their regression analysis to determine the sodic soils threshold of ESP = 15.

As a review, an electrolyte concentration of 0.3 dS/m is the minimum value of calcium and magnesium contributions to soil solution associated solely to arid soil weathering. This suggests that an arid Powder River Basin soil with a SAR of 16 (ESP = 10), will have no sodicity related impacts to the hydraulic conductivity, even when the salt concentration of the irrigation or rainwater is equal to that of distilled water.

Of course, irrigation water in the Powder River Basin has an intrinsic electrical conductivity greater than that of distilled water. Use of surface water for irrigation will actually supplement the inputs of calcium and magnesium from weathering and carbonate dissolution alone.

Using the aforementioned Powder River Basin soils assessment database (KC Harvey LLC, 2006), an average surface soil ECe of 1.64 dS/m was calculated from 81 individual surface soil samples. This value suggests that electrolyte concentrations in surface soils of the Powder River Basin, in equilibrium with mineral dissolution, the salinity of runoff irrigation water, and rainwater/snowmelt, is about 1.6 dS/m, or five times (1.6 dS/m divided by 0.3 dS/m) the concentration required to maintain the hydraulic conductivity of a soil at an ESP of 16.

Closing Statement

Results of the Powder River Basin regression analysis indicates that a relationship between ESP and soil/water SAR exists, which allows the calculation of one parameter from the other. Using the proposed, default ESP cap of 10 percent, the scientific literature indicates that water with a SAR of 16 can be effectively used for irrigation without adverse effects on the physical structure or hydraulic conductivity of Powder River Basin soils during irrigation. Furthermore, it has been shown that inputs of Ca and Mg from the natural dissolution of plagioclase, feldspars, hornblends and other sparingly soluble minerals, especially calcium carbonate and gypsum, will provide an effective buffer to residual soil sodicity after the discontinuation of produced water discharge and the transition back to native irrigation, precipitation, and runoff regimes.

References Cited

Abrol, I.P., Yadav, J.S.P. and Massoud, F.I. 1988. Salt-affected soils and their management. FAO Land and Water Management Division, Soils Bulletin 39.

Ayers, A.D., Aldrich, D.G. and Coony, J.J. 1951. Sodium chloride and injury of Fuerte avocado leafs. California Avocado Soc. Yearbook: 1951 174-178 illus.

Ayers, R.S. and Wescot, D.W. 1985. Water quality for agriculture. FAO Irrigation and Drainage Paper, 29 (rev. 1).

Brown, J.W., Wadleigh, C.H. and Hayward, H.E. 1953. Foliar analysis of stone fruit and almond trees on saline substrates. Amer. Soc. Hort. Proc. 61: 49-55.

Evangelou, V.P. 1998. Environmental soil and water chemistry principles and applications. John Wiley and Sons (Pub), New York, NY.

Felhendler, R.I., Shainberg, I. and Frenkel, H. 1974. Dispersion and hydraulic conductivity of soils in mixed solutions. Int. Congr. Soil Sci., Trans. 10th (Moscow) 1:103-112.

Hanson, B., Grattan, S.R. and Fulton, A.F. 1999. Agricultural salinity and drainage. Division of Agriculture and Natural Resources Publication 3375. University of California Irrigation Program. University of California, Davis, CA.

KC Harvey, LLC. 2006. Unpublished data. Compilation of various soil investigation sampling and analysis data from Sheridan, Johnson and Campbell Counties, Wyoming. Bozeman, MT.

Levy, G.J., Shainberg, I. and Miller, W.P. 1998. Physical Properties of Sodic Soils. In: Sumner, M.E. and Naidu, R. 1998. Sodic soils: Distribution, properties, management and environmental consequences. Oxford University Press, Inc. New York, NY.

Lilleand, O., Brown, J.G. and Swanson, C. 1945. Research shows sodium may cause leaf tip burn. Almond Facts 9 (2): 1, 5, illus.

McNeal, B.L and Coleman, N.T. 1966. Effect of solution composition on hydraulic conductivity. Soil Sci. Soc. Am. Proc., 30, 308-312.

Rhoades, L.D. 1968. Mineral weathering correction for estimating the sodium hazard of irrigation waters. Soil Sci. Soc. Am. Proc. 32:648-652.

Robinson, K.M. and Bauder, J.W. 2003. Soil behavior upon wetting with saline sodic water part 2: Soil chemical responses. Adapted from Robinson, K.M. 2003. Effects of saline-sodic water on EC, SAR, and water retention.

Shainberg, I., Bresler, E., and Klausner, Y. 1971. Studies on Na/Ca montmorillonite systems, I: The swelling pressure. Soil Sci. 111:214-219.

Shainberg, I., Rhoades, J.D., Suarez, D.L. and Prather, R.J. 1981. Effect of mineral weathering on clay dispersion and hydraulic conductivity of sodic soils. Soil Sci. Soc. Am. J. 45:287-291.

Soil Improvement Committee, California Plant Health Association. 2002. Western Fertilizer Handbook, ninth edition. Interstate Publishers, Inc. Danville, Illinois.

Soil Science Society of America. 2001. Glossary of Soil Science Terms. Madison, WI.

Sparks, D.L. 1995. Environmental Soil Chemistry. Academic Press, San Diego, Ca.

Sumner, M.E., Rengasamy, P. and Naiud, R. 1998. Sodic soils: A reappraisal. In: Sumner, M.E and Naidu, R. 1998. Sodic soils: Distribution, properties, management and environmental consequences. Oxford University Press, Inc. New York, NY.

U.S. Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. USDA Agric. Handbook no. 60, Washington, D.C.

* * * * *

Thank you very much for your time and consideration of this review and the recommendations stemming from it. If you, your WDEQ colleagues, or the members of the Water and Waste Advisory Board have any questions or comments regarding our findings, please contact me.

Sincerely,

Kevin C. Harvey, M.Sc., CPSSc.
Principal Soil Scientist

KC HARVEY, LLC
SOIL AND WATER RESOURCE CONSULTANTS

May 4, 2006

Mr. Bill DiRienzo
Wyoming Department of Environmental Quality
Water Quality Division
Herschler Building, 4th Floor West
122 West 25th Street
Cheyenne, Wyoming 82002

Subject: Comments pertaining to the derivation of default effluent limits for EC in the Draft Section 20 Agricultural Use Protection Policy.

Dear Mr. DiRienzo:

I respectfully submit for your consideration the following comments regarding the fourth draft of the Section 20 Agricultural Use Protection Policy as it pertains to the derivation of default effluent limits for EC. These comments are being submitted on behalf of Yates Petroleum Company, Williams Production RMT Company, Petro-Canada Resources (USA) Inc., Marathon Oil Company, Lance Oil & Gas Company, Inc., Fidelity Exploration & Production Company, Devon Energy Production Company L.P., Bill Barrett Corporation, and Anadarko Petroleum Corporation. I have submitted additional comments regarding the derivation of SAR limits and the proposed SAR cap to you in a separate letter.

By way of introduction, I am a board-certified professional soil scientist having practiced as an environmental consultant in Montana and Wyoming, and throughout the world, for nearly 25 years. For the past seven years, my practice has focused on water management and soil and water salinity/sodicity issues associated with oil and gas development. I am credited as the first to research, develop, and apply managed irrigation techniques for the beneficial use of coalbed natural gas produced water. I have directed or participated in over 75 separate projects related to produced water management, WPDES permitting, soil and water chemistry investigations, and reclamation for coalbed and conventional natural gas projects in Wyoming, Colorado, and Montana. I have a M.S. degree in land rehabilitation (soil science emphasis) from Montana State University, and a B.S. in Resource Conservation (soil science emphasis) from the University of Montana.

I would like to comment on the proposed changes made to the Agricultural Use Protection Policy by the WDEQ subsequent to the January 26, 2006 meeting of the Water and Waste Advisory Board. My comments will focus on the comments provided by Dr. Larry Munn in his letter to the DEQ dated December 5, 2005. It is my understanding that Dr. Munn's comments resulted in the changes made to the proposed Policy. Specifically, I comment on Dr. Munn's request that the California-based soil salinity tolerance thresholds be used to establish default effluent limits for electrical conductivity (EC) under the Tier 1 process.

233 EDELWEISS DRIVE, UNIT 11, BOZEMAN, MONTANA 59718
VOICE: 406/585-7402, FAX: 406/585-7428, EMAIL: INFO@KCHARVEY.COM

Summary of Findings

The fourth draft of the Agricultural Use Protection Policy describes a 3-tiered decision making process for deriving appropriate effluent limits for EC and SAR whenever a proposed discharge may reach irrigated lands. The Tier 1 process would be followed for deriving "default" limits, and as such, this procedure would require a minimum of background information from the applicant. Specifically, the default EC limits would be based on the species-specific 100 percent yield potential values for soil EC reported by the USDA Agricultural Research Service (ARS) Salt Tolerance Database (USDA ARS, 2006).

Alfalfa is considered to be the most salt sensitive plant irrigated in northeastern Wyoming. Given this, my comments focus on the relevant information regarding alfalfa salinity tolerance. The ramifications of the concepts and data discussed herein for alfalfa can be applied to the more tolerant irrigated forage species commonly found in northeastern Wyoming, for example, western wheatgrass and smooth brome.

A considerable amount of research went into preparing these comments, including three months searching and reviewing the relevant scientific literature, and compiling and analyzing available and relevant soil, plant, and water data. The key conclusions of the literature review and data analysis are presented below and will be substantiated by the discussion that follows.

California Based Salinity Thresholds

- The ARS Salt tolerance database relies on California based salinity thresholds developed to approximate the specific plant, soil and environmental variables associated with that region.
- Regional differences in soil chemistry, climate and agricultural practices are likely to have a profound effect on the applicability of California based salinity threshold data to alfalfa growing in Wyoming.

Chloridic Versus Sulfatic Soils

- The natural soil salinity in the Powder River Basin is dominated by the sulfate ion; California soils are dominated by chloride. This conclusion is supported herein by the literature and by an evaluation of actual soil chemistry data provided by the USDA National Soil Survey Center.
- The term "gypsiferous" refers to sulfatic soils and is applicable to the Powder River Basin of Wyoming. Numerous documents, including the ARS Salt Tolerance Database, indicate that in sulfatic (or "gypsiferous") soils, plants will tolerate about 2 dS/m higher salinity than indicated.

The Influence of Soil Salinity on Alfalfa Yield

- Alfalfa is considered the most salt sensitive plant irrigated in northeastern Wyoming. Conditions required for the growth of alfalfa at 100 percent of its physiological yield potential probably do not exist anywhere in northeastern Wyoming and place doubt on the application of this benchmark value there.

- Sources of research and field guidance outside of California suggest alfalfa has a higher relative 100 percent yield soil EC tolerance than 2 dS/m, perhaps as high as 4 to 8 dS/m.

- Alfalfa yield comparisons between California and Wyoming show actual harvest values independent of soil salinity. Identical yields were reported in Wyoming for soil EC values ranging from 1.8 dS/m to 6.5 dS/m.

Based on the review summarized herein, we respectfully suggest that the WDEQ consider adopting an acceptable average root zone EC threshold of 4 dS/m for protection of alfalfa. This would equate to a default (Tier 1) effluent limit of 2.7 dS/m based on the 1.5 concentration factor cited by the draft Agricultural Use Protection Policy. The EC limits for protecting other species of concern in the Powder River Basin, e.g., western wheatgrass, should also be adjusted accordingly, based on the inherent differences in soil chemistry and climate between the northern Great Plains and the California agricultural areas. These conclusions and recommendations are substantiated by the discussion below.

California-based Salinity Thresholds

The majority of salinity tolerance data generated in the United States have been a product of field and laboratory trials conducted by the U.S. Salinity Laboratory (USSL) in Riverside, California. The salinity tolerance data generated by the USSL were prompted in response to agricultural production in the areas of the San Joaquin and Imperial Valleys of California. In 1977, Maas and Hoffman compiled the California research in a seminal article titled "Crop Salt Tolerance -- Current Assessment," listing salt tolerance levels for various crops. The subsequent year, Francois and Maas (1978) published an indexed bibliography of plant responses to salinity from 1900 to 1977 with 2,357 references to about 1,400 species. These articles serve as the primary references regarding crop tolerance and yield potential of selected crops as influenced by irrigation water (EC_w) or the average root zone soil salinity level (EC_e). This information was updated by Mass (1990). The ARS Salt Tolerance Database relies entirely on the Mass (1990) summary as the primary source of relative salt tolerance levels among crops. With respect to alfalfa, the original salt tolerance listings remain unchanged from the original Mass and Hoffman (1977) article.

The Mass and Hoffman (1977) and Mass (1990) listings of salt tolerance levels include the establishment of the 100 percent yield threshold for soil salinity. This value refers to the maximum allowable average root zone salinity level (EC_e) that results in no yield reduction for crops grown in chloritic soils. The term chloritic soil refers to the dominant salt type found in California soils (see below). For alfalfa, Mass and Hoffman (1977) and Mass (1990) list the 100 percent yield potential for alfalfa grown in chloritic soils as 2.0 dS/m (EC_e). The Mass and

Hoffman (1977) and Mass (1990) assessments also contain a disclaimer that the yield potentials listed should only serve as a guide to relative tolerances among crops, and that the absolute salt tolerance of crops is not simply a function of soil EC but is dependent on "many plant, soil, water, and environmental variables."

Six studies conducted at the US Salinity Laboratory in Riverside, California, served as the foundation for the determination of Maas and Hoffman's 2.0 dS/m threshold value (Gauch and Magistad, 1943; Brown and Hayward, 1956; Bernstein and Ogata, 1966; Bower et al., 1969; Bernstein and Francois, 1973; Hoffman et al., 1975). These studies vary in their methodology, including greenhouse and field experiments, different growth mediums (sand, gravel and soil), various watering regimes (automatic watering, tension-based watering), and multiple sources of chloritic salinity (NaCl, $CaCl_2$, and $MgCl_2$). These studies were designed to assess relative yield values, irrigation leaching fractions, root zone salt profiles, or salinity-ozone interactions. They were not specifically designed to determine a threshold salinity value for alfalfa. Usually, only four salinity levels were tested, with data used to produce a crop yield reduction line.

Furthermore, the source of salinity in the six studies was consistently chloride dominated, with either NaCl or a blend of NaCl, $CaCl_2$, and $MgCl_2$ added to the irrigation water. In Southern California, where these studies occurred, salts found in the soils are largely chloride-dominated. None of these studies were conducted using sulfate-dominated salts, such as are found in Wyoming soils (see below). Such regional differences in soil salinity are likely to have a profound effect on the application of existing salinity threshold data to alfalfa growing in the Northern Great Plains. Recognizing this, Mass (1990), Ayers and Westcot (1985), Hanson et al. (1999), as well as the ARS Salt Tolerance Database, all indicate that plants grown in sulfatic soils will tolerate average root zone EC_e values about 2 dS/m higher than indicated by each of these references. For alfalfa, this would equate to a 100 percent yield threshold of approximately 4 dS/m. This fact is discussed in detail below.

Chloridic Versus Sulfatic Soils

Research efforts of the USSL in California identified adjustments in effective plant salinity tolerance expressed or repressed in the field by physiological responses to climate, cultural practices, soil fertility, irrigation methods, physical condition of the soils and the distribution and speciation of salts within soil profiles. A critical difference between the environmental conditions in California and the northern Great Plains (including northeastern Wyoming) is soil chemistry and the primary salt constituents found in these soils. It is widely accepted that the soils of the agricultural areas of California are dominated by salts where chloride is the dominant anion, and that the soils of the northern Great Plains are dominated by salts where sulfate is the dominant anion. In earlier publications, sulfatic soils are sometimes termed "gypsiferous," referring to the most common sulfate salt found in semi-arid soils -- gypsum (calcium sulfate dehydrate). The correct term used today is sulfatic soils.

To incorporate the variation of salinity tolerance exhibited by plant response to different salt distributions and dominant salt species, the authors of salt tolerance research included a provision for sulfatic soils. Soils may contain amounts of sparingly soluble salts, such as gypsum and other sulfate salts, many times greater than can be held in solution in the field water-content range. Sulfatic soils may appear to be saline when exhaustively extracted in the lab (i.e., saturated paste extract), but the in-situ soil solution may be nonsaline because of the limited solubility of gypsum and other sulfate salts (Bernstein, 1975). Thus, the EC measured in a saturated paste extract is higher than the actual concentration of salts seen by plants in sulfatic soils. It was suggested originally by Bernstein (1962) that plants will tolerate about 2 dS/m higher soil salinity (EC_e) than indicated in sulfatic soils due to this solubility effect. Since calcium sulfate is disproportionately dissolved in preparing saturated-soil extracts, the EC_e of sulfatic soils will range an average of 2 dS/m higher than that of chloritic soils with the same water conductivity at field capacity (Bernstein 1962). Therefore, plants grown in sulfatic soils will tolerate an EC_e of approximately 2 dS/m higher than those grown where chloride is the predominant ion (Maas, 1990). This narrative provision for sulfatic soils is included in the ARS Salt Tolerance Database, and the classic irrigation guidelines presented in Ayers and Wescot (1985).

Sulfatic soils are the rule not the exception in Wyoming and the northern Great Plains. Sulfatic soils identified by salinity tolerance references are characterized by the presence and influence of gypsum, or calcium sulfate dihydrate ($CaSO_4 \cdot 2H_20$), within the soil profile, as well as the geological and climactic prerequisites for sulfatic soil conditions. Soil gypsum may stem from one of several sources. Soils formed from geologic material containing anhydrite or gypsum often contains gypsum. The amount of rainfall and the topographic setting will strongly influence the amount and location of gypsum in the soil (Dixon and Weed, 1989). Accumulations of soluble salts, including sulfates in the surface layers, are characteristic of saline soils of arid and semiarid regions (Brady, 1974), including Wyoming. Research conducted by the U.S. Geological Survey confirms the presence of gypsiferous parent materials in the Powder River Basin (Johnson, 1993). At this point, it is important to differentiate between the soil taxonomic terms "gypsic" or "petrogypsic," which are used to describe significant gypsum accumulation within soil horizons, from the terms "gypsiferous" or "sulfatic" soils which refer to the dominate salt type in soils of Wyoming and the northern Great Plains.

Published research has addressed the issue of prevailing salt distribution and climate influenced salt dominance. In Springer et al. (1999), Curtin et al. (1993) and Trooien (2001), northern Great Plains prairie soil chemistry is comparatively summarized and/or contrasted to soils of California. Research suggests that recommendations developed for the western United States, where chloride is the major anion in soil and water chemistry, may not be appropriate for sulfatic soils (Springer et al., 1999). Trooien (2001) notes that most plant salinity tolerance information is developed in California and that the chemistry of salinity is different in the northern Great Plains (i.e., sulfate dominated salinity). Therefore, Trooien (2001) indicates that salinity thresholds are greater and yield losses are somewhat smaller in the Northern Great Plains compared to those of California (i.e., chloride dominated salinity). Research in Canadian prairie soils by Curtin et al. (1993) and Wentz (2001) suggest that salt tolerance testing at the Swift Current, Saskatchewan, salinity laboratory (and also at the US Salinity Laboratory) has mostly involved the determination of crop responses to chloride salinity. However, there is reason to suspect that responses to sulfate salinity, which is the predominant form of salinity in prairie soils, may differ from those observed in chloride salt systems. Wentz (2001) summarizes that crop tolerances developed for chloride dominated soils, such as those in California, may not be applicable to crops grown on the sulfate dominated soils typically found in western Canada.

Comparison of actual soil analytical data from the NSSC Soil Survey Laboratory, Lincoln, Nebraska, supports the chloride and sulfate salt dominance designations suggested by Springer et al. (1999), Curtin et al. (1993), Trooien (2001), and Wentz (2001). Analyses from the U.S. Soil Survey Laboratory are available online at http://ssldata.nrcs.usda.gov/ and organized by soil pedon. Data from selected counties in Wyoming and California were obtained from the NSSC Soil Survey Laboratory Research Database in order to determine the dominance of chloride or sulfate soil chemistry in the respective regions. Soil chemistry data were downloaded for use in this study for counties of the Powder River Basin in Wyoming (Sheridan, Campbell and Johnson Counties). Soil chemistry data were also downloaded for counties in California where intensive agricultural production takes place (Imperial, Fresno, Kern, Kings and Tulare).

Data pertaining to soil chloride and sulfate in the saturated paste extract are arranged and averaged by county and state in Table 1 below. These values are based on all of the available data provided by the U.S. Soil Survey Laboratory.

Table 1
A Comparison of Average Soil Saturated Paste Extract Sulfate and Chloride Levels from Counties in Wyoming and California.

County	Average Soil Sulfate Level (meq/L)	Average Soil Chloride Level (meq/L)
Sheridan, WY	14.9	4.1
Campbell, WY	130.4	3.0
Johnson, WY	30.9	1.8
Wyoming Average	**58.7**	**2.9**
Imperial, CA	48.4	295.7
Fresno, CA	98.6	26.3
Kern, CA	44.3	73.0
Kings, CA	110.7	23.9
Tulare, CA	9.3	21.6
California Average	**62.3**	**88.1**

The summary data suggest that the relative proportion of chloride salts in the selected California counties outweigh the proportion of sulfate salts and verify the chloride dominance suggested by the literature summarized above. In northeastern Wyoming, the relative proportion of sulfate salts in selected counties outweigh the proportion of chloride by an order of magnitude and verify the sulfate dominance and sulfatic conditions implied by the literature. Therefore, the recommendation by the ARS Salt Tolerance Database signifying that plants grown in sulfatic soils will tolerate average root zone EC_e values about 2 dS/m higher than indicated, is valid for the Powder River Basin, and probably all of Wyoming. For alfalfa, this would equate to a 100 percent yield threshold of 4 dS/m.

The Influence of Soil Salinity on Alfalfa Yield

As indicated above, the *relative* 100 percent yield potential reported for alfalfa in the ARS Salt Tolerance Database is 2 dS/m (EC_e). As such, alfalfa is regarded in the California-based literature as "moderately sensitive" to salinity. An *absolute* salinity tolerance would reflect predictable inherent physiological responses by plants, but cannot be determined because interactions among plant, salt, water and environmental factors influence the plant's ability to tolerate salt. *Relative* salt tolerance is a value based on the climatic and cultural conditions under which a crop is grown (Maas and Hoffman, 1977). Research generated outside the U.S. Salinity Laboratory in the U.S. and Canada has introduced alternative salinity tolerance values for alfalfa influenced by these climatic and cultural conditions.

In a study based on field trials in western Canada, McKenzie (1988) reported the "relative maximum salinity crops will tolerate when combined with intermittent moisture stress throughout the growing season." McKenzie (1988) places alfalfa within a moderate tolerance category, as opposed to moderate sensitivity, and extends alfalfa's 100 percent yield tolerance to an EC range of 4-8 dS/m, as opposed to 2 dS/m. Similar tolerance descriptors and EC values for alfalfa can be found associated with Britton et al. (1977), who supports moderate salt tolerance and an EC range of 5-10 dS/m for alfalfa. Likewise, Milne and Rapp (1968) present alfalfa with a moderate tolerance and an EC range of 4-8 dS/m. Cavers (2002); Wentz (2001); Schafer (1983); Holzworth and Wiesner (1990) and Dodds and Vasey (1985) also contribute to a departure from the established Maas classification of alfalfa salinity tolerance and threshold values. Bower et al., suggests an alfalfa tolerance somewhat between the previous authors and Maas (1990), suggesting maximum alfalfa yield is obtained when the average EC_e value for the root zone is 3 dS/m. Using salinized field plots in southern Saskatchewan, Holm (1983) reported a small, 0.037 ton/acre, reduction in alfalfa yields resulting from an increase in the surface EC_e (0 to 15 cm sample) from a 0 to 4 dS/m range to a 4 to 8 dS/m range. Holm presented these scales as representative of low and medium EC levels.

Relative salinity tolerances reported outside of peer reviewed literature stem from professional observations and judgments, roundtable discussions, experience in the field, and experience with the region, culture and climate; not from experimental data. Incorporation of field experience, observation, and limited data into supporting documents of the Salt Tolerance Database is acknowledged in Ayers and Wescot (1985). Alternative sources listed herein do not always report EC values in terms of 100 percent yield thresholds for alfalfa, but should not be discounted, as they pertain to what is realistic in the field. As an example, the Montana Salinity Control Association reports forage salt tolerances in terms of marginal establishment levels, not 100 percent yield potentials. Conditions allowing alfalfa to produce at 100 percent of its physiochemical yield potential probably do not exist anywhere within the northern Great Plains.

A suggested field-yield value corresponding to the 100 percent yield of alfalfa has never been reported by authors of salinity literature. Specifically, what yield of alfalfa, in tons per acre, could one expect if it was grown under conditions supporting 100 percent yield? Conditions supporting 100 percent alfalfa yields recommended by the ARS Salt Tolerance Database and its supporting documents would be: a soil EC_e of 2 dS/m or less, an irrigation water EC_w less than or equal to 1.3 dS/m, water contents maintained at field capacity, available N, P and K nutrient levels maximized for alfalfa growth, a sufficiently long growing season, no associated phytotoxicity or pest issues, etc. This data limitation precludes the direct comparison of alfalfa yields generated in an agricultural area to the potential yields theoretically available under optimized conditions. The only available analysis is to compare an alfalfa yield to the average yield generated in its area, or generated between areas.

Using data available from the National Agricultural Statistics Service, selected county agricultural commissioner's data, and the U.S. Census of Agriculture (2002, 1997), irrigated alfalfa yield data were obtained for periods of interest. Alfalfa yield data for Wyoming counties are available from 1959 through 2005, but were averaged from 1970-2005 to reflect the integration of new irrigation technologies. Alfalfa yield data were summarized for the area encompassing the Powder River Basin: Sheridan, Johnson and Campbell counties. Alfalfa yield data for California counties are available from 1980-2004 so the entire dataset was averaged. Alfalfa data were summarized for counties in California related to intensive agriculture: Imperial, Fresno, Kern, Kings and Tulare counties.

Soil salinity data (as measured by EC) collected by the USDA National Soil Survey and analyzed by the National Soil Survey Center (NSSC) Soil Survey Laboratory were also obtained and summarized for the aforementioned counties. Average root zone EC values were calculated to a maximum depth of five feet. The county alfalfa yield and average root zone EC summaries are presented in Table 2 below.

Table 2
Comparison of Average Root Zone Soil Salinity (EC) Values with Historical Alfalfa Yields for Selected Counties in Wyoming and California.

County	Average Root Zone Soil Salinity (EC as dS/m)	Historical Average Alfalfa Yield (tons/acre)
Sheridan, WY	1.5	2.7
Johnson, WY	1.9	2.4
Campbell, WY	2.0	2.4
Wyoming Average	**1.8**	**2.5**
Tulare, CA	2.8	8.4
Kings, CA	6.9	6.9
Kern, CA	4.6	8.0
Fresno, CA	6.7	7.9
Imperial, CA	6.7	7.8
California Average	**5.5**	**8.0**

Values expressed in Table 2 show substantially higher average root zone salinities in California than in Wyoming. Alfalfa yields reported in California are three times greater than those in Wyoming, even though, on average, the soil salinity values are nearly three times higher than those reported for the Wyoming counties. The values generated in this exercise suggest that environmental factors other than salinity, e.g., climate, may be dictating the obtainable degree of alfalfa yield produced. However, the data also suggest that the California-based 100 percent yield threshold of 2 dS/m may not be appropriate for even the chloritic soils of California. For example, the historical average yield of alfalfa in Tulare County is 8.4 tons per acre with a corresponding average root zone EC of 2.8 dS/m. The yield from Tulare County is actually slightly greater than the yields from Fresno and Imperial Counties where the corresponding average root zone EC values are substantially higher at 6.7 and 6.7 dS/m, respectively. Regardless, there does not appear to be a substantial difference in yields reported by the California counties with soil EC values ranging from 2.8 to 6.7 dS/m.

Other field data from Wyoming have been reviewed that also suggest an alternative to the California-based salinity tolerance values. The Use Attainability Analysis (UAA) report for Cottonwood Creek (SWWRC et al., 2002) was downloaded from the Wyoming Department of Quality, Water Quality Division webpage. Cottonwood Creek is located in Hot Springs County within the Bighorn Basin of Wyoming. This is an area of extensive conventional oil and gas production. According to the UAA report, discharge of produced water from the Hamilton Dome oil field to Cottonwood Creek constitutes the majority of flow to the ephemeral stream and constitutes the only irrigation water source for approximately 35 ranching operations. The waters of Cottonwood Creek exhibit an EC_w between 4.1 and 4.5 dS/m. At an average EC_w of 4.3 dS/m, an average root zone soil EC_e value can be calculated using the widely accepted relationship: $EC_e = 1.5\ EC_w$ (Ayers and Wescot, 1985). This relationship is expressed in the draft Section 20 Agricultural Use Protection Policy. From this relationship, an average root zone soil EC value of 6.5 is estimated for the fields irrigated long-term with water from Cottonwood Creek. Average alfalfa hay yields reported in the UAA amount to 2.5 tons per acre. This yield is identical to the average of the three Wyoming counties reported in Table 2 above. This is compelling given that the average soil EC value for the three other Wyoming counties is 1.8 dS/m, while the estimated soil EC for the fields irrigated with water from Cottonwood Creek is 6.5.

Closing Statement

Based on the review summarized herein, we respectfully suggest that the WDEQ consider adopting an acceptable average root zone EC threshold of 4 dS/m for protection of alfalfa. This would equate to a default (Tier 1) effluent limit of 2.7 dS/m based on the 1.5 concentration factor cited by the draft Agricultural Use Protection Policy. Other species of concern, including western wheatgrass, should be given equal consideration due to the inherent differences in soil chemistry between the northern Great Plains and the California agricultural areas for which the ARS Salt Tolerance Database is based. Factors such as extreme climate, periodic drought, soil moisture regime, duration of growing season, soil depth, and fertility limitations can collectively exert an overriding regional influence on the yield potential of forage crops. Based on this, we ask that the WDEQ exercise caution interpreting the applicability of specific salinity tolerances outlined by the ARS Salt Tolerance Database and thoughtfully consider the difficulty in detecting a "measurable" change in plant production due to soil salinity alone.

References Cited

Ayers, R.S. and Wescot, D.W. 1985. Water quality for agriculture. FAO Irrigation and Drainage Paper, 29 (rev. 1).

Bernstein, L. 1975. Effects of salinity and sodicity on plant growth. p. 295-312. In: Baker, K.F., Zentmyer, G.A. and Cowling, E.B. (ed.) Annual Review of Phytopathology. Vol. 13. Palo Alto, California.

Bernstein, L. 1962. Salt affected soils and plants. Problems of the Arid Zones. Proc. UNESCO Symp. 18: 139-174. Paris, France.

Bernstein, L. and Francios, L.E. 1973. Leaching requirement studies: Sensitivity of alfalfa to salinity of irrigation and drainage waters. Proceedings, Soil Science Society of America. 37:931-943.

Bernstein, L. and Ogata, G. 1966. Effects of salinity on nodulation, nitrogen fixation, and growth of soybeans and alfalfa. Agronomy Journal. 58:201-203.

Bower, C.A., Ogata, G., and Tucker, G.M. 1969. Rootzone salt profiles and alfalfa growth as influenced by irrigation water salinity and leaching fraction. Agronomy Journal. 61:783-785.

Brady, N.C. 1974. The nature and properties of soils 8th ed. Macmillan Publishing Company, Incorporated, New York, NY.

Brown, J.W. and Hayward, H.E.. 1956. Salt tolerance of alfalfa varieties. Agronomy Journal. 48:18-20.

Britton, M.G., Buchannan, L.C. and Muir, W.E. 1977. Principles and practices of commercial farming (5th edition). Faculty of Agriculture, University of Manitoba. Winnipeg, Manitoba.

Cavers, C. 2002. Please don't pass the salt – Preventing and Managing Soil Salinity. Manitoba Agriculture & Food; Soils and Crops Branch. Accessed from the internet, 3/20/06 from; http://www.umanitoba.ca/afs/ agronomists_conf/2002/pdf/cavers.pdf.

Curtin, D., Steppuhn, H. and Selles, F. 1993. Plant responses to sulfate and chloride salinity: Growth and Ionic Relations. Soil Science Soc. Am. J. 57:1304-1310.

Dixon, J.B. and Weed, S.B., eds. 1989. Minerals in soil environment 2nd ed. SSSA book series no. 1.

Dodds, D.L. and Vasey, E. 1989. Forages for salt-affected soils. Bulletin R-584 Rev. Cooperative Extension Service, North Dakota State University; Fargo, North Dakota.

Francois, L.E. and Maas, E.V. (ed.). 1978. Plant responses to salinity: An indexed bibliography. USDA-SEA (Science and Education Admin.) Agric. Reviews and manuals, ARM-W-6. U.S. Gov. Print. Office, Washington, DC.

Gauch, H.C. and Magistad, O.C. 1943. Growth of strawberry clover varieties and of alfalfa and Ladino clover as affected by salt. Journal of American Society of Agronomy. 35:871-880.

Hanson, B., Grattan, S.R. and Fulton, A.F. 1999. Agricultural salinity and drainage. Division of Agriculture and Natural Resources Publication 3375. University of California Irrigation Program. University of California, Davis, California.

Hoffman, G.J., Maas, E.V. and Rawlins, S.L. 1975. Salinity-ozone interactive effects on alfalfa yield and water relations. Journal of Environmental Quality. 4:326-331.

Holm, H.M. 1983. Soil salinity, a study in crop tolerances and cropping practices. Sask. Agriculture, Plant Industries Branch, Publ. 25M/3/83.

Holzworth, L.K. and Wiesner, L.E. 1990. Principles of establishment and seedling year management. p. 170-228. In: Baldridge, D.E. and Lohmiller, R.G. (ed.) Montana Interagency Plant Materials Handbook for Forage Production, Conservation, Reclamation and Wildlife. Montana State University, Bozeman, Montana.

Johnson, E.A. 1993. Depositional history of triassic rocks in the area of the powder river basin, northeastern Wyoming and southeastern Montana. U.S. Geological Survey Bulletin 1917 Chapter P.

Maas, E.V. 1990. Crop salt tolerance. p. 262-304. In: K.K. Tanji (ed.) Agricultural salinity assessment and management. ASCE Manuals Rep. Eng. Practive no.71. Am. Soc. Civ. Eng., New York, NY.

Maas, E.V. and Hoffman, G.H. 1977. Crop salt tolerance – current assessment. J. Irrigation and Drainage Div., Am. Soc. Civil Eng. 103(IR2):115-134.

McKenzie, R.C. 1988. Tolerance of plants to soil salinity. Soil and water program, 1987. Alberta Special Crops and Horticultural Research Centre Pamphlet 88-10. Brooks, AB.

Milne, R.A. and Rapp, E. 1968. Soil salinity and drainage problems; causes, effects, management. Publication 1314; Canadian Department of Agriculture.

Schafer, W.D. 1983. Salinity control under irrigation. Montguide Document MT 8382. Cooperative Extension Service, Montana State University; Bozeman, Montana.

Soil Survey Staff. 2006. National Soil Survey Characterization Data; Soil Survey Laboratory, National Soil Survey Center USDA-NRCS - Lincoln, NE. Saturday, March 11, 2006.

Springer, G., Wienhold, B.J., Richardson, J.L. and Disrud, L.A. 1999. Salinity and sodicity changes in dispersive clay and saturated hydraulic conductivity in sulfatic soils. Communications in soil science and plant analysis. 30(15&16), 2211-2220.

States West Water Resources Corporation, Western EcoSystems Technology, Inc., Blankenship Consulting LLC. 2002. Merit Energy Company Use Attainability Analysis to Accompany Petition to Change Use Criteria on Cottonwood Creek Near Hamilton Dome, Hot Springs County, Wyoming as Provided Under Wyoming Surface Water Standards, Chapter 1.

Trooien, T.P. 2001. Salinity down under. In: Proceedings of the South Dakota No-Till Association Meeting. pp. 35-38.

U.S. Census of Agriculture. 1997. Accessed from the U.S. Census Bureau website: http://www.census.gov/prod/www/abs/agric.html

U.S. Census of Agriculture. 2002. Accessed from the USDA National Agricultural Statistics Service website: http://www.nass.usda.gov/Census_of_Agriculture/index.asp.

U.S.D.A. Agricultural Research Service. 2006. Salt Tolerance Database. Relative Salt Tolerance of Herbaceous Crops. George E. Brown, Jr. Salinity Laboratory. Riverside, California.

U.S. Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. USDA Agric. Handbook no. 60, Washington, D.C.

Wentz, D. 2001. Salt tolerance of plants. Alberta Agriculture, Food and Rural Development. Accessed from the internet, 3/25/06 from; http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3303

* * * * *

Thank you very much for your time and consideration of this review and the recommendations stemming from it. If you, your WDEQ colleagues, or the members of the Water and Waste Advisory Board have any questions or comments regarding our findings, please contact me.

Sincerely,

Kevin C. Harvey, M.Sc., CPSSc.
Principal Soil Scientist

PETROLEUM ASSOCIATION OF WYOMING

951 Werner Court, Suite 100
Casper, Wyoming 82601
(307) 234-5333

fax (307) 266-2189
e-mail: paw@pawyo.org
www.pawyo.org

June 8, 2007

Mr. John Wagner
Administrator, Water Quality Division
Department of Environmental Quality
122 West 25th Street
Cheyenne, Wyoming 82002

Dear Mr. Wagner:

The Petroleum Association of Wyoming (PAW) is pleased to present to you comments addressing the Department of Environmental Quality, Water Quality Division's (Division) proposed arsenic criterion found in the proposed Agricultural Use Protection Policy rule.

PAW is Wyoming's largest oil and gas trade association, members of which account for over 90% of the natural gas and 80% of the crude oil produced in the state.

PAW asked Penny Hunter, a consultant, to review the literature and report her findings regarding the criterion for arsenic. It appears as though, the 20 ug/L value proposed by the DEQ in the current Agriculture Use Protection Policy rule, is a typographical error transposed from the numeric criterion of the New Mexico State University Agriculture Extension Bulletin. It appears that the DEQ adopted the 20 ug/l value, based on the New Mexico State University Publication. Ms. Hunter's review shows the peer reviewed number to be 200 ug/L as outlined in the attached report. By virtue of this letter, PAW requests the DEQ to revise the arsenic criteria for drinking water in livestock from 20 ug/l total recoverable to 200 ug/l dissolved.

Please review the attached report and call with any questions.

Sincerely,

John Robitaille
Vice President

Cc: Glen Sugano, Chairman WWAB

* Replace one sent earlier -

PJH Environmental Inc.
4623 Chestnut Lane Boulder, CO 80301 Phone: 303.818.1978

Memorandum

TO: Marvin Blakesley, Tyler Vanderhoef, David Applegate, Kevin Harvey

FROM: Penny Hunter

DATE: June 11, 2007

RE: Guidelines for Livestock Arsenic Water Quality Proposed in the Agricultural Use Ruling

---

Executive Summary

The Wyoming Environmental Quality Council (EQC) is proposing adding an arsenic livestock drinking water criterion of 20 µg/L (total recoverable) for Chapter 1 of the Wyoming Water Quality Rules and Regulations. This criterion is proposed for the protection of livestock.

However, the proposed arsenic criterion, 20 µg/L, is inconsistent with available guidelines and supporting primary literature, which show that a drinking water criterion of 200 µg/L (dissolved) is a reasonable limit for livestock. Published guidelines and studies include those by US Environmental Protection Agency (US EPA), National Academy of Sciences (NAS), National Research Council (NRC), Canadian Council of Ministers of the Environment (CCREM), and the Food and Agriculture Organization of the United Nations. Several western state university extension bulletins also recommend livestock arsenic water quality standards, and most are consistent with a 200 µg/L criterion; the one exception is New Mexico State University (NMSU), however the references provided by NMSU support a 200 µg/L limit. State university bulletins in general are not a peer reviewed source of literature, and should not be used to establish water quality criteria.

In addition, EPA (Protho 1993) recommends the use of dissolved metal concentrations to set water quality standards, because the dissolved fraction (<0.45 µm) more closely approximates the bioavailable (hence, toxic) fraction of metals to animals. Total recoverable metals may include metals associated with suspended sediments. Many surface water bodies in Wyoming could exceed 20 or 200 µg/L total recoverable arsenic, given that ambient soil arsenic concentrations in Wyoming can be as high as 100 mg/kg (Shacklette and Boerngen 1984). More importantly, the data will not accurately reflect potential risk for livestock from surface water consumption.

Therefore, I recommend that the EQC consider a livestock arsenic drinking water criterion of 200 μg/L (dissolved) for Chapter 1 of the Wyoming Water Quality Rules and Regulations.

Introduction

Guidelines for livestock drinking water quality have been published by the US Environmental Protection Agency (US EPA), National Academy of Sciences (NAS), National Research Council (NRC), Canadian Council of Ministers of the Environment (CCREM), and the Food and Agriculture Organization of the United Nations. All of these guidelines (Table 1) recommend an arsenic criterion of 200 μg/L or higher for the protection of livestock. The guidelines are based on review of original research papers on livestock and other animals.

Other animal guideline publications (Table 2) also support the recommendation of a 200 μg/L arsenic criterion for livestock. These publications derived a more generalized livestock tolerance threshold for arsenic, which was expressed in terms of dose per body weight (mg arsenic per kg body weight) or dose in food (parts per million arsenic or ppm). From these publications, a water quality limit was derived by assuming an 800 pound adult cow with a daily water intake of 75 L-day and a daily feed intake of 6.7 kg-day (NRC 2000). The specific guidance includes those by US EPA (2005), which derived daily intake criteria (toxicity reference value) for mammals; and two NRC publications (NRC 1980, 2005) that recommended maximum tolerable limits for livestock. All of the guidelines shown in Table 2 based their guidelines on original research papers and have been peer reviewed by the scientific community.

Finally, there have been a number of agricultural extension bulletins from western state universities that recommend arsenic water quality criteria for livestock (Table 3). State university bulletins are not a peer reviewed source of literature, and should not be used to establish water quality criteria. Nevertheless, they are sometimes used as a rule of thumb by livestock owners. All but 1 publication recommends an arsenic water quality criterion of 200 μg/L or higher for livestock. The bulletins and other publications in Table 3 are secondary sources; most cite the same two primary references, either NAS (1972) and/or NRC (1974), both of which support a 200 μg/L arsenic criterion for livestock. Other references listed by each bulletin (see Table 3) are also consistent with a 200 μg/L criterion. Only New Mexico State University lists a 20 μg/L criterion for arsenic, however the reference given in support of this criterion is consistent with a 200 μg/L limit.

In conclusion, there is no supporting data in the body of peer-reviewed literature that suggests that 20 μg/L should be an upper limit for livestock drinking water quality. Conversely, a drinking water criterion of 200 μg/L is consistent with all published guidelines and primary literature sources.

In addition, EPA (Protho 1993) recommends the use of dissolved metal concentrations to set water quality standards, because the dissolved fraction (<0.45 µm) of metals in surface water more closely approximates the bioavailable (hence, toxic) fraction of metals to animals. Current published criteria, including EPA arsenic water quality criteria for ecological receptors, are based on dissolved fractions (US EPA 2006).

Total recoverable metals include metal concentrations dissolved in the water column as well as those sorbed to suspended solids. The bioavailability of metals associated with solids is much lower than dissolved fractions (NRC 1999). Bioavailability is defined here as the fraction of a constituent available for uptake and absorption by an organism. Hence it is only the bioavailable fraction that would elicit a toxic response in the organism. Many surface water bodies in Wyoming could exceed 20 or 200 µg/L total recoverable arsenic, given that ambient soil arsenic concentrations in Wyoming can be as high as 100 mg/kg (Shaklette and Boerngen 1984) and the regional soil arsenic mean is 7 mg/kg (US EPA 2005). More importantly, the data will not accurately reflect potential risk for livestock from surface water consumption.

Table 1. Primary guidance publications on livestock water quality criteria for arsenic.

Primary Guidance	Recommended Water Quality Criteria for Livestock
Ayers and Wescot 1976	200 µg/L
CCREM 1987	500 µg/L
NAS 1972	200 µg/L
NRC 1974	200 µg/L
US EPA 1972,1973	200 µg/L

Table 2. Other primary guidance on livestock and arsenic limits.

Supporting Guidance	Water Quality Criteria for Livestock
NRC 1980 Based on 50 ppm maximum criteria for livestock	5,200 µg/L
NRC 2005 Based on 30 ppm maximum criteria for livestock	3,100 µg/L
US EPA 2005 Based on a 46 mg/kg bw/d criteria for all mammals	613 µg/L

Note: Water quality criteria for livestock were calculated assuming an 800 pound adult cow with a daily water intake of 75 L-day and a daily feed intake of 6.7 kg-day (NRC 2000).

Table 3. Agricultural extension service publications with livestock water quality criteria for arsenic.

Extension Service Publication -Supporting primary references	Suggested Criteria for Livestock
Colorado State U Extension	200 µg/L
-Ayers and Wescot 1976	200 µg/L
-NAS 1972	200 µg/L
Montana State U Extension	200 µg/L
-NRC 1980	5,200 µg/L
-NRC 1974	200 µg/L
New Mexico State U Extension	20 µg/L
-NRC 1980	5,200 µg/L
North Dakota State U Extension	200 µg/L
-NRC 1974 ("Shirley et al. 1974")	200 µg/L
Utah State U Extension	200 – 5,000 µg/L
-NRC 1974	200 µg/L
-NAS 1972	200 µg/L

Literature References

Ayers, R.S. and D.W. Westcot. 1967. Water Quality for Agriculture. Food and Agriculture Organization of the United Nations, Rome.

CCREM. 1987. Canadian Water Quality Guidelines. Water Quality Branch, Inland Waters Directorate, Environment Canada, Ottawa.

NAS. 1972. Water Quality Criteria. Environmental Studies Board, Academy of Sciences and National Academy of Engineering, Washington, D.C.

NRC. 1974. Nutrients and Toxic Substances in Water for Livestock. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 1980. Mineral Tolerances of Domestic Animals. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 1999. Arsenic in Drinking Water. National Academy of Sciences, Washington D.C. National Research Council.

NRC. 2000. Nutrient Requirements of Beef Cattle. 7th revised edition update. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 2005. Mineral Tolerances of Animals. National Academy of Sciences, Washington, D.C. National Research Council.

Prothro, M. 1993. Office of Water policy and technical guidance on interpretation and implementation of aquatic life metals criteria. Memorandum to Regions I–X. US Environmental Protection Agency, Washington, DC.

Shacklette, H.T. and Boerngen, J.G. 1984. Element concentrations in soils and other surficial materials of the conterminous United States. US Geological Survey. 105.

Shirley, R.L., C.H. Hill, J.T. Maletic, O.E. Olson, and W.H. Pfander. 1974. Nutrients and toxic substances in water for livestock and poultry. National Academy of Sciences.

US EPA. 1972. Water quality criteria. Prepared by the National Academy of Sciences and the National Academy of Engineering for the US Environmental Protection Agency, Washington D.C. EPA/R3-73/033

US EPA. 1973. Quality of Water for Livestock. Vol. I. Washington, D.C.

US EPA. 2005. Ecological soil screening levels for arsenic. Interim final. US Environmental Protection Agency Office of Solid Waste and Emergency Response. Washington, D.C.

US EPA. 2006. National recommended water quality criteria. US Environmental Protection Agency Office of water and Office of Science and Technology. Washington, D.C.

State University Bulletin References

Colorado State U Extension
Soltanpour, P.N. and W.L. Raley. Livestock Drinking Water Quality. No. 4.908. Online at: http://www.ext.colostate.edu/PUBS/LIVESTK/04908.html

Montana State U Extension
Hutcheson, D. Water quality and guidelines. Online at: http://www.animalrangeextension.montana.edu/Articles/Beef/Wklynwsltr/10-23-01.htm

New Mexico State U Extension
C. Runyan and J. Bader. Water quality for livestock and poultry. Guide M-112. Online at: http://cahe.nmsu.edu/pubs/_m/m-112.html

North Dakota State U Extension
Lardy, G. and C. Stoltenow. Livestock and water. AS-954. Online at: http://www.ag.ndsu.edu/pubs/ansci/livestoc/as954w.htm

Utah State U Extension
Bagley, C.V., J.Kotuby-Amacher and K. Farrell-Poe. Analysis of Water Quality for Livestock. AH/Beef/28. Online at: http://extension.usu.edu/files/publications/factsheet/AH_Beef_28.pdf

Draft Agricultural Use Rule Risk Management Framework Proposal

June 29, 2007

Prepared for:

Petroleum Association of Wyoming
951 Werner Court, Suite 100
Casper, WY 82601

Prepared by:

Penny Hunter
PJH Environmental Inc.
Boulder, CO

Executive Summary

The Wyoming Environmental Quality Council (EQC) is considering updating numeric chemical constituent criteria in Chapter 1 of the Wyoming Water Quality Rules and Regulations. The updated criteria are proposed for the protection of livestock (the proposal is referred as the agricultural use rule, or AUR). The ruling has been put on hold until the EQC reviews Dr. Merl Raisbeck's risk assessment. Because a risk assessment provides only one piece of the information needed to make risk management decisions, a protocol should be established to integrate the risk assessment into a larger risk management plan.

This paper presents a risk management framework designed to help guide interpretation of risk assessments in the context of risk management goals. The framework's goal is to define some key concepts which can be used as the basis for interpreting risk assessments in the context of all risk management goals. Specifically addressed is the concept of "measurable decrease" in livestock production (Appx H, a, p H-1). The AUR only vaguely defines this term as effects on growth or reproduction, and acute effects. Consequently, what constitutes a "measurable decrease" in livestock growth or reproduction is subject to wide interpretation, but not all interpretations are relevant to the aim of the AUR proposal.

Ultimately, the significance of measurable decreases on growth, reproduction, and acute effects should be evaluated in the context of other risk management goals. Those risk management goals are outlined in Wyoming statute 35-11-302, which provides a range of criteria to consider before making water quality recommendations. Four risk management indices are proposed to evaluate a "measurable decrease":

1. Toxicological relevance
2. Statistical relevance
3. Livestock variability baseline
4. Costs to other sectors of industry

These indices will provide a foundation with which to integrate the results of the risk assessment into a larger risk management plan. The outcome of the risk management plan should be to determine an acceptable threshold of effect that incorporates the values of the Wyoming livestock industry and the state's citizens, and balances the benefits and costs to all affected parties.

Using Geomega's (2007) risk assessment and a petitioners' proposal to update sulfate criteria, this paper demonstrates how the findings of two risk analyses may be interpreted in the context of risk management goals. The example demonstrated that Geomega's (2007) proposed sulfate water quality criterion of 3,100 mg/L meets toxicological and statistical criteria identified in the risk management framework, is within baseline variability indices, and minimizes additional costs to livestock or other industries affected by livestock protection water quality criteria. In contrast, the petitioners' proposed water quality criterion of 500 mg/L does not meet the most basic toxicological or statistical criteria, and at the same time, would result in substantial costs to the livestock industry as well as other affected industries. Thus, the 3,100 mg/L criteria is consistent with the risk management goals outlined in applicable Wyoming statute (W.S. 35-11-302) while the petitioners' proposed criteria does not meet any of the goals.

Table of Contents

Tables

1 Introduction

The Wyoming Environmental Quality Council (EQC) is considering updating numeric chemical constituent criteria in Chapter 1 of the Wyoming Water Quality Rules and Regulations. The updated criteria are proposed for the protection of livestock (the proposal is referred as the agricultural use rule, or AUR). The EQC appears to be relying heavily on Dr. Merl Raisbeck's risk assessment of the constituents of interest before final decisions are made on water quality limits, because the ruling has been put on hold until Dr. Merl Raisbeck's risk assessment is completed.

While a risk assessment is a valuable tool for identifying the nature and magnitude of animal risks arising from exposure to environmental constituents, a risk assessment does not provide all of the information the EQC needs for a balanced decision-making process. As mandated by the state (W.S. 35-11-302), the EQC must consider a range of effects on the people, animals, and plants, as well as social and economic values. A protocol should be established to demonstrate how the risk assessment will be integrated into a larger risk management plan.

This paper presents a risk management framework designed to help guide interpretation of risk assessments in the context of risk management goals. The risk management framework begins by more clearly defining key terms of the AUR. The framework also provides guidance on how to integrate multiple studies (including the risk assessment) into a risk management plan. An example is provided in the last section to illustrate the concepts presented in the framework proposal.

2 Risk Management Framework

This framework establishes a guideline to help interpret risk assessments in the context of risk management goals. Risk management is the process of determining which action to take when a risk assessment indicates that a probability of harm exists. Risk managers consider multiple factors beyond toxicological analyses. The risk assessment that will be provided by Dr. Merl Raisbeck provides a toxicological analysis of the constituents under consideration in the AUR proposal. However, the risk assessment will not provide all of the information the EQC needs to achieve a risk management decision. In fact, Wyoming statute mandates that the state consider a range of criteria before recommending water quality standards. These criteria (W.S. 35-11-302(vi)) include:

(A) the character and degree of injury to or interference with the health and well-being of people, animals, wildlife, aquatic life and plant life affected;

(B) the social and economic value of the source of pollution;

(C) the priority of location in the area involved;

(D) the technical practicability and economic reasonableness of reducing or eliminating the source of pollution; and

(E) the effect upon the environment.

The framework's goal is to define some key concepts which can be used as the basis for interpreting risk assessments in the context of all risk management goals. According to the proposed agricultural protection rule, the aim of the surface water quality criteria is to prevent a "measurable decrease" in livestock production (Appx H, a, p H-1). The AUR explains that the basic concept behind protecting livestock production is to "ensure that water quality is not acutely toxic to livestock or does not contain pollutants in concentrations that would affect growth or reproduction. (section b.i., p. H-2)."

No further definition of livestock protection is provided in the proposal. Consequently, what constitutes a "measurable decrease" in livestock growth or reproduction is subject to wide interpretation, but not all interpretations are relevant. The aim of the AUR plan is to protect livestock. Effects on livestock important to the livestock industry are implicit in the definition of "livestock protection" because livestock is a commodity. Thus, indices of growth, reproduction or acute effects should have industry values in mind, and these values can differ from considerations of non-commodity populations of animals.

Ultimately, defining measurable decreases should be in the context of other risk management goals. Four risk management indices are proposed to define and evaluate a "measurable decrease":

1. Toxicological relevance
2. Statistical relevance
3. Livestock variability baseline
4. Costs to other sectors of industry

These indices will more clearly define the term "measurable decreases" and provide a foundation with which to integrate the results of the risk assessment into a larger risk management framework. The outcome of the risk management framework should be to determine an acceptable threshold of effect that incorporates the values of the Wyoming livestock industry and the State's citizens, and balances the benefits and costs to all affected parties. It is beyond the scope of this paper to address all risk management considerations, however the framework will address the fundamental basis of the AUR, which is defining unacceptable harm to livestock from chemical exposure to surface water bodies in Wyoming.

2.1 Toxicological Relevance

Adverse growth effects should be further defined as weight loss measured over a chronic (i.e., long term) time period. Indirect indices of growth, including feed or water intake rates and digestibility should not considered adequate endpoints in themselves to evaluate the potential effects on growth of livestock species, because research has shown that there is considerable individual variation in feed and water intake above and below that expected or predicted on the basis of size and growth (e.g., Zinn 1994, Hickman 2002, Schwartzkopf-Genswein 2004). Individuals of the same body weight often require widely different amounts of feed for the same level of production (NRC 2000). In addition, some early studies considered microorganism changes in the ruminant gut, or other types of biochemical changes in the body, as an indicator of adverse effects (NRC 1980), but these effects have never been clearly correlated with growth impairment. Thus, only studies or risk assessments which measure the effect on weight loss or gain in addition to intake rates or other performance parameters such as digestibility should be considered.

Similarly, adverse reproductive effects should be defined as declines in calving rates, milk production rates, or egg production rates. Other measures of reproduction which are not relevant to the livestock industry should not be considered in the context of the AUR plan.

Finally, the term "acutely toxic" should refer to the mortality or adverse effects clearly linked to death or loss of livestock marketability on organisms following soon after a brief exposure (less than 2 weeks) to a chemical agent (Hodgson and Levi 1987). Symptoms affecting marketability would include polioencephalomalacia (PEM), dyspnea, blindness, ataxia, hemorrhage, seizures, paralysis, cardiac arrest or coma. Conversely, symptoms such as diarrhea, dehydration, gut microbial changes, or mild behavioral changes are sometimes cited as "effects" in toxicological studies but should have no consequences to a livestock's potential marketability.

2.2 Statistical Relevance

Statistical analysis provides an objective means to determine whether an observed phenomena is the result of random chance or if there is a relationship between two variables, such as exposure to sulfate and effects on weight gain. Thus, statistical relevance is the essence of a "measurable" effect. A toxicological study or data analysis that does not identify a statistical effect therefore can not objectively identify a "measurable decrease."

Statistical significance is often expressed in terms of a p-value (the probability of error). The p-value represents an index of reliability of a result. The lower the p-value, the more probable that the relation between 2 (or more) variables in the test is a reliable indicator of the relation between those variables in the population. Standard statistical analyses for environmental effects include determining significant differences between populations to $p<0.05$ or in some cases, $p<0.1$ (ASTM 2002).

When quantifying a threshold of effect on a species, statistical differences between populations exposed to varying levels of an environmental constituent are needed. Ideally a no-adverse effect threshold or level (NOAEL) and low-adverse effect level (LOAEL) should be identified by statistical analysis. The NOAEL selected represents the highest dose reported not to have an adverse effect on the test animal, while the LOAEL represents the lowest dose reported to have a significant adverse effect on the test animal. Both LOAELs *and* NOAELs are important to the risk decision process, because the two numbers essentially characterize the full range of probability of effect. Risk management decisions must consider the full spectrum of probability of effect in order to make balanced decisions. A risk assessment which has only considered NOAEL effects has not identified a "threshold of effect;" consequently, a risk management decision based only on an evaluation of a NOAEL can bias decisions unnecessarily low.

2.3 Livestock Variability Baseline

Defining a set of baseline conditions is needed to be able to compare to the magnitude of effect identified in a risk assessment. It is not enough to identify a statistically significant and toxicologically relevant effect; the effect must be put into context of relevancy to Wyoming's citizens and their livestock industry. Even though this concept is a fundamental part of defining "measurable decreases," the complexity of establishing a baseline is difficult. Characteristics of an appropriate baseline to consider are exposure scenarios of livestock (open range or feedlot, length of exposure), other environmental stressors (forage quality or quantity of water available), and multiple chemical constituent effects (e.g., additive or modifying).

Wyoming livestock exposed to produced water sources, for example, are typically in open range environments for a few weeks, months or in some cases, year round. Therefore, risk assessments should ideally determine the probability of effect from produced water sources in open range type environments over subchronic or chronic time periods. Differences in exposure conditions can have large effects on the risk analysis, for example, Johnson and Patterson (2004) showed that growing cattle confined to feedlot environments and provided with natural water sources from South Dakota (with 3,000 mg/L sulfate) generally exhibited adverse effects, while cattle grazing on the open range did not exhibit adverse effects at water concentrations as high as 4,600 mg/L. The differences in tolerance thresholds were attributed to forage quality differences and more stressful feedlot conditions (higher temperatures, lack of shade, etc.).

Additionally, Wyoming presents a unique condition in cases where water discharges are altered in terms of water quality *and* quantity. Both variables will affect livestock stress and subsequent tolerance to constituent intake, yet these conditions are not largely addressed in toxicity studies. Hence "measurable decreases," as defined in a risk assessment literature review, do not necessarily translate to a "measurable decrease" for Wyoming's environment.

2.4 Costs to Other Sectors of Industry

It is beyond the scope of this framework to quantify all other costs to related industries. However, on a qualitative basis, potential effects on other industries can include production changes and related job availability differences, tax revenues to counties and the State, and subsequent impacts on funding for schools, hospitals, parks, and other facilities. Geomega (2007) provided a summary of some of the social and economic value to residents in Wyoming, and possible injury caused by unnecessarily low water quality benchmarks for sulfate, TDS or barium. The review showed that wildlife, and many ranchers and other landowners in the Powder River and Bighorn basins of Wyoming benefit from produced water discharges through irrigation and/or stock watering. Economic injuries of reduced exploration and development, caused by unnecessary low water quality criteria, included lost revenue from oil and gas extraction facilities in the form of jobs and associated earnings, basic export revenue to several counties, including Hot Springs, Natrona and Johnson counties, and lost tax revenue to the State.

3 Example of How to Evaluate a Risk Assessment in the Context of the Risk Management Goals

There are currently two proposals before the Wyoming Department of Environmental Quality (WDEQ) to change the current Wyoming effluent sulfate limits for coal bed natural gas (CBNG) industry produced water. A group of petitioners proposed an effluent limit of 500 mg/L. In response to the proposal, Geomega (2007) completed a risk assessment which proposed an alternative criterion of 3,100 mg/L. Both criteria are proposed with the objective of protecting wildlife and livestock. Both proposals were compared to the risk management indices provided above to demonstrate how the risk management framework might provide guidance as to how to integrate the findings of risk analyses with other considerations of effects on the people, animals and environment, and social and economic values.

3.1 Toxicological Relevance, Example

In Geomega (2007), livestock measurement endpoints (i.e., measurable environmental characteristics that are to be protected) identified in the risk assessment included weight loss, reproductive impairment (including milk production loss, calving rate declines, and chick production declines), or longevity effects. Subsequently, all literature sources referenced in support of the proposed criteria met these toxicological measures. The measures of effect in Geomega (2007) are also consistent with the objectives of the AUR plan.

In contrast, the petitioner's references in support of a 500 mg/L appeared to include the potential for "slight" effects above the limit, including temporary diarrhea (Geomega 2007). Recommended limits from the supporting references were vaguely referred to as being "suitable" for livestock. Hence, the measures used in the petitioners' proposal are not consistent with growth, reproductive or acute endpoints identified in the AUR plan.

3.2 Statistical Relevance, Example

Geomega (2007) compiled a database of peer-reviewed literature that met the toxicological criteria. Of the livestock studies (16 total), 11 identified a statistically significant effect threshold. The risk assessment used these statistically significant values to derive a proposed benchmark of 3,100 mg/L by identifying a no-adverse effect level (NOAEL) and low-adverse effect level (LOAEL).

In contrast, the petitioners' references in support of its proposed benchmark did not identify any statistically significant differences. Neither of the supporting references, which included Kober (1993) and a web publication, referenced any data or statistical analyses in support of recommended limits.

3.3 Livestock Variability Baseline, Example

Establishing baseline variability within the livestock industry is complex. Two sources of available data include a metadata analysis of literature, and USDA livestock production data. Methods and results are presented in sections 3.3.1 and 3.3.2.

Both analyses indicated that the variability in cattle weights corresponding to an exposure of up to 3,100 mg/L is less than the baseline variability in cattle weights from either the control study population or the USDA data set. Thus, the analyses suggest that variability of weight gains in cattle exposed to as much as 3,100 mg/L sulfate are insignificant in the context of baseline variation in cattle. We acknowledge that the analyses are preliminary and further investigation into baseline variability is needed. However, we offer these analyses as examples of potential baseline indices.

3.3.1 Metadata Analysis of Literature Studies

Analysis of the entire livestock-sulfate database from Geomega (2007) indicates that cattle drinking as much as 3,100 mg/L sulfate in water could result in a variation in weight of ≤4.6% compared to control groups (Table 1).

This variation was compared to variation across control studies. Of the studies in the Geomega (2007) sulfate database, 9 studies reported weight gains of calves or yearlings from their control groups during the study (Table 2). All of the control groups were exposed to <450 mg/L sulfate on a daily basis. Type of feed varied slightly (Table 2), as did duration of exposure, however the growing conditions of the feedlot environments and initial weights of the growing animals were similar. Standard errors were not typically reported from individual studies, thus we could not evaluate variability within studies. Variation between studies showed that average daily gain (ADG) of growing steers and heifers varied by 14% among studies conducted in feedlot-only environments. Variability increased if open range studies or finishing calves were considered. Thus, baseline variability of the controlled lab studies was determined to be 14%.

Thus, variability in cattle weights when exposed to ≤3,100 mg/L is about a third of the variability of cattle weights under controlled conditions.

3.3.2 Data analysis of Wyoming Livestock Industry

The 4.6% variability in weight gains calculated from the metadata analysis was also compared to Wyoming livestock production data. Variability in livestock production was calculated from ten-years' worth of USDA production data (Table 3). The years used for the calculation were between 1990 and 1999, representing a relatively stable cattle production cycle (Mathews et al. 1999) as well as the most recent trends in production before the drought began in 2000. Precipitation affects forage quality and therefore livestock production (Clawson 1979), thus we did not use data after 1999 to compute baseline variability. Precipitation records over this time period are stable and normal (Table 3). Market analysis over this time period indicates that there were relatively stable market conditions (Matthews et al. 1999). The variation in production was calculated by taking the standard deviation over the average (expressed as a percent). Between 1990 and 1999, production per head varied by 8.7%. Production per farm varied by 8.5%.

The analyses shows that that the potential weight variation of cattle drinking ~3,100 mg/L is about half that of the normal variability in Wyoming's cattle production.

3.4 Costs to Other Sectors of Industry, Example

Costs to the livestock industry of a 3,100 mg/L limit would be minimal, because the current limit is already 3,000 mg/L and many ranchers are taking advantage of produced water containing concentrations close to the limit (Geomega 2007). Letters of beneficial use, written by landowners and received by industry and state agencies, describe a heavy dependence on water discharges with sulfate concentrations up to 3,010 mg/L to support their livelihood in ranching and farming. An estimated two-thirds of all crop production in the Cottonwood Creek area was attributable to produced water discharges (Geomega 2007), and good portion of the crops includes grass hay and alfalfa, which are used to feed cattle in winter months, thus further benefiting the livestock industry.

In contrast, costs to the livestock industry of lowering the sulfate limit to the proposed 500 mg/L may be substantial. The decision to change current effluent limits would affect not both water quality and quantity, because unnecessarily stringent effluent limits for produced water would likely result in reduced water discharge to surface water bodies. The economics of treating large quantities of produced water are such that injection/reinjection, deep disposal, and/or reduced exploration and development are likely results of additional treatment requirements.

Therefore, additional costs to the livestock industry of lowering the limit to 500 mg/L sulfate can include developing alternate water sources (wells, water hauling, ice breaking, etc.) if produced water were not available. J. Kearns (1989) estimated an initial cost of $140,000 and $10,000 annually to maintain watering wells on Bighorn basin properties if produced water were not available. Meanwhile, potential added production of a 4.6% growth increase would correspond to an additional gross income of ~$6,500 per farm (<5% of total gross income), based on the price per pound in 2006. Costs to other aspects of industry are estimated in the millions (Geomega 2007) as a result of reduced exploration, tax revenue and associated jobs.

3.5 Conclusions

In conclusion, the proposed sulfate water quality criterion of 3,100 mg/L meets toxicological and statistical criteria identified in the risk management framework, is within baseline variability indices, and minimizes additional costs to livestock or other industries of livestock protection. In contrast, the petitioners' proposed sulfate water quality criterion of 500 mg/L does not meet the most basic toxicological or statistical criteria. In addition, costs to the livestock industry of a 500 mg/L limit would be substantial as would costs to other industries that would be affected.

Therefore, the proposed criteria of 3,100 mg/L sulfate is the most consistent with all risk management goals, while the proposed criteria of 500 mg/L sulfate does not meet any of the goals.

4 References

ASTM 2002. Annual Book of Standards. Vol. 11.05 Biological Effects and Environmental Fate; Biotechnology; Pesticides. ASTM International, West Conshohocken, PA: E 1847-96 Standard Guide for Statistical Analysis of Toxicity Tests Conducted Under ASTM Guidelines.

Clawson. 1979. The western range livestock industry. Ayer publishing. 401pp.

Digesti, R.D. and H.J. Weeth. 1976. A defensible maximum for inorganic sulfate in drinking water of cattle. J. Anim. Sci. 42:1498-1502.

Embry, L.B., M.A. Hoelscher and R.C. Wahlstrom. 1959. Salinity and livestock water quality. SD. Agric. Expt. St. Bull. 481:5.

Geomega. 2007. Water Quality Effects and Beneficial Uses of Wyoming Produced Water Surface Discharges. Geomega, Inc: Boulder, CO.

Grout, A.S., D.M. Veira, D.M. Weary, M.A.G. von Keyserlingk and D. Fraser. 2006. Differential effects of sodium and magnesium sulfate on water consumption by beef cattle. J. Anim. Sci. 84:1252-1258.

Hickman, D.D., T.A. McAllister, K.S. Schwartzkopf-Genswein, D.H. Crews, Jr., C.R. Krehbiel, and R. Silasi. 2002. Relationship between feeding behavior and performance of feedlot steers. J. Anim. Sci. 80(Suppl. 1):15.

Hodgson and Levi. 1987. A textbook of modern toxicology. Appleton & Lange.

Johnson, P.S. and H.H. Patterson. 2004. Effects of sulfates in water on performance of steers grazing rangeland. Proc. Western Section, Am. Soc. Anim. Sci. 55:261.

Kearns, J. 1989. Inter-office memo to Bureau of Land Management. May 15. Cody, WY.

Kober, J.A. Water: the most limiting nutrient. Agri-Practice 14:39-42. February 1993.

Loneragan, G.H., J.J. Wagner, D.H. Gould, F.B. Garry and M.A. Thorens. 2001. Effects of water sulfate concentration on performance, water intake, and carcass characteristics of feedlot steers. J. Anim. Sci. 79:2941-2948.

Mathews, K.H. Jr., W.F. Hahn, K.E. Nelson, L.A.

Duewer, and R.A. Gustafson. 1999. U.S. Beef Industry: Cattle Cycles, Price Spreads, and Packer Concentration. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1874.

NRC. 1974. Nutrients and Toxic Substances in Water for Livestock. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 1980. Mineral Tolerances of Domestic Animals. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 2000. Nutrient Requirements of Beef Cattle. 7th revised edition update. National Academy of Sciences, Washington, D.C. National Research Council.

NRC. 2005. Mineral Tolerances of Animals. National Academy of Sciences, Washington, D.C. National Research Council.

Patterson, H.H., P.S. Johnson, T.R. Patterson, D.B. Young and R. Haigh. 2002. Effects of water quality on performance and health of growing steers. Proc. Western Section, Am. Soc. Anim. Sci. 53:217.

Patterson, H.H., P.S. Johnson and W.B. Epperson. 2003. Effect of total dissolved solids and sulfates in drinking water for growing steers. Proc. Western Section, Am. Soc. Anim. Sci. 54:378.

Patterson, H.H., P.S. Johnson, E.H. Ward and R.N. Gates. 2004. Effects of sulfates in water on performance of cow-calf pairs. Proc. Western Section, Am. Soc. Anim. Sci. 55:265.

Schwartzkopf-Genswein, K. S., K. A. Beauchemin, T. A. McAllister, D. J. Gibb, M. Streeter, and A.D. Kennedy. 2004. Effect of feed delivery fluctuations and feeding time on ruminal acidosis, growth performance, and feeding behavior of feedlot cattle. J. Anim. Sci. 82: 3357-3365.

Ward, E.H. and H.H. Patterson. 2004. Effects of thiamin supplementation on performance and health of growing steers consuming high sulfate water. Proc. Western Section, Am. Soc. Anim. Sci. 55:375.

Weeth, H.J. and D.L. Caps. 1972. Tolerance of cattle for sulfate water. J. Anim. Sci. 34:256-260.

Weeth, H.J. and J.E. Hunter. 1971. Drinking of sulfate-water by cattle. Journal of Animal Science 32:277-281.

Zimmerman, A.S., D.M. Veira, D.M. Weary, M.A.G. von Keyserlingk, and D. Fraser. 2003. Sodium and magnesium sulphates reduce water consumption by beef cattle. J. Anim. Sci. 81:336 (Abstr.)

Zinn, R. A. 1994. Influence of fluctuating feed intake on feedlot cattle growth-performance and digestive function. In: Southwest Nutr. and Manage. Conf. Proc., Phoenix, AZ. p 77-83.

Table 1. Sulfate literature database.

Reference	Animal sex	Physical state	No. animals per trt	Season	Duration (days)	Rough. Type/level	Age	Initial weight (kg)
Digesti & Weeth 1976	heifer	growing	4	summer	90	57% grass hay	calf	165
Digesti & Weeth 1976	heifer	growing	4	summer	90	57% grass hay	calf	165
Digesti & Weeth 1976	heifer	growing	4	summer	90	57% grass hay	calf	165
Embry et al. 1959	mixed	finishing	6	summer	112	30% rough.	yrlg	334
Embry et al. 1959	steer	finishing	6	summer	84	30% rough.	yrlg	304
Embry et al. 1959	steer	finishing	6	summer	84	30% rough.	yrlg	307
Embry et al. 1959	mixed	finishing	6	summer	112	30% rough.	yrlg	333
Embry et al. 1959	steer	finishing	6	summer	84	30% rough.	yrlg	304
Embry et al. 1959	mixed	finishing	6	summer	112	30% rough.	yrlg	332
Embry et al. 1959	heifer	finishing	6	summer	84	30% rough.	yrlg	306
Johnson & Patterson 2004 yr 1	steer	growing	53	summer	112	range	yrlg	286
Johnson & Patterson 2004 yr 1	steer	growing	53	summer	112	range	yrlg	289
Johnson & Patterson 2004 yr 2	steer	growing	53	summer	63	range	yrlg	286
Johnson & Patterson 2004 yr 2	steer	growing	53	summer	63	range	yrlg	282
Lonergan et al. 2001	steer	finishing	48	summer	116	10% rough.	yrlg	304
Lonergan et al. 2001	steer	finishing	48	summer	116	10% rough.	yrlg	304
Lonergan et al. 2001	steer	finishing	48	summer	116	10% rough.	yrlg	304
Lonergan et al. 2001	steer	finishing	48	summer	116	10% rough.	yrlg	304
Lonergan et al. 2001	steer	finishing	48	summer	116	10% rough.	yrlg	304
Patterson et al. 2004	heifer	adult	48	summer	84	range	adult	633
Patterson et al. 2004	steer	growing	48	summer	84	range	calf	77
Patterson et al. 2004	heifer	adult	48	summer	84	range	adult	631
Patterson et al. 2004	steer	growing	48	summer	84	range	calf	81
Patterson et al. 2002	steer	growing	21	summer	84	grass hay	yrlg	318
Patterson et al. 2002	steer	growing	21	summer	84	grass hay	yrlg	315
Patterson et al. 2002	steer	growing	21	summer	84	grass hay	yrlg	317
Patterson et al. 2003	steer	growing	21	summer	104	grass hay	yrlg	291
Patterson et al. 2003	steer	growing	21	summer	104	grass hay	yrlg	290
Patterson et al. 2003	steer	growing	21	summer	104	grass hay	yrlg	290
Patterson et al. 2003	steer	growing	21	summer	104	grass hay	yrlg	290
Ward & Patterson 2004	steer	growing	21	summer	64	55% grass hay	yrlg	334
Ward & Patterson 2004	steer	growing	21	summer	64	55% grass hay	yrlg	332
Weeth and Caps 1972	heifer	growing	3	summer	30	grass hay	yrlg	240
Weeth and Caps 1972	heifer	growing	9	summer	30	grass hay	yrlg	240
Weeth and Caps 1972	heifer	growing	3	summer	30	grass hay	yrlg	240
Weeth and Hunter 1971	heifer	growing	9	summer	30	grass hay	yrlg	256
Weeth and Hunter 1971	heifer	growing	9	summer	30	grass hay	yrlg	256

Table 1. Sulfate literature database. *(continued)*

Reference	Final weight (kg)	Weight loss vs. control	SO4 concen-tration	Control or Test group	Admin-istration route	ADG (kg/day)	Significance?**
Digesti & Weeth 1976	246	--	110	Control	water	0.9	--
Digesti & Weeth 1976	237	3.7%	1250	Test	water	0.8	N
Digesti & Weeth 1976	237	3.7%	2500	Test	water	0.8	N
Embry et al. 1959	457	--	0	Control	water	1.1	--
Embry et al. 1959	403	--	0	Control	water	1.18	--
Embry et al. 1959	403	0.1%	4733	Test	water	1.14	N
Embry et al. 1959	449	1.7%	4775	Test	water	1.04	N
Embry et al. 1959	408	10.7%	6762	Test	water	1.24	Y
Embry et al. 1959	424	7.3%	6817	Test	water	0.82	N
Embry et al. 1959	291	27.8%	10000	Test	water	-0.18	Y
Johnson & Patt. 2004 yr 1	379.3	--	404	Control	water	0.84	--
Johnson & Patt. 2004 yr 1	372.9	1.7%	3947	Test	water	0.75	N
Johnson & Patt. 2004 yr 2	360.7	--	441	Control	water	1.1	--
Johnson & Patt. 2004 yr 2	341.9	5.2%	4654	Test	water	0.81	N
Lonergan et al. 2001	555	--	136	Control*	water	2.16	--
Lonergan et al. 2001	551	0.6%	291	Test	water	2.13	N/A
Lonergan et al. 2001	555	0.0%	583	Test	water	2.16	N/A
Lonergan et al. 2001	550	0.8%	1219	Test	water	2.12	N/A
Lonergan et al. 2001	543	2.1%	2360	Test	water	2.06	N/A
Patterson et al. 2004	640	--	388	Control	water	0.08	--
Patterson et al. 2004	166	--	388	Control	water	1.06	--
Patterson et al. 2004	615	3.9%	2608	Test	water	-0.19	N
Patterson et al. 2004	172	-3.6%	2608	Test	water	1.08	N
Patterson et al. 2002	370	--	404	Control	water	0.63	--
Patterson et al. 2002	355	4.1%	3087	Test	water	0.46	Y
Patterson et al. 2002	356	3.8%	3947	Test	water	0.46	Y
Patterson et al. 2003	375	--	441	Control*	water	0.81	--
Patterson et al. 2003	368	1.9%	1725	Test	water	0.75	N/A
Patterson et al. 2003	360	4.0%	2919	Test	water	0.67	N/A
Patterson et al. 2003	322	14.1%	4654	Test	water	0.28	N/A
Ward & Patterson 2004	389	--	393	Control	water	0.81	--
Ward & Patterson 2004	366	5.9%	3786	Test	water	0.49	Y
Weeth and Caps 1972	262	--	110	Control	water	0.73	--
Weeth and Caps 1972	254	3.1%	1462	Test	water	0.47	Y*
Weeth and Caps 1972	250	4.6%	2814	Test	water	0.33	Y*
Weeth and Hunter 1971	275	--	110	Control	water	0.63	--
Weeth and Hunter 1971	241	12.4%	5000	Test	water	-0.5	N

Notes for Table 1:

Y* = a statistically significant difference relative to control was determined, however sample size was unbalanced but not controlled for in the statiscal analysis (test group size also less than EPA-recommended minimums); coefficient of variation of test.

Control* a control group was not formerly established. SO4 concentration represents the lowest dosage administered to livestock. This group assigned as "control" for the purposes of computing variability in weight gains among control populations.

** Significantly different than control?

Table 2. Metadata analysis of sulfate control group studies.

Reference	Animal sex	Physical state	Exposure Duration (days)	Rough. Type/level	Age	Initial weight (kg)	Final weight (kg)	SO4 concentration	ADG (kg/day)
Patterson et al. 2004	heifer	adult	84	range	adult	633	640	388	0.08
Lonergan et al. 2001	steer	finishing	116	10% rough.	yrlg	304	555	136	2.16
Embry et al. 1959	mixed	finishing	112	30% rough.	yrlg	334	457	0	1.1
Embry et al. 1959	steer	finishing	84	30% rough.	yrlg	304	403	0	1.18
Ward & Patterson 2004	steer	growing	64	55% grass hay	yrlg	334	389	393	**0.81**
Digesti & Weeth 1976	heifer	growing	90	57% grass hay	calf	165	246	110	**0.9**
Patterson et al. 2002	steer	growing	84	grass hay	yrlg	318	370	404	**0.63**
Patterson et al. 2003	steer	growing	104	grass hay	yrlg	291	375	441	**0.81**
Weeth and Caps 1972	heifer	growing	30	grass hay	yrlg	240	262	110	**0.73**
Weeth and Hunter 1971	heifer	growing	30	grass hay	yrlg	256	275	110	**0.63**
Johnson & Patterson 2004 yr 1	steer	growing	112	range	yrlg	286	379	404	0.84
Johnson & Patterson 2004 yr 2	steer	growing	63	range	yrlg	286	361	441	1.1
Patterson et al. 2004	steer	growing	84	range	calf	77	166	388	1.06

Std. Deviation	**0.11**
Average	**0.75**
Variability, feedlot growing steers only	**14%**

Notes:

All studies were conducted in the summer with at least 3 animals per treatment. Sulfate was administered via water. See Table 1 for additional details.

Longergan et al. (2001) and Patterson et al. (2003) did not identify specific control groups. For these studies, the lowest sulfate exposure group shown was assumed to be the control for the purposes of the metadata analysis.

ADG = average daily growth.

Table 3. USDA livestock production data for Wyoming, 1990-1999.

Year	Inventory - cattle/calves all (1,000 head)	Production (1,000 lbs) 1/	Annual rainfall (in)	Calf Crop (1,000 head)	Cattle Crop (1,000 head)	% Cattle in Inventory	Number of Farms	Production per Head (lbs)	Production per farm (lbs)
1990	1220	468,490	12.75	620	600	49%	5900	384.0	79.4
1991	1190	548,200	14.80	670	520	44%	5400	460.7	101.5
1992	1290	552,870	12.59	710	580	45%	5800	428.6	95.3
1993	1350	618,186	13.67	740	610	45%	6000	457.9	103.0
1994	1480	557,334	15.66	740	740	50%	5900	376.6	94.5
1995	1470	590,465	18.27	740	730	50%	5700	401.7	103.6
1996	1490	631,483	14.22	770	720	48%	5700	423.8	110.8
1997	1580	580,909	10.22	870	710	45%	5700	367.7	101.9
1998	1660	604,007	12.09	830	830	50%	6400	363.9	94.4
1999	1560	613,065	16.27	830	730	47%	6300	393.0	97.3

	Production per Head (lbs)	Production per farm (lbs)
Std. Deviation	**35.4**	**8.3**
Average	**406**	**98.2**
Variability (%)	**8.7%**	**8.5%**

Notes:

1/ Adjustments made for changes in inventory and for inshipments.

Annual rainfall periods are between Sept-Dec of the previous year and Jan-August of the current year.

Avg size of farm has not changed between 1993-1999

Inventory and production data calculated January of each year.

Williams.

Williams Production RMT Company
300 North Works Avenue
Gillette, WY 82716
307.686.1636
307.686.7574 (fax)

June 12, 2007

David Waterstreet
Herschler Building – 4W
122 West 25th Street
Cheyenne, WY 82002

Re: Comments on Revisions to Appendix H, Agricultural Use Protection and Associated Language in Section 20 of Chapter 1

Dear Mr. Waterstreet:

Williams Production RMT Company ("Williams") appreciates the opportunity to submit comments to the Wyoming Water and Waste Advisory Board ("WWAB") regarding revisions to Appendix H, Agricultural Use Protection and associated language in Section 20 of Chapter 1 of the Wyoming Water Quality Rules and Regulations. Williams is a significant operator in Wyoming and, in particular, in the Power River Basin. Williams is concerned about Appendix H's potential to affect its coalbed natural gas operations adversely.

Appendix H has undergone significant changes over the past two and a half years and multiple public comment periods. Williams continues to have concerns about multiple provisions of Appendix H which is currently under consideration by the WWAB. Williams incorporates by reference its most recent comments on February 14, 2007 to the Wyoming Environmental Quality Council. See Attachment 1. However, at this time, Williams wishes to focus its comments on 1) the definition of historical discharges which would not be subject to Appendix H; and 2) clarification of the effect of a landowner's denial of access on an applicant's data collection and application obligations.

The revised Appendix H establishes a bright line of applicability. The Wyoming Department of Environmental Quality ("DEQ") will not use Appendix H to establish new effluent limits on discharges of produced water that began prior to January 1, 1997. DEQ has issued permits with effluent limits on discharges of produced water both prior to and since January 1, 1997. To date, discharges of produced water pursuant to valid, existing permits have protected agricultural uses, having met the narrative standard of Section 20 i.e., no measurable decrease in existing livestock or crop production. As currently drafted, Appendix H arbitrarily protects certain historical conventional oil and gas discharges while expressly targeting coalbed natural gas operations for application of the new, more stringent standards. DEQ does not present any rationale for the selection of the January 1, 1997 cutoff date or for the selective application of the new, more stringent standards to coalbed natural gas operations – nor could it. The historical discharges of record are the best empirical evidence that no measurable decrease to existing livestock and crop production has occurred. Therefore, Appendix H should not apply to establish effluent limits on discharges which have been occurring pursuant to a valid and existing permit as of the date of the adoption of Appendix H. See Attachment 2.

Appendix H includes a section entitled "Reasonable Access Requirement." To the extent the applicant for a discharge permit seeks effluent limits other than the Tier 1 default limits, the applicant has the burden of proof to provide data supporting the use of Tiers 2 and 3 of Appendix H. Appendix H should acknowledge that the applicant can develop only so much data for a Section 20 analysis without landowner cooperation on access issues. In order to prove that no measurable decrease in agricultural production will occur, the applicant must have access to collect data to meet that burden. Williams believes that Reasonable Access Requirement section requires some minimal but important revisions to ensure that the applicant will be able to obtain a permit based upon the best information that can reasonably be obtained by the applicant. Similarly, the identification of naturally irrigated lands should not be made solely on the basis of landowner testimony in the absence of granting an applicant reasonable access to determine the extent of the claimed naturally irrigated lands. See Attachment 2.

Williams appreciates the opportunity to comment on the Agricultural Use Protection Standards in Appendix H, and appreciates your consideration of our comments. We would be pleased to discuss our comments further with you and respond to any questions you may have.

Sincerely,

Joe Olson by [illegible]

Joe Olson
Facilities Engineer

Attachments

3720383_1.DOC

Williams Production RMT Company
300 North Works Avenue
Gillette, WY 82716
307.686.1636
307.686.7574 (fax)

February 14, 2007

Wyoming Department of Environmental Quality
Water Quality Division
Herschler Building – 4W
122 West 25th Street
Cheyenne, WY 82002
Attn: Bill DiRienzo

Re: Comments on Proposed Revisions to Chapter 1 of the Wyoming Water Quality Rules and Regulations, Appendix H, Agricultural Use Protection

Dear Mr. DiRienzo:

Williams Production RMT Company (Williams) appreciates the opportunity to submit comments to the Environmental Quality Council (EQC) regarding the adoption of Appendix H, Agricultural Use Protection standards, as part of the revisions to Chapter 1 of the Wyoming Water Quality Rules and Regulations. Williams is a significant operator in Wyoming and, in particular, in the Powder River Basin (PRB). Williams is concerned about Appendix H's potential to affect its coalbed natural gas (CBNG) operations adversely.

Appendix H has undergone significant changes over two years and four public comment periods. Throughout that time, the agricultural use protection standards in Appendix H were proposed as a Wyoming Department of Environmental Quality (DEQ) implementing policy. It was only in the last several months that DEQ decided to submit the Agricultural Use Protection Policy to the EQC as a rule rather than a policy. DEQ has failed to consider the mandatory factors specified in the Environmental Quality Act (EQA) for proposing Appendix H as a rule to the EQC. W.S. § 35-11-302 (a)(vi).

The Agricultural Use Protection standards in Appendix H have the potential to impose significant costs and technical burdens upon CBNG operators. Yet, DEQ failed to consider these impacts, and failed to balance the burdens imposed against the purported environmental effects sought to be protected, prior to recommending the adoption of Appendix H as a rule. Williams believes Appendix H would be significantly different in its requirements and breadth if the DEQ had thoroughly considered the factors set forth in W.S. § 35-11-302(a)(vi).

Williams' specific comments regarding the text of the proposed Appendix H follow. In addition, Williams encourages the EQC to consider seriously the development of a risk-based approach to implementation of the agricultural protection narrative standard, as opposed to the one-size-fits-all approach of the currently proposed Appendix H.

I. Purpose - Chapter 1, Section 20 Should Not be Implemented to Protect Illegal Irrigation.

We agree with DEQ that the purpose of Ch. 1, Section 20 is to protect irrigation that existed prior to an application for a WYPDES discharge permit. As the DEQ has noted, the language infers a pre-existing agricultural use prior to an application for a WYPDES permit, which can serve as a baseline from which a decrease in crop or livestock production could be measured. We also agree that, to be afforded the protection of Section 20, a landowner must have an existing irrigation structure or mechanism in place for diverting water. However, in Appendix H, the DEQ proposes the continuation of its historic practice of protecting illegal diversions, i.e., irrigation which occurs in the absence of a valid existing water right. Williams takes issue with this practice, particularly when the DEQ endorses in a rule this illegal practice be followed by State personnel when translating the Section 20 narrative goals into appropriate WYPDES permit limits.

If a landowner is irrigating without the benefit of a water right from the office of the State Engineer, then the irrigation is illegal. Since there is no right to the use of the water in the drainage, the irrigation could be ordered to cease and desist at any time. Therefore, there is really nothing for the DEQ to protect. Moreover, the DEQ's current practice of protecting illegal irrigation is in direct conflict with the Wyoming law regulating the use of water:

> Water being always the property of the state, rights to its use shall attach to the land for irrigation, or to such other purposes or object for which acquired in accordance with the beneficial use made for which the right receives public recognition, under the law and the administration provided thereby. W.S. § 41-3-101.

By allowing unauthorized structures to trigger application of the standard, Appendix H protects unlawful irrigation use, sanctions the unlawful conduct, and rewards the offender for its offense. We submit that this practice constitutes egregiously bad public policy and produces an absurd result in violation of the canons of statutory and regulatory interpretation declared by the Wyoming Supreme Court. See *In re KP v. State*, 102 P.3d 217, 224 (Wyo. 2004) ("[T]his Court will not interpret a statute in a manner producing absurd results"); *Corkill v. Knowles*, 955 P.2d 438, 444 (Wyo. 1998).

Lastly, the EQA expressly states that the actions of the DEQ shall not limit or interfere with the jurisdiction, duties or authority of the State Engineer in administering water rights. W.S. §35-11-1104(a)(iii). Protection of illegal diversions could certainly be construed as interfering with these jurisdictional constraints, as it aids conduct directly contrary to the requirements for use of water set out above.[1] CBNG dischargers should not be required to protect such illegal practices. Appendix H should expressly state that in the future unauthorized irrigation use will not be protected and that existing diversion structures not covered by an existing water right will not trigger application of the agricultural standard.

II. Presumption of Naturally Irrigated Lands is Overly Broad

Appendix H implies there is a pre-existing agricultural use of a stream or drainage when "a substantial acreage of naturally sub-irrigated pasture within a stream floodplain" exists. Appendix H states that infra-red photography, surficial geologic maps, wetland mapping, landowner testimony or any combination of these sources may be used to establish that lands are naturally irrigated. Each of these information sources presents a snapshot of conditions at a specific time, and conditions may have changed e.g., wetlands mapping.[2] In addition, a permit applicant has no method by which it could disprove the presumption of sub-irrigation presented in Appendix H. The application of EC and SAR effluent limits should not be applied unless there is some presence and evidence of the ability to irrigate with a surficial flow.

The EC and SAR effluent limits will be applied where the naturally irrigated land reaches a threshold deemed "agriculturally significant." This threshold is triggered when a stream segment contains "single parcels of naturally irrigated land

---

[1] The lack of a water right is often an indication that the drainage did not maintain adequate flows or water quality to facilitate irrigation or that the soils or other conditions were simply not supportive of irrigation adequate to allow the landowner to prove up its beneficial use of water and thus obtain a valid water right. And, in the absence of a valid existing water right, applicants for a discharge permit have no notice of irrigation use by such downstream landowners and no way to account for them in their WYPDES permit applications.

[2] The DEQ should not be able to rely solely upon landowner testimony which is inherently biased to establish the existence of naturally irrigated lands.

greater than 20 acres or multiple parcels in near proximity that total more than 20 acres." Given the size of parcels in Wyoming, the definition of agricultural significance could be easily met through single parcels or the sum of smaller parcels. The practical effect of this definition combined with an easily triggered (unrefutable) definition of sub-irrigated land is that Appendix H's irrigation effluent limits would be applied to discharges into virtually any and every drainage in the State. The agricultural protection standards in Appendix H, if implemented, would result in a gross over-extension of the prior agricultural use presumption, would be overly protective of established agricultural uses which may no longer exist and would significantly restrict CBNG operators' ability to discharge into State waters without expensive treatment of discharges to protect nominally useful parcels of land.

III. <u>Irrigation Data and Information</u>

Appendix H indicates that "the goal is to ensure that preexisting irrigated crop production will not be diminished as a result of the lowering of water quality." The difficulty, of course, is in assessing the preexisting or baseline crop production that existed prior to any proposed discharge. Often there are no records of crop yield, stream flows, historic water quality, etc., making it very difficult for all parties to apply the "no measurable decrease" standard. This has caused DEQ to historically take an overly conservative approach in developing numeric permit effluent limitations to assure no measurable decrease in crop production. For that reason, we recommend that the following be added to the data and information required under Section d:

- Extent of irrigation permitted by Office of the State Engineer under a valid and existing Wyoming water right.

- Rate of flow required to activate irrigation under the system in place.

- As to the season of use, the EQC should further refine the definition of "irrigation season." The EC and SAR limits will apply during those periods when crop growth is occurring and then only when irrigable flows exist. Irrigable flows are those in which adequate water exists to activate a spreader dike system for artificially irrigated lands or to cause natural flooding or sub-irrigation on naturally irrigated lands. It is not reasonable to assume that the irrigation season is generally considered year-round in Wyoming for passively irrigated lands, given the variation and intensity of storm events supplying water to ephemeral or intermittent drainages used for irrigation purposes. In the absence of such events, the naturally-occurring salinity in these drainages limits their utility for irrigation. When irrigation cannot occur, the water quality standards protective of irrigation should not be applied. Operators should not be required to make the water quality in the stream system better year round than mother nature provided.

- Most importantly, in place of using published tolerance values for the most sensitive crops grown, we suggest use of the Hanson Diagram to manage the SAR limit for two reasons. First, the published tolerance values for most crops generally assume conditions exist for attaining a 100% crop yield. Our experience throughout the PRB is that, given the growing conditions, e.g., a lack of precipitation, poor alkaline and saline soils, and intermittent flows, etc., irrigators in the PRB achieve a crop yield well below the 100% value. Second, as Appendix H acknowledges, the significant irrigation-related effluent limits in the PRB are EC and SAR. The EQC is aware that, within certain broad limits, it is the ratio of EC and SAR that determine the suitability of water quality for irrigation purposes for any given crop. We therefore suggest that the EQC apply the Hanson Diagram in establishing SAR limits. As stated above, these limits should be applied only when adequate water is available to create an irrigable flow. At all other times, to apply effluent limitations which are adequate to irrigate the most sensitive crop would require the dischargers to make the water in the stream better than mother nature provides. That is an undue burden, with no environmental benefit, which will not in any meaningful way enhance the crop production. It will only impose unnecessary additional expense and effort on dischargers of water from CBNG operations.

IV. Tiered Approach Should Protect Measurable Decrease in Crop Production.

The agricultural protection standards in Appendix H establish a tiered approach which is designed to establish appropriate effluent limits to ensure there is no measurable decrease in crop production. While a tiered approach is absolutely necessary to address the variety of background conditions and quality of discharges in different drainages within the PRB, the default EC and SAR limits in Tier 1 require revision. As discussed above, Williams does not believe that the use of default EC limits should be based on tolerance values for the most sensitive crop or upon 100% yield threshold values. To the extent the EQC decides to use such criteria, calculated values should be based on data which more accurately reflects soil chemistry and crop production in the PRB and Wyoming, not California. The Tier 1 approach is overly conservative and protects against <u>any</u> decrease in crop production, not merely a <u>measurable</u> decrease in such production. Appendix H proposes the application of effluent limits to achieve an end beyond that described in the narrative goals stated in Chapter 1, Section 20 and does so without sufficient supporting credible evidence. This point is well made and fully documented in letters dated May 5, 2006 submitted to the Water and Waste Advisory Board by Kevin C. Harvey on behalf of several CBMG operators including Williams, and we urge the EQC to carefully and fully consider Mr. Harvey's comments and conclusions and modify Appendix H accordingly. See attached letters.

Tier 2 offers dischargers a viable permitting option in instances in which background water quality is worse than its CBNG effluent quality. In such circumstances, Tier 1 default limits should be inapplicable. Williams requests that the EQC amend Appendix H to state that if such circumstances exist, EC and SAR effluent limits must be based upon those background conditions rather than tolerance values for the most sensitive crop.

V. A New Approach

The agricultural protection standards in Appendix H have undergone a number of changes over the past two years as DEQ and the Water and Waste Advisory Board have struggled with how best to implement Chapter 1, Section 20's prohibition against measurable decrease in crop or livestock production. The agricultural use protection standards were originally contemplated as internal policy guidance, giving DEQ sufficient flexibility to change the standards as needed. Given the renewed consideration of the standard as a rule rather than a policy, Williams believes it is time for the EQC and DEQ to step back and consider whether Appendix H truly addresses its originally intended purpose—to provide a practical, workable, and predictable solution for applying the narrative measurable decrease standard in Chapter 1, Section 20. The last two years of consideration by the Water and Waste Advisory Board, DEQ, and the public has culminated in proposed rule that Williams believes fails to achieve that purpose. Appendix H does not in any practical or realistic way define what is a "measurable decrease" and what is the best way to avoid it.

Williams suggests that the EQC and DEQ take a fresh look at the no measurable decrease standard and work with all stakeholders to develop a new rule that reflects the realities of agricultural production in an arid environment. Measurable decrease must be considered in the context of the background conditions. Not all waters of the State have the same quality and not all agricultural use has the same value. For example, where water quality is poor and agricultural use is limited to low-yield production from naturally irrigated native plants, less protection may be necessary than in situations where the background water quality is high and artificial irrigation supports high-yield commercial crops. Any new rule should take into account site-specific conditions and uses of water in each drainage, rather than applying blanket standards which are derived from data generated in California.

Williams recommends that the newly drafted rule take a risk-based approach to measurable decrease. Effluent limits should reflect that agricultural production in most areas of Wyoming is not at 100% yield under natural conditions due to lack of precipitation, poor alkaline and saline soils, and intermittent flows. EC and SAR standards should not be set to protect 100% yield, but should reflect the actual yield where produced water may actually be applied. Further, in many cases, stream conditions are such that there is little risk that produced water will reach irrigated acres unless mixed with substantial quantities of natural flows. Any rule should require consideration of whether the water being discharged will be applied to irrigated acreage, the impact of irrigation practices (the amount of water necessary to activate artificial and natural irrigation systems), and the condition of the soil being irrigated. Though Appendix H as currently drafted attempts to address these issues, it does so in an inflexible manner that does not acknowledge varied applications in the field.

Williams appreciates the opportunity to comment on the agricultural use protection standards in Appendix H and appreciates your consideration of our comments. We would be pleased to discuss our comments further with you and respond to any questions you may have.

Sincerely,

/s/

Joe Olson
Facilities Engineer

Attachments

3668614_1.DOC

ATTACHMENT 2

Williams Production RMT Company
Proposed Revisions to Appendix H
Agricultural Use Protection and Associated Language
in Section 20 of Chapter 1

Page H-1, Paragraph 3, "Measurable Decrease" – delete "prior to January 1, 1997"; insert "pursuant to a valid and existing permit issued prior to the date of the adoption of Appendix H"

Page H-3, Paragraph 1, "Naturally Irrigated Lands" – Insert at the end of the paragraph, "However, landowner testimony may be used only if the landowner provides the discharge permit applicant with reasonable access to the landowner's lands to determine the extent of the claimed naturally irrigated lands."

Page H-7, Paragraph 2, Final Sentence, "Reasonable Access Requirement" – 1) Insert at the beginning of the sentence "Since the applicant has the burden of proof under Tiers 2 and 3,"; 2) insert after "access" "to the applicant"; and 3) insert after "obtained" "by the applicant".

3722474_1.DOC

Appendix H

Agricultural Use Protection

(a) **Purpose**

Formatted: Bullets and Numbering

All surface waters in Wyoming are protected to some extent for agricultural uses. "Agricultural uses" are described in Section 3 as being either stock watering or irrigation.

The purpose of this Appendix is to provide a benchmark against which a determination can be made as to whether a waterbody is impaired and requires some kind of corrective action and to provide a basis for establishing permit limits on regulated activities (WYPDES & Section 404 permits). The purpose of this Appendix is also to provide the criteria and procedures to be used by the Water Quality Division when translating the narrative goals expressed in the Section 20 standard into appropriate WYPDES permit limits where maintaining agricultural use of the receiving waters is an issue.

"Measurable Decrease"

The first part of translating the standard is defining what is meant by *"measurable decrease in crop or livestock production"*. The phrase implies that there is a pre-existing agricultural use of a stream or drainage prior to an application for a WYPDES discharge permit. For livestock watering purposes, a pre-existing use will always be assumed. For irrigation purposes, there needs to be either a current irrigation structure or mechanism in place for diverting water from the stream channel, or a substantial acreage of naturally sub-irrigated pasture within a stream floodplain. Where neither of these conditions exist, there can be no irrigation use, nor loss in crop production attributable to water quality.

Where there are pre-existing agricultural uses, it may often be impossible to measure a loss in crops or livestock that can be attributed to water quality because of the many other factors that will affect actual production. It is also important to be able to predict the probability of a measurable decrease in production rather than relying solely on after-the-fact measurements. Therefore, the implementation of the narrative criteria through WYPDES permits will always involve making reasonable judgments and assumptions.

Effluent limits on discharges of produced water that began pursuant to a valid and existing permit issued prior to the date of the adoption of Appendix H will not be affected by this Appendix in relation to the protection of agricultural uses. Where discharges have been occurring for at least ten years with no prior indication or complaint of reduced agricultural production, it will be assumed that the discharge has had no adverse effect on production. Therefore, it is not necessary to modify those discharges in order to achieve the goal of "no measurable decrease" in crop or livestock production. It would only be necessary to maintain the existing quality of the discharge. It is important to note, however, that effluent limits on historic discharges may be made where the quality of the discharge is shown to constitute a hazard to humans, livestock or wildlife.

Deleted: prior to January 1, 1997

(b) **Livestock Watering**

Formatted: Bullets and Numbering

(i) The following limits apply to discharges that will be used for livestock watering. Each limit must be achieved at the end-of-pipe prior to mixing with the receiving stream:

Formatted: Bullets and Numbering

5000 mg/L TDS;
3000 mg/L Sulfate;
2000 mg/L Chloride;

In addition to the basic effluent limitations above, the following limits for livestock protection may be incorporated into WYPDES permits when there is reason to believe they may be associated with a discharge:

Selenium	50 µg/L	Total Recoverable
Fluoride	4000 µg/L	Dissolved
Arsenic	20 µg/L	Total Recoverable
Copper	500 µg/L	Dissolved
Cadmium	50 µg/L	Dissolved
Boron	5000 µg/L	Dissolved
Chromium	1000 µg/L	Dissolved
Lead	100 µg/L	Dissolved
Mercury	10 µg/L	Dissolved
Zinc	2500 µg/L	Dissolved

(ii) Livestock watering waiver - An exception to the limits above may be made whenever the background water quality of the receiving water is worse than the value listed for the associated pollutant or when the livestock producer requests use of the water and thereby accepts any potential risk to his livestock.

Formatted: Bullets and Numbering

(c) **Irrigation**

Formatted: Bullets and Numbering

Electrical conductivity (EC) and sodium adsorption rate (SAR) limits will be derived in permits where effluent discharges are used for irrigation. Each limit must be achieved at the end-of-pipe prior to mixing with the receiving stream.

(i) For the purposes of this rule, irrigated lands include the following:

Formatted: Bullets and Numbering

(A) "Artificially Irrigated Lands" means the artificially irrigated lands where water is intentionally applied for agricultural purposes. Artificially irrigated lands will be identified by the presence of canals, ditches, spreader dikes, spray irrigation systems or any other constructed mechanism intended to divert water from a stream channel for application on adjacent lands.

Formatted: Bullets and Numbering

(B) "Naturally Irrigated Lands" means lands along stream channels that have enhanced vegetative production due to periodic natural flooding or sub-irrigation. Naturally irrigated lands are those lands where a stream channel is underlain by unconsolidated material and on which the combination of stream flow and channel geometry provides for enhanced productivity of agriculturally significant plants. Naturally irrigated lands may be identified by an evaluation of infra-red aerial imagery, surficial geologic maps, wetland mapping, landowner testimony or any combination of that information. However, landowner testimony may be used only if the landowner provides the discharge permit applicant with reasonable access to the landowner's lands to determine the extent of the claimed naturally irrigated lands.

Formatted: Bullets and Numbering

(ii) Appropriate effluent limits for EC and SAR will be calculated and applied to WYPDES discharge permits in all instances where the produced water discharge may reach any artificially irrigated lands.

Formatted: Bullets and Numbering

(iii) EC and SAR limits will be applied to WYPDES permits where the produced water discharge may reach stream segments containing single parcels of naturally irrigated land greater than 20 acres in size or multiple parcels in near proximity that total more than 20 acres. In making this estimation, small drainage bottoms may be excluded from consideration. Two specific criteria which may be used to exclude lands include lack of a persistent active channel and unconsolidated floodplain deposits which are generally less than 50 feet in width.

Formatted: Bullets and Numbering

(iv) If there are no pre–existing diversions within reach of a discharge, if the water will be impounded or managed so as not to reach a diversion during the irrigation season, or if the discharge will not reach an irrigated field, either because of natural conditions or water management techniques, then permit limits will be established to protect other relevant water uses (e.g. livestock watering, wildlife, aquatic life, etc.)

Formatted: Bullets and Numbering

(v) Data and Information. A minimum amount of data must be collected to identify existing irrigation uses and to appropriately set effluent limits on discharges that may affect those uses. At a minimum, the following information must be obtained:

Formatted: Bullets and Numbering

(A) Location(s) of irrigation diversions and/or naturally irrigated acreage;
(B) Crops grown under irrigation;
(C) Published tolerance values for the most sensitive crop;
(D) Season of use

Formatted: Bullets and Numbering

Additional information may be required of the applicant to ensure that appropriate effluent limits are set to protect the receiving water.

(vi) Establishing Effluent Limits. A 3-tiered decision making process will be used to establish appropriate effluent limits for EC and SAR whenever a proposed discharge will likely reach irrigated lands.

Formatted: Bullets and Numbering

(A) Tier 1 -Default EC and SAR limits. Default limits for EC and SAR may be used where the quality of the discharge water is relatively good or the irrigated crops are

Formatted: Bullets and Numbering

salt-tolerant. The default values shall be based upon the published soil EC tolerance values for the most sensitive crop and shall be calculated as follows:

(I) Default EC limits will be based upon 100 percent yield threshold values for soil EC as reported by the USDA Agriculture Research Service (ARS) Salt Tolerance Database. In the event that the species of interest is not included in the ARS Salt Tolerant Database, then the following alternative references can be consulted:

Formatted: Bullets and Numbering

(1.) Hanson et al. 1999. Agricultural Salinity and Drainage. DANR Pub. 3375. Univ. of Calif. Davis;

Formatted: Bullets and Numbering

(2.) Ayers and Westcot. 1985. Water Quality for Agriculture. UN FAO Irrigation and Drainage Pager 29 (revised); and

Formatted: Bullets and Numbering

(3.) CPHA. 2002. Western Fertilizer Handbook. 9th Edition. Interstate Pub., Inc., Danville, IL.

Formatted: Bullets and Numbering

(II) The relationship between soil EC values and irrigation water EC values will be: EC (soil) = 1.5 EC (water), i.e., the published soil EC threshold obtained from the appropriate reference will be divided by the soil concentration factor of 1.5 to establish the discharge EC limit.

Formatted: Bullets and Numbering

However, in circumstances where the background water quality of the receiving water(s) is known to be significantly better than would otherwise be required based on a theoretical 100% yield, effluent limits may be set to maintain that higher quality.

(III) Default limits will be set to ensure the relationship between SAR and EC remains within the designated zone of "no reduction in rate of infiltration" as depicted in Figure 1 at the end of this appendix. The following equation will be used to determine the default SAR limit: SAR = (7.10 x EC) – 2.48. If the actual EC concentration of the discharge is observed to be of higher quality than the published default concentration then the SAR limit may be adjusted to actual EC concentrations depending on site specific conditions. When the calculated default SAR value exceeds 10, the limit will be set at 10 as the maximum default limit. The maximum default limit is only intended to apply to calculating Tier 1 limits and may be modified according to the provisions of sections B and C below.

Formatted: Bullets and Numbering

(IV) At a minimum, the EC and SAR limits will apply during the irrigation season and when flows are sufficient to support the use. For sub-irrigated lands and passively irrigated lands such as those under spreader dike systems, EC and SAR limits will generally apply year-round.

Formatted: Bullets and Numbering

(B) Tier 2 - Background Water Quality. If sufficient data is available to demonstrate or calculate that the pre-existing background water quality at the point(s) of diversion is worse than the effluent quality, EC and SAR effluent limits may be based upon those background conditions rather than tolerance values for the most sensitive crop.

Formatted: Bullets and Numbering

(I) Measured Data. Background water quality may be established based upon published pre-discharge historic data. Generally, this data only exists on larger, perennial, mainstem stream channels where historic gauging has taken place. Actual measured data is the most reliable means of establishing background and must be considered on those waters where it is available.

Formatted: Bullets and Numbering

(II) Calculated Background. On intermittent and ephemeral stream channels, pre-discharge water quality data is usually scarce or non-existent and very difficult to collect. In these circumstances, background water quality can be estimated by conducting soil surveys on land that has been historically irrigated from the subject stream.

Formatted: Bullets and Numbering

In the event that soil studies are used as a means to estimate baseline water quality for a given drainage, the following requirements apply:

(1.) Sample Site Selection. Soil samples shall be taken at semi-random sites within each contiguous irrigated segment downstream of the proposed discharge. "Semi-random" in this case is intended to mean that the applicant will identify the various major distinguishing terrain zones within each irrigated segment and select sample sites randomly within each terrain zone. For example, the channel bottom may constitute one terrain zone, the first small terrace above the channel bottom may be another terrain zone, and the adjacent meadow or field may be a single remaining terrain zone, or that meadow / field may actually be comprised of several other known zones such as discharge-affected soils vs. non-affected soils, sub-irrigated reaches vs. non-sub-irrigated reaches, etc.

Formatted: Bullets and Numbering

(2.) Number of Sample Sites. Listed below are the minimum number of soil sample sites required for each of the identified terrain zones (based on zone area) within a contiguous irrigated segment:

Formatted: Bullets and Numbering

Zone Area	**Minimum Number of Sample Sites**
0 – 5 acres	3
5 - 10 acres	5
10 + acres	7

(3.) Sample Collection. Sample sites must be located a minimum of 50 feet apart from one another. Each sample site shall be sampled at a minimum of four depths (0-12", 13-24", 25-36", 37-48"). If alfalfa is present within the terrain zone, each sample site within that terrain zone must be sampled at a total of 6 depths (at the above-noted depths, plus 49-60" and 61-72"). Each twelve inch sample increment must be analyzed either individually or combined (composited) with other corresponding depth samples from the other sample sites within the same terrain zone (e.g., all 0-12" samples from a given terrain zone bulked together and analyzed as a single composite sample).

Formatted: Bullets and Numbering

(4.) Sample Analysis. At a minimum, a saturated paste extract for each sample shall be analyzed for EC. Though not necessary for the estimation of background water conductivity, it is advisable to also analyze the soil samples for pH, SAR, soil texture and exchangeable sodium percentage (ESP) to avoid having to duplicate the sampling if the results indicate that a "no harm analysis" *(item (C) below)* needs to be completed. Percent organic matter shall be analyzed in the surface 0-12 inch samples only. In addition, analyses to identify the clay mineralogy types present in the soils may also be warranted.

Formatted: Bullets and Numbering

(III) Soil Report Preparation. At a minimum the applicant shall submit:

Formatted: Bullets and Numbering

(1.) A map or diagram identifying where each of the soil sample sites is located. At a minimum, the map or diagram must show the basic topography and stream course, irrigation structures *(if present - such as spreader dams or head gates)*, estimated boundaries of the irrigated acreage, surface ownership of the irrigated acreage *(including downstream irrigated areas)* and section / township / range identification. This map must also show any delineated terrain zones, plus elevations of the terrain zones

Formatted: Bullets and Numbering

(2.) An accompanying location table which includes the quarter / quarter, section, township, range, and latitude / longitude for each sample site

Formatted: Bullets and Numbering

(3.) Summary data table showing the analytical results for each of the soil parameters listed above, for each depth, at each sample site

Formatted: Bullets and Numbering

(4.) All associated lab sheets

Formatted: Bullets and Numbering

(C) Tier 3 - No Harm Analysis. The actual effects of EC and SAR on crop production are variable based upon soil type and chemistry and may be mitigated to some extent by managing irrigation practices. EC and SAR effluent limits may also be established based upon a scientifically defensible site specific study that examines local soil characteristics, natural water quality, expected crop yield, irrigation practices and/or other relevant factors related to crop production.

Formatted: Bullets and Numbering

Because of the site-specific nature of this approach and the number and complexity of variables that may need to be considered, there is a burden of proof placed upon the applicant to demonstrate through a comprehensive study that levels of EC and/or SAR, higher than either the default values or estimated background water quality, would most likely not measurably harm an existing irrigation use. Refined limits for EC and SAR resulting from a "no harm" analysis should incorporate a reasonable margin of safety to account for variables that cannot be precisely measured or modeled.

(vii) Irrigation Waiver. An exception to EC or SAR limits established under the Tier 1, 2 or 3 procedures may be made when affected landowners request use of the water and thereby accept any potential risk to crop production on their lands. Irrigation waivers will only be granted in association with an irrigation management plan that provides reasonable assurance that the lower quality water will be confined to the targeted lands.

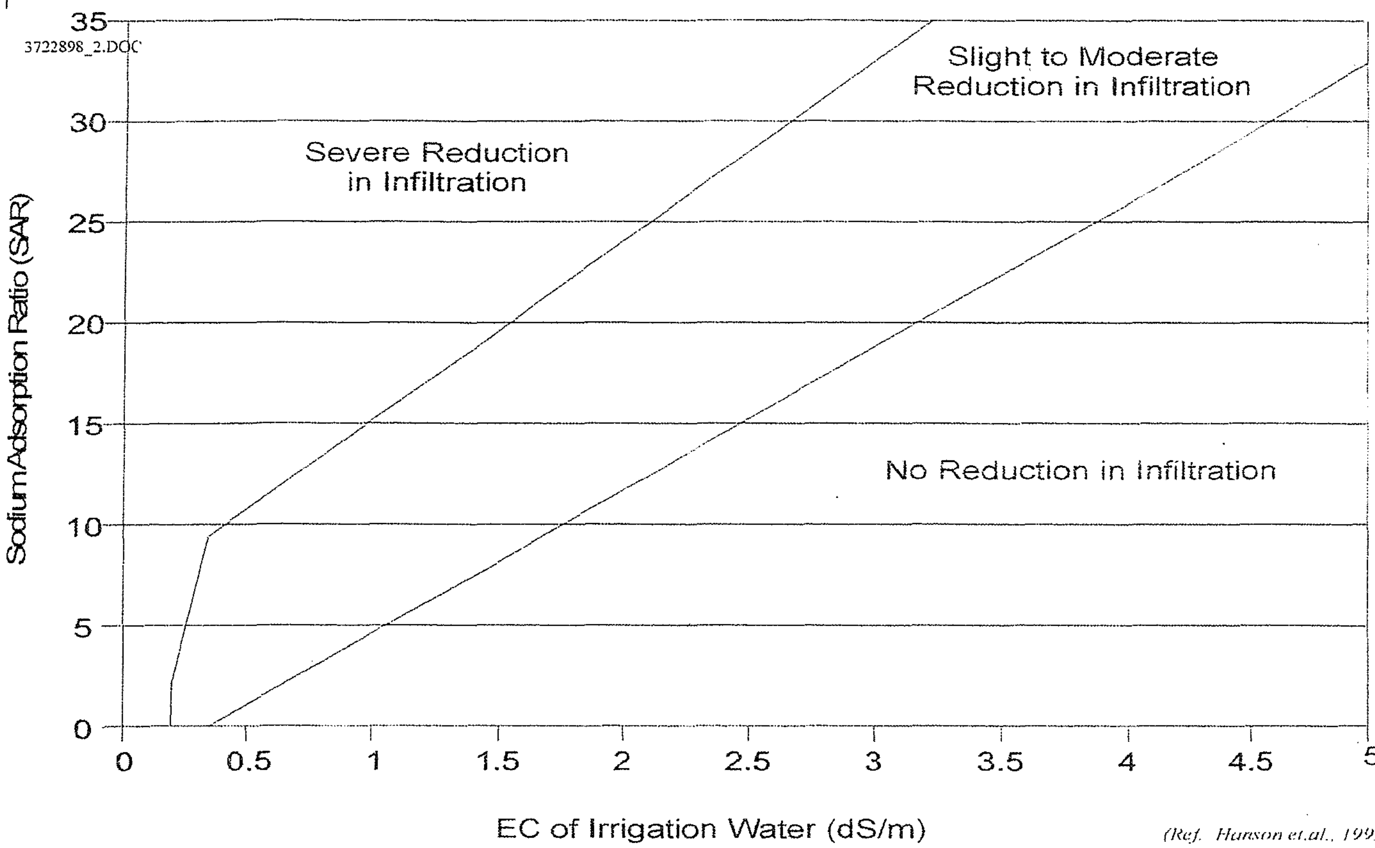
Formatted: Bullets and Numbering

(viii) Reasonable Access Requirement. The procedure for establishing default EC and SAR limits is intended to provide the ability to permit the discharge of high quality water without an obligation to conduct site specific studies. In practice, the use of the default procedure will only apply where permitted discharges are of exceptionally high quality. In many applications, appropriate limits for EC and SAR will be based on refined procedures rather than default. Because the refined procedures require the acquisition of site-specific data, it is necessary that permit applicants and/or the DEQ have reasonable access to obtain the required information. Since the applicant has the burden of proof under Tiers 2 and 3, in circumstances where a landowner chooses to deny access to the applicant for the purpose of developing a Section 20 analysis, EC and SAR limits will be based upon the best information that can be reasonably obtained by the applicant and may be less stringent than Tier 1 default limits.

Formatted: Bullets and Numbering

Deleted: I

3722898_2.DOC



(Ref. Hanson et.al., 1999)

hearing

WYOMING MINING ASSOCIATION

HITCHING POST INN
P.O. Box 866
Cheyenne, Wyoming 82003

June 15, 2007

Wyoming DEQ/Water Quality Division
Water Quality Advisory Board
122 West 25th Street
Herschler Building, 4th Floor West
Cheyenne, WY 82001

Re: Appendix H, Agricultural Use Protection Comments

Mr. Chairman and members of the committee, my name is Matt Grant and I am the Assistant Director of the Wyoming Mining Association (WMA). The WMA is a state-wide trade organization that represents the coal, trona, bentonite and uranium industries. The WMA member companies employ over 9,000 people within Wyoming.

The WMA would like to comment on the proposed revisions to Appendix H, Agricultural Use Protection and associated language in Section 20 of Chapter 1. In general the WMA does not support these rules in the format they are written. For instance, many of the statements are very open ended and could be easily misinterpreted and very difficult to enforce in a uniform manner. We believe at a minimum the following issues must be addressed.

Within Appendix H, by limiting discharges that began after January 1st, 1997, would force many operations to recreate the water quality that did exist or to not degrade waters that are now superior to what they were in 1997. On many streams in the Powder River Basin (PRB), there was minimal baseline information collected prior to coal-bed methane (CBM) discharges beginning. For example, at Porcupine Creek in the southern PRB or other streams in the PRB, the surface water quality due to CBM is much better than it was prior to 2003. The discharges from CBM wells have washed the surface salts that previously existed on the floodplain altering alluvial water quality, (Murphree, 2007[1]). It would, therefore, not be possible in many cases to recreate the water quality existing prior to onset of the flow through the use of soil data. In addition, CBM flow also fills pools in normally ephemeral or intermittent stream channels and makes it more likely for runoff events to wash over the flood plain. It also doesn't take long for CBM or mine discharge to completely change the surface water quality, and in many cases, this is now better than it was prior to the onset of flow. Appendix H should, therefore, only apply to WYPDES discharge permits issued after 2006.

Further, the rule excludes discharges of "produced water" that began prior to January 1, 1997 in relation to the protection of agricultural uses. It is not clear if this only applies to produced water, as now stated,

---

[1] Murphree, P.A. 2007. Effect of Coalbed Methane Produced Water on Native and Reclaimed Stream Channels and Aquifers at Coal Mines in the Powder River Basin, Campbell County, Wyoming; Presentation to the 2007 National Meeting of the American Society of Mining and Reclamation, Gillette, WY, June 2-6, 2003. ASMR, Lexington, KY.

or if it also applies to runoff water, treated waste water or excess water. All of these events now occur at mining operations. To avoid confusion, the WMA recommends the following changes;

- "Effluent limits on discharges from locations with WYPDES discharge permits which were issued prior to January 1, 1997 will not be affected by this Appendix in relation to the protection of agricultural uses."

- Page H-1 the last sentence of the last paragraph, states that effluent limits on historic discharges may be made where the quality of the discharge is shown to constitute a hazard to humans, livestock or wildlife. Further clarification must be provided as to what constitutes a hazard if the rule is to be applied uniformly. In its current format the statement is far too subjective. In addition for a complaint to be considered regarding a discharge that has occurred for at least 10 years, the complainant should be required to provide proof of reduced agricultural production before the complaint is given any credibility.

- Page H-2 requires that discharges must meet TDS, sulfate and chloride standards under the Livestock Quality Standards. Following significant precipitation events, mines are required to discharge water from required sediment control reservoirs in order to maintain the permitted reservoir storage volume. Discharges due to significant precipitation event (10 year-24 hour) should be exempt from sampling under the livestock quality standards as these discharges will make up a small portion of the total runoff volume following a precipitation event. Additionally, the bulk of the water in the ponds is typically precipitation related water and not produced water.

In order to balance the needs of our State to derive the critical revenues from industries other than the agricultural industry, we believe the rules should be revised to allow a period when discharges can occur without having to meet the irrigation standards. During the winter months, discharges should be allowed since the ground is generally frozen. There should also be allowances in the rules for short periods when treatment systems are inadvertently not operating.

Other specific changes recommended are;

- Page H-3, Sections (c)(ii and iii): The statement that WYPDES effluent limits for EC and SAR will be applied in all instances where the produced water discharge may reach any artificially irrigated lands should be changed to state where produced water discharge may compose a significant portion of the irrigation water supply for naturally or artificially irrigated lands. To do otherwise would place unnecessary limits on dischargers when the discharge water would only reach irrigated areas in combination with runoff water or natural stream flow.

- Page H-3, Section (c)(vi)(A): Default limits are based on published soil EC tolerance values for the most sensitive crop. This is overly conservative, and should be instead based on the weighted average of the actual crops present.

- Page H-4, Section (c)(vi)(A)(I): The tier 1 standards are based on 100% crop yield. This is unrealistic and overly conservative. Crop yield should be based on actual historic yield.

- Page H-4, Section (c)(vi)(A)(II): Measurement of water quality should be allowed since EC and TDS can vary depending on the water type. Paragraph 2 of this section should be struck. This is unnecessarily conservative and overly burdensome on industry.

Wyoming Mining Association appreciates the consideration of the Wyoming Department of Environmental Quality, Water Quality Advisory Board's consideration of these comments. If you have any questions please feel free to contact us at (307)635-0331

Sincerely,

Matt Grant
Assistant Director
Wyoming Mining Association

Received
June 13, 2007
WQD Wyoming
DHW

June 13, 2007
Wyoming Department of Environmental Quality
Water and Waste Advisory Board
122 W. 25th St., Herschler Bldg., Room 1714
Cheyenne, WY 82002

Dear Chairman Cahn,

I offer the following comments on the Water and Waste Advisory Board's consideration of requested rulemaking by the WDEQ Water Quality Division, Chapter 1, Appendix H.
The WWAB should reject the request for rulemaking, specifically the Agricultural Use Protection Policy (AUPP) Appendix H revisions for the following reasons:

1. The WDEQ have not met the burden of proof by providing credible, peer reviewed scientific evidence for the default limits proposed, followed by public review.
2. The consequences to operators and landowners who desire the use of CBNG and/or other sources of produced water far outweigh any as yet unproven benefits by the proposed rule.
3. The WDEQ has repeatedly told legislators, landowners, operators and other regulatory bodies that the AUPP is a "policy" not a rule, with no consequences to those outside of the coalbed natural gas arena. In other words, the WDEQ has changed horses in mid-stream with no notice or opportunity for additional input.
4. Adopting the rule proposed by the WDEQ may provide a "feel-good" answer, but in the end will not alleviate future conflicts. One downstream landowner will have the power to dictate a watershed, depriving those who want the use of produced water.

Burden of proof
I have personally attended every hearing on the above-mentioned proposed rulemaking and have reviewed all of the information submitted by the WDEQ. Additionally, I have the benefit of having researched and written about CBNG production in the Powder River Basin for my own publication as well as others, both local and regional, for the better part of a decade. I have, in many cases, both first-hand knowledge of historic events and documents retrieved from public information and testimony that led to the discussion and Section 20 revisions.
The evidence relied upon by the WDEQ provides little in the way of standard scientific data collection and robust review by a team of qualified scientists. The WDEQ has chosen instead to base the AUPP on what has been termed "erring on the side of conservatism." The WDEQ should be held to the highest standard of proof and accountability.

Unintended consequences
By now, the WWAB and EQC has heard testimony from scores of landowners both in and out of the Powder River Basin who have been or are using produced water in their agricultural operations to their benefit. A statewide rule with general applications will not fit the majority of landowners, and will deny adjudicated water rights to those who depend upon produced water for their operations.
Producers given "default limits" in the permit for EC and SAR that CBM produced water typically cannot meet, unless the Producer is willing and can convince the landowner that all reservoirs they discharge into would contain <u>all of the produced water</u> and <u>all of the 50 year/ 24 hour flood event</u>. Or the producer can conduct extensive downstream soil and vegetation and water quality "Section 20" work to essentially prove to WYDEQ that the limits they set in the default are too conservative. WY DEQ has stated that they know the default limits are very conservative. The operator has to do this even if they are never going to see reservoirs overtop except during rain or snow melt events. For example, a reservoir receives CBM discharge 12 stream miles above a location that has either permitted or non-permitted irrigation or someone (anyone) has said that there is a location where natural irrigation (say of alfalfa) is occurring. The water has conductivity of 1800 and has an SAR of 12. The reservoir never overtops during dry conditions but might during rain events. Water from this reservoir never leaves the upstream ranch. The reservoir

drains about a square mile of drainage and was put in by a previous landowner back in the 1930s. The CBM company permitted it and brought it up to current standards when the present landowner agreed to its use for CBM. The permit would renew (or be issued) with an SAR limit at end of pipe of ~6.5 – 7.5 and an EC of ~1330. The produced water can't meet the limits. The reservoir cannot be designed to contain the 50y/24hr flood event plus the produced water. The result is that the landowner cannot utilize the produced water going into that reservoir. As one rancher, David Flitner of Shell Wyoming, observed, the results of adopting the proposed rules to the agricultural community will create chaos. Surely there is a better answer.

Public input

The changes and various modifications to the AUPP have been difficult for the public to follow. The request for rulemaking as reported in mainstream media and in public meetings has been confusing and contradictory. The EQC must carefully consider how the proposed rule will play out in other scenarios and in other Basins, and must notice the rule with the appropriate period of review and discussion.

Providing real solutions

If the goal of the WWAB and EQC is to provide solutions rather than a feel-good political compromise, one answer might to lie with mediation for the minority of landowners who say they are affected. The state has a duty to protect the rights of those to enjoy the benefits of produced water, without the fruitless efforts of rulemaking that will surely be overturned later. Operators have been willing and able to seek communication and solutions for affected landowners, but have been rebuffed. A mediation program could mean a new start in crafting solutions that are beneficial for everyone involved, providing the parties approach the issue from the standpoint of honest cooperation and a desire to see the conflicts resolved.

Sincerely,

Geraldine Minick
Publisher
Rocky Mountain Energy Reporter
PO Box 1510
Casper, WY 82601

TESTIMONY – JUNE 15, 2007

PAW & Member Companies

Waste & Water Advisory Board Meeting

CHAPTER 1 WATER QUALITY RULES AND REGULATIONS

Resubmitted by

PETROLEUM ASSOCIATION OF WYOMING

August 26, 2008

again.

This is a good example -- I guess I will try and not put words in your mouth. See if you agree with me - of site-specific situation. It is not necessarily going to be the same throughout the Powder River Basin. It is not going to be the same throughout the state. This is a perfect example of -- in my interpretation of why you have difficulty with an encompassing rule that tries to fit everyone. Is that -- am I putting words in your mouth?

MR. BRUG: You're right on. And there's a lot of people that have discharge on them maybe don't have the same interest in it as I do. And since I'm going to be irrigating with it I watch it really closely because what comes out of the discharge point isn't necessarily what I pump out on my land. And that's the reason I'm taking samples out of the reservoir, so I know what I've got when I use it. And it is very site specific, you know. And sometimes these rules that are brought down on us and regulations don't fit.

MR. WELLES: Well, we thank you very much. These are very illuminating and appreciate your time.

MR. BRUG: Thank you.

CHAIRMAN SUGANO: Yes, next. Go ahead.

MR. GRANT: Good morning, Mr. Chairman, members of the committee. My name is Matt Grant with the

Wyoming Mining Association. I submitted these comments to the DEQ on Wednesday of this week. I don't know if you reviewed them. I have general comments and then I have specific comments.

Specific changes, I can read all of them or I can just read the general comments and you can review the specific changes if you would like. I'm with the Wyoming Mining Association. We represent coal, trona, bentonite and uranium industries in the state. Our members employ over 9,000 people in the state of Wyoming.

We would like to comment today on the Appendix H, Section 20, Chapter 1. In general the WMA does not support these rules in the format that they are written. For instance, many of the statements are very open-ended and could easily be misinterpreted and are very difficult to enforce in a uniform manner.

We believe that a minimum the following issues should be addressed: Limiting discharge to after - setting a date of January 1st, 1997 and taking those - the water back to a level of that in the Powder River Basin would many times degrade the water as it is today. The CBM flows have improved the water quality. At the mines we generally use most of the water we produce on haul roads. We discharge very little. But there could be times we would have to discharge water and it would be of

a higher standard than the quality of water from 1997.
And also the irrigation -- agriculture is very important to the state, but we feel irrigation only occurs for maybe three months out of the year and we don't see why that standard should have to be met for the whole year on the irrigation standard.
I have referenced Phil Murphy here on the bottom of the first page. He's with me today. If you have specific questions, he and I could sure answer those questions. If not, I don't need to read my comments, I don't think, on the specific changes. They can be submitted into the record. I have about ten copies. I have extra copies here for other people to review. If not, I would accept any other questions.
CHAIRMAN SUGANO: Mr. Grant, maybe it would be good if you could highlight the bullet points that you have on the bottom of the second page.
MS. CAHN: I think everybody needs to understand that none of us on the Board have seen any of the comments that were submitted this go-around, so - including ones that were submitted you know as far back as -- we just got the Petroleum Association of Wyoming that were submitted June 8th, but they weren't given to us. So we're sitting up here -- if you want us to take into consideration your public comments that you have

submitted to DEQ for this reading or for this hearing, you need to let us -- you need to say what they are.

MR. GRANT: Okay. All right. I can just start here on the first page. It is kind of going to repeat what I have already said.

The discharges from CBM wells have washed away the surface salts that previously existed in the floodplain altering alluvial water quality, and that's reference to Phil Murphy on the bottom. It would, therefore, not be possible to recreate the water quality existing prior to the onset of flow through the use of soil data.

In addition, coalbed methane flows also fill pools in normally ephemeral or intermittent stream channels and makes it more likely for runoff events to wash over the floodplain.

It also doesn't take long for CBM or mine discharges to completely change the surface water quality, and in many cases this is not better than it was prior to the onset of the flow. Appendix H, therefore, only applied to the Wyoming NPDES, the WYPDES permits issued after 2006.

Further, the rule excludes discharges of the produced water that began prior to January 1st, 1997 in relation to the production -- protection of agriculture uses. It is not clear if this only applies to produced water as now stated or if it applies to runoff water, treated wastewater or excess water. All of these events now occur at mining operations.

To avoid confusion, the WMA recommends the following changes. The first bullet point: Effluent limits on discharges from locations within the WYPDES discharge permits which were issued prior to '97 will not be affected by this appendix in relation to the protection of agriculture uses.

Page H-1, the last sentence of the last paragraph, states that effluent limits on historic discharges may be made where the quality of discharge is shown to constitute a hazard to humans, livestock or wildlife. Further clarification must be provided as to what constitutes a hazard if the rule is to be applied uniformly.

In its current format, the statement is so -- is far too subjective. In addition, for a complaint to be considered regarding a discharge that has occurred for at least ten years, the complainant should be required to provide proof of reduced agricultural production before the complaint is given any credibility.

Page H-2 requires that discharge must meet TDS, total dissolved solids, sulfate and chloride standards under the livestock quality standard. Following the significant precipitation events mines are required to discharge waters from required sediment control reservoirs in order to maintain the current permitted reservoir storage volume.

Discharge is due to significant precipitation events. 10-year, 24-hour event should be exempt from sampling under the livestock quality standards as these discharges will make up a small portion of the total runoff volume following a precipitation event.

Additionally the bulk of the water in the ponds is typically precipitation-related water, not produced water.

In order to balance the needs of our state to derive the critical revenues from industry and other agricultural -- from industries other than the agriculture industry, we believe that the rule should allow -- be revised to allow a period when discharges can occur without having to meet the irrigation standards.

During the winter months discharges should be allowed since the ground is generally frozen. There should also be allowances in the rules for short periods when treatment systems are inadvertently not operating.

Other specific changes recommended, page H-3, Sections (c)(ii) and (iii), the statement that the WYPDES effluent limits for EC and SAR will be applied in all instances where the produced water discharge may reach artificially irrigated lands should be changed to state the produced water discharged may compose a significant portion of the irrigated water supply for naturally or artificially irrigated lands. To do otherwise would place unnecessary limits on discharges when the discharged water would only reach irrigated areas in combination with runoff water or natural stream flow.

Page H-3, Section (c)(vi)(A), default limits are based on published soil EC tolerance values for the most sensitive crop. This is overly conservative and should be instead based on the weighted average of the actual crops present.

Page H-4, Section (c)(vi)(A)(I), the Tier 1 standards are based on a hundred percent crop yield. This is unrealistic and overly conservative. Crop yields should be based on actual historic yields.

Page H-4, Section (c)(vi)(A)(II), measurement of water quality should be allowed since EC and TDS can vary depending on water type.

Paragraph 2 of this section should be struck. This is unnecessarily conservative and overly burdensome on industry.

The Wyoming Mining Association appreciates the consideration of the Wyoming Department of Environmental

Quality, Water Quality Advisory Board of these comments.
If you have any questions, please feel free to contact us.
Thank you.

CHAIRMAN SUGANO: Thank you, sir.
Does the Board have any questions, comments? We thank you for your comments.
Is there anyone else that wants to approach?

MS. VELASQUEZ: My name is Melissa Velasquez, Marathon Oil Company, Pennaco Energy.
Do you all have a copy of these in front of you?

CHAIRMAN SUGANO: No, we don't have anything.

MS. VELASQUEZ: We just submitted these yesterday. I will be sure to get copies of it to you. We submitted them to Mr. Waterstreet.
Marathon Oil Company submits the following comments to the Water and Waste Advisory Board, or WWAB, or the board, on the revisions to Appendix H, agricultural use protection, for adoption by the Department of Environmental Quality, DEQ.
Please include these comments in the record of the WWAB's consideration of the proposed rule. And as I said, we will provide a copy to the Board members.
Marathon concurs in the comments submitted by Williams Production/RMT Company in this matter on

June 12th, 2007. Marathon would like to make two additional comments and recommendations for WWAB's consideration.

1, default effluent limits for EC and SAR under Tier 1 should be the same limits the Board found appropriate barely four months ago, rather than the substantially lower limits DEQ is proposing;

And 2, all effluent limits in WYPDES permits that are intended to be protective of irrigation use under Tiers 1, 2 or 3 should be imposed at relevant irrigation compliance points, ICPs, as the Water Quality Division has done previously in many permits, rather than at end of pipe limits on discharges into reservoirs that do not themselves discharge except during precipitation events.

Regarding Tier 1 default limits, on February 5th, 2007, the Board recommended to DEQ that the Tier 1 default limits for EC and maximum SAR in the draft Section 20 policy should be respectively 2700 microsiemens per centimeter and 16. These limits were derived from expert opinions submitted to DEQ by Mr. Kevin Harvey in two letters in May 2006. Because Williams has attached Harvey's letters to its comments we will not burden the record with duplicates.

In one of the letters Mr. Harvey undertook an exhaustive survey of relevant literature and concluded that basing the default limits for EC on the soil EC levels corresponding to 100 percent yield potential values for alfalfa reported by the USDA Agricultural Research Service, the ARS, the salt tolerance database would be scientifically unjustified.

Mr. Harvey advised DEQ that the ARS data were based on research in California that used soil, plant and environmental conditions. As a result, the California data are not reliable as a guide for evaluating the effects of EC on irrigated alfalfa in Wyoming where each of those conditions is different.

Based on other research on salt tolerance of alfalfa in the northern Great Plains on and analysis of historical yields in Wyoming, Mr. Harvey recommended that the default limit for EC in water that is actually applied for irrigation in the Powder River Basin should be not less than 2700 microsiemens per centimeter.

In his second letter, Mr. Harvey explained why an SAR cap of 16 rather than 10 would be fully protective of soil structures in the Powder River Basin. Mr. Harvey described the empirical relationship between exchangeable sodium percentage, ESP, and SAR in a large number of samples of soils in floodplains in northeastern Wyoming and found that the critical ESP threshold of 15 percent above which clay swelling and dispersion occur would not be exceeded in these soils at SAR values below 26. Mr. Harvey recommended a cap of 16 rather than 26 as a highly conservative standard that would yield ESP values that would not exceed even 10 percent. Marathon respectfully refers WWAB to Mr. Harvey's May 4th, 2006 submissions and incorporates them in these comments. Mr. Harvey's findings were consistent with research at Bridger Plant Materials Center on plant salinity tolerances and the effects of sodicity on soils in Montana. Barely four months ago, WWAB agreed that Mr. Harvey's recommended EC limit in irrigation water of 2700 microsemens per centimeter as protective of alfalfa was scientifically well founded. The Board also concluded that the Bridger data suggestive of a default SAR of 16 are more reliable because the soil samples used in the Bridger study more closely approximate the soil conditions in Wyoming. Indeed, DEQ incorporated these numerical limits as the default limits in the proposed rule it submitted to the Board and subsequently to the EQC. The DEQ has not presented any new or different scientific information that was not available in February and that would now justify a departure from the numerical limits this Board adopted a few months ago. Accordingly, Marathon respectfully submits that WWAB should reject the proposed Section 20 agricultural use rule unless the default limits under Tier 1 are adjusted to conform with the limits the Board so recently found to be protective of crops and soils in Wyoming.

Regarding end-of-pipe effluent limitations on impounded discharges, effluent limits on EC and SAR are important only at the nearest upstream location where irrigation occurs and only after intervening mixing, dilution or other processes affecting water chemistry. DEQ is currently writing many WYPDES permits and renewals for CBM discharges with terms and conditions that preclude direct discharges. These permits instead require discharges to be impounded in an on-channel reservoir and allow only precipitation induced discharges under specified conditions; i.e., overtopping for a limited period of time.

This means that even if it is assumed that the Tier 1 default limit of 1330 EC and associated SAR limit of 7.5 under the Hanson formula were reasonably related to protecting irrigated crops and soil characteristics at those locations where water is actually applied to land or natural irrigation occurs, imposition of those limits on impounded discharges is unreasonably conservative. Any discharge of impounded water will occur only because enough precipitation falls on or runs into the on-channel reservoir to fill it up and then displaces water out of it. All such precipitation will necessarily mix with and dilute the impounded water and such dilution will be even more substantial if significant freeboard were present before the precipitation event.

DEQ's prior approach to WYPDES permits for CBM discharges before WQD began applying the policy version of the proposed agricultural use protection rule routinely included effluent limits applicable only at irrigation compliance points.

In Marathon's experience, monitoring at these ICPs has been an effective tool for protecting water quality at locations where discharged water may be actually diverted for irrigation.

DEQ has not demonstrated why this approach is not fully protective of the Section 20 narrative standard.

The proposed rules imposition of end-of-pipe limits on discharges into impoundments rather than at appropriate ICPs is not consistent with WDEQ's duty under the environmental law, Wyoming Statute 35-11-302(a)(vi).

The statute directs WDEQ to consider when issuing a discharge permit all the facts and circumstances bearing upon the reasonableness of the pollution involved, including, A, the character and degree of injury to or interference with the health and well-being of the people, animals, wildlife, aquatic life and plant life affected; B, the social and economic value of the source of pollution; C, the priority of location in the area involved; D, the technical practicability and economic reasonableness of reducing or eliminating the source of pollution; And E, the effect upon the environment. Wyoming Statute 35-11-302(a)(vi) applying this balancing test it makes little sense to require CBM-produced water discharges that flow into impoundments to meet the Tier 1, 2 or 3 standards for EC and SAR that would be protective of downstream irrigated crops and soils, produced water discharges into on-channel reservoirs, as distinct from outflows that reach irrigation diversions and have no adverse impact on the health or well-being of people, animals, wildlife, aquatic life or plant life. And the other side of the statutory equation, the treatment that would be required for most CBM discharges to meet and in many cases even appropriate Tier 2 or Tier 3 limits, let alone Tier 1 limits at end of pipe is technically unproven and prohibitively costly. Requiring end-of-pipe compliance with irrigation protective EC and SAR standards would impose a huge burden on the production of economically and socially valuable energy resources in Wyoming and is not rationally related to the protection of irrigation.

In view of DEQ's failure to apply the five-part balancing test in Section 35-11-302(a), when deciding whether to impose end-of-pipe limits the Board should reject the proposed rule. Respectfully submitted, David T. Hill and, myself, Melissa Velazquez.

CHAIRMAN SUGANO: Thank you, Melissa.

Any questions, comments from the Board?

CHAIRMAN SUGANO: Just as a point of clarification, the DEQ has not submitted new information on the EC or SAR. They have just gone back to the USDA information that was submitted early on and they more or less overruled the Board on the higher limits. They have gone back to the USDA.

MS. VELASQUEZ: Thank you.

CHAIRMAN SUGANO: Any other members of the public that wish to come forward?

Yes, ma'am.

MS. LERESCHE: Good morning, citizens. My name is Carol LeResche and I have a farm on Clear Creek. Clear Creek is a tributary of the Powder River. I'm here today to tell you about how I came to the conclusion of usually here and they are just unable to attend. I like to see them come and represent themselves, but it is just the spring of the year and that's hard to do. Thank you for your time.

CHAIRMAN SUGANO: Joanne, where exactly is your geographic area?

MS. TWEEDY: My geographic area, I live approximately as a crow flies 20 miles south-southwest from Gillette. Tom Harriet is up by Buffalo, Powder River, if you will. Knudsen, Powder River. Faye Mackey would be in the Gillette area. Harris has a large ranch north of Gillette. Gene Litton has a large ranch south of Wright, Wyoming. Joel Ohman is about 30 miles south of Gillette and his land runs all the way over to Highway 59.

CHAIRMAN SUGANO: Great, that helps. Thank you very much. Questions or comments? Thank you, Joanne. Anyone else that would like to come forward?

MR. PALMA: Good morning, members of the Board. My name is Jack Palma. I'm an attorney in Cheyenne. I represent Williams Production Company/RMT and I appreciate the opportunity to present some testimony this morning which is basically to highlight the written comments that we provided and filed with the DEQ earlier this week. I am glad to hear that it is not going to be redundant, and I appreciate Miss Cahn's mention of the fact that, in fact, you have not received those copies of the written comments and have not had time to read them.

What I have handed out is really just a basic outline of the comments I want to address this morning. I think we want to take the opportunity to also on behalf of Williams thank both the DEQ and this Board for its hard work over a long period of time to try to get this right. And I think we're getting closer.

I understand that the attempt is, again, to provide guidance to the DEQ and to the regulated community with regard to the implementation of those standards in Chapter 1, Section 20, regarding agricultural use protection. Agricultural use protection is important to everyone in this room, and we take it seriously.

And we share the DEQ's goals which are to provide a set of reasonable program regulations that can make Chapter 1, Section 20 work in the context of permit writing. Williams also seeks rules which can be applied consistently, fairly and practically. And I want to address my comments to those considerations this morning as well.

Within that set of goals we have suggested three areas of change for the Board's consideration which would protect and continue to protect agricultural uses but we think would increase the certainty, enforceability and the credible science behind the rules, and it would do it all within the existing framework of the rules.

We really have three issues that we want to address: The need for consistency in the application of the rules, historic discharges and the issue of reasonable access requirements.

And let me take the first, the consistency issue. We understand that in the interpretation of a narrative standard there needs to be flexibility, the opportunity for reasonable judgment and assumptions to be made by the permit writers and that the rules need to be flexible enough to account for site-specific conditions and circumstances.

But how that rule is interpreted is as important as the language of the rule itself. And the need for flexibility has to be balanced with a need for consistency and predictability.

In our experience over the years, oftentimes the way the rules have been interpreted vary from permit writer to permit writer, and so it is difficult oftentimes to understand given a certain -- same set of circumstances how we end up with a different result in permit writing.

One suggestion that we offer -- it is not really a rule change, but one that we offer and would certainly be willing to work with both this Board and the DEQ on is perhaps the use of fact sheets similar to those I think you might be familiar with in the Voluntary Remediation Program which has a set of fact sheets.

These could identify acceptable methodologies and protocols. They could answer the key questions regarding the rule, and they could explain the fundamental processes and the interpretations and requirements in the rule.

I think that that would go a long way toward providing certainty for the regulated community, for DEQ, and frankly, for those folks who want to make sure that the rules are working for them in protecting their agricultural uses.

So that's the first thing that I think we want to offer for the Board's consideration.

Let me turn next to the issue of historic discharges which I think others have spoken to. I think this Board understands, but I want to emphasize that these rules have the potential to impose significant costs, significant technical burdens on CBM operators and other dischargers. And so they should really only be imposed where they're absolutely necessary.

Under the DEQ-proposed language regarding historic discharges that is not the case. The DEQ proposal that you have before you exempts from the rule discharges which were permitted prior to January 1, 1997. There's absolutely no rationale offered, frankly, nor could there be. It is an arbitrary bright-line date. It is not based on science, and it clearly discriminates against CBM dischargers.

The Williams proposal -- and I have provided the language changes that we have suggested in a separate piece of paper for you -- would exempt discharges under valid existing permits which were issued prior to the date of this rule. And here is why: When a discharge permit is issued, it is presumed to be protective and it went - underwent public comment and then the discharge occurred and the proof is in the pudding. You have a record of historic discharge and the best evidence of whether that discharge is causing measurable decrease is just the record of history itself.

You just heard Miss Tweedy say there are beneficial uses being made of this water, CBM water. 200,000 acres of folks have lined up saying they want to be able to continue to use those -- that water. And what this rule would do by imposing the 1997 artificial deadline or cutoff is it would say that CBM discharges which have historically occurred, even where there's no demonstration of a measurable decrease in ag production as a result of those discharges, will have to meet a higher standard, even though both industry and you heard Miss Tweedy point out agriculture have invested money and have installed infrastructure based upon the use of that water under the permit limits that were in those valid and existing permits.

So with absolutely no rationale all of that water would be potentially cut off from beneficial use with no evidence to support or rationales as to why that should occur.

We think and our proposal points out that what should occur is that permits, CBM permits -- any valid existing permit should be renewed with the same permit limits. That goes out for public comment and the burden should be shifted to a landowner who is downstream who can come in and present evidence if there is evidence that that discharge has been causing a measurable decrease. And if that's the case, then certainly the permit can be reopened. It can actually always be reopened if there's a demonstration of impact.

So there's absolutely no reason to differentiate and discriminate between CBM discharges which have been historically occurring and other kinds of discharges.

If you do it the way DEQ suggests, it allows any one landowner who chooses not to sign up or for whatever reason is opposed to CBM discharges to come in and block the beneficial use of that water. And DEQ has suggested that, well, you can use the ag use waiver that is in this rule. But again, the ag use waiver is premised on the fact that every landowner in a drainage signs up and agrees to the use of that water. And you have folks on both sides of that issue that you've heard from. It is not fair to allow one landowner to hold a stream hostage unless they can come forth with evidence that the water is causing an impact. And if they don't, why should the permit limits be raised beyond those that have historically allowed that water to be used.

Let me turn next to the issue of reasonable access requirements. Williams has suggested changes to two sections of the rule, and it is a recognition of two important points. The first is that the permit applicant bears the burden of proving no measurable decrease. And the second is that we all agree that the site-specific data is the best data to use in the permit process.

And the best data to use in order to protect the downstream landowners, which is what this policy -- excuse me -- rule now is intended to do.

So with that in mind, we suggest two changes.

The first occurs in the provisions of -- relating to naturally irrigated lands. And it would require a landowner to provide the permit applicant with reasonable access to the lands that a downstream landowner claims are naturally irrigated.

That doesn't exist right now. And the point is it recognizes, again, that the site-specific data that that landowner has is going to be the most credible, reasonable data to rely on. And since the permit applicant bears the burden of proving that its discharge is not going to cause a measurable decrease to those lands, then the permit applicant needs access to that data, access to those lands to do data sampling and data collection in order to meet his burden.

Similarly on Tiers 2 and 3 at the tail end of the rule, in view of that applicant's burden of proof, we suggest that a landowner be required to provide access to an applicant to collect that soil and/or water quality data and to recognize -- and to recognize in the rule that if the landowner denies access to that permit applicant, then the permit applicant can use the best data available in order to meet its burden of proof that its discharge will not cause a measurable decrease.

If you don't adopt this proposal, you leave the applicant in -- at a point where it is trying to prove a negative, trying to prove no measurable decrease without access to the lands, to the site-specific data by which to prove that. And it penalizes the permit applicant for the landowner's lack of cooperation. And let's face it, this process requires cooperation by all parties. And if the landowner isn't willing to cooperate to allow you to collect the best data, then I don't think the permit applicant should be penalized.

And under the current DEQ proposal the applicant doesn't have the ability to get on those lands and collect that data. And again, let's keep in mind, the whole purpose of this process, the whole purpose of the applicant's burden of proof, is to assure that the landowners' agricultural use is protected. And you can't do that without site-specific information and without access to that.

So in closing I want to thank you for your indulgence. I know you've heard from a lot of people over a lot of years about these issues. We have three modest rule changes that we have provided and handed out to you. We respectfully hope that you will consider them and revise the DEQ proposal before you -- to add those into your rule.

Thank you for your time and I would be happy to answer any questions if you have them.

CHAIRMAN SUGANO: Thank you, Jack.

Questions, comments?

MS. CAHN: I'm just a little confused on the three suggestions. I have got the two that you've got in here -

MR. PALMA: Well, they're actually three places. There's the historic discharge change which would, again, protect all valid existing permits, exempt them from the rule.

There are two rule changes with respect to reasonable access, one in the naturally irrigated lands provision which would say that if a landowner comes forward and says, "I have naturally irrigated lands," that that landowner allow access to the permit applicant to do the sampling to corroborate that claim; and then the third one is a rule change relating to reasonable access essentially under Tiers 2 and 3 at the tail end.

MR. OLSON: Mr. Chairman, there's a letter and then there's also a marked-up version of the rule that I don't think we got. All we got, I think, was the one page that said there's more information that accompanied that single page.

So Lorie, I think if you had the whole thing you would probably be better able to understand the insertions and/or deletions that would be requested.

MR. PALMA: I do apologize. I thought

that you would have the permit -- excuse me -- the written submittal. Our written submittal does have the actual change in the context of the rules. I should have brought that along with me as well.

MR. OLSON: It wasn't submitted until June 12th. So the entire package wasn't included in what was given to us.

CHAIRMAN SUGANO: Thank you.

It is 10:00 and I think the Board will take a break now, and we will reconvene in about 15 minutes.

(Recess taken 10:00 a.m. until 10:20 a.m.)

CHAIRMAN SUGANO: Ladies and gentlemen, we need to reconvene. Take your seats.

We will reconvene at 10:22.

The court reporter has just talked to me, and she asks if you come forward to speak would you spell your last name. We need to have that information. We thought we would have a sign-up sheet that she could work from, but since there is no sign-up sheet, we will ask everyone to spell your names. If you have handouts for the Board, she would also appreciate copies of your handouts so she could work from those.

And John Wagner, there was a Joanne that came in and talked about the 200,000 acres that were represented. She named some of the -- her neighbors. Do you have a list of those people?

I see Joanne is still there. Could we have a copy of those for the court reporter?

MS. TWEEDY: I will have to write them down.

CHAIRMAN SUGANO: If you would.

Also, John, the court reporter was wondering, do you have a contact person in your office that she could work with?

MR. WAGNER: Work with David Waterstreet, please.

CHAIRMAN SUGANO: Thank you.

And then looking out at the audience, I see some different faces that we haven't heard from. Could we have a show of hands of people that would like to speak before now and noon? Very good.

All right, we will reopen the public hearing and ask for the next person to come forward, whoever that wants to be.

Sir, if you want to come forward, that's fine.

MR. BURRON: Thank you, Mr. Chairman. My name is Keith Burron, B U R R O N. I'm an attorney in Cheyenne and I'm here today representing PetroCanada Resources USA. We have commented extensively in the past on the Section 20 policy -- now rule.

I guess what I'm going to do today is be very brief and tell you that in general PetroCanada concurs with the information that Williams has submitted and what Mr. Palma just went through. I would add to that a couple clarifying points and point -- maybe point to a couple particular provisions of the document to draw your attention to.

First, with regard to the issue of historic discharges -- I have looked at the Williams submittal and if I can direct you to page H-1 of the DEQ draft.

MS. CAHN: We do not have a copy of the Williams submittal.

MR. BURRON: Do you have a copy of the DEQ proposed or the DEQ Section 20 document? The very last paragraph of that document is the provision that deals with historic discharges and references the January 1st, 1997 date. If you can find that on the very last paragraph on H-1, starting -- the sentence starting with "Effluent limits on discharges of produced water that began prior to..."

MR. OLSON: Just to clarify, last paragraph, page H-1 of Appendix H?

MR. BURRON: Correct.

What Williams has proposed there is to strike "prior to January 1, 1997," and insert "pursuant to a valid and existing permit issued prior to the date of the adoption of Appendix H," and PetroCanada would concur with that.

We would also suggest if you go down three lines where the reference is made to "at least ten years," to insert the same phrase that Williams has proposed there which would be "pursuant to a valid and existing permit."

On the historic discharge issue, I think Mr. Palma did a good job outlining the rationale for not going with an arbitrary ten-year limit or, I guess, a limit of any set number of years. If there is an existing permit in place, presumably it has gone through the public process, through public comment, and those limits would be presumptively protective.

There are instances where an operator may come in on a renewal and want to go from a default limit in their existing permit to a Tier 2 or Tier 3 limit, and in that case the burden falls on the discharger to make that case and make that demonstration.

It is just as fair to require somebody coming in to challenge an existing permit and argue for more stringent limits to have to demonstrate, to put the burden on the person protesting it to demonstrate those limits which have already gone through the public process are not protected.

I would urge the Board in terms of any recommendation, you might have to not propose a set number of years. DEQ has proposed ten years. You know, typical WYPDES permit is issued for five years. Because of the watershed permitting process there are a number of permits that have been issued for less than five years in anticipation of the fact that the watershed process is going to begin sooner than the five-year process.

So what PetroCanada would propose is just to make that if there's an existing permit that's being renewed, then those are the presumptive limits.

The other comment that I would like to address is on page H-2 of the document, and it is the definition of naturally irrigated land. And with regard to that definition, there was extensive testimony in front of the Environmental Quality Council on the definition of naturally irrigated land. This is at the top of page H-3 of the DEQ version.

In terms of establishing how do you determine what is naturally irrigated land, there's heavy reliance placed on evaluation of infrared photography. And we do not believe that's an appropriate way to assess naturally irrigated land or you know irrigation.

And Hugh Lowham who was with the USGS in northeastern Wyoming for 31 years provided extensive testimony on this at the EQC hearing in February. He pointed particular attention at the provision calling for use of infrared photography to determine naturally irrigated land, said that was very problematic because that doesn't correlate very well with what is truly naturally irrigated land along some of these bottomlands and ephemeral drainages. In fact, he indicated that the color infrared photography is often the same information that's used in wetland mapping.

So on page H-3 where it refers to "naturally irrigated lands may be identified by an evaluation of infrared aerial imagery, surficial geologic maps, wetland mapping, landowner testimony or any combination of that information," essentially the infrared aerial imagery, the wetland mapping are probably going to use that same database.

What PetroCanada would argue for is some other criteria, some other scientifically defensible criteria, also being available. Certainly that information can be referenced, but shouldn't be determinative. So I think a change in that section is warranted to basically leave open the alternative addressing what is naturally irrigated lands through scientifically defensible methods, not necessarily limited to what is listed in the section right there currently.

With that I'm finished unless anyone has any questions and would just again reiterate that, you know, Williams has taken a very soft hand to the DEQ version, but it does make some changes that are very critical and important from the CBM industry's perspective. I would urge you to give those strong consideration. Thank you.

CHAIRMAN SUGANO: Thank you. Questions, comments.

MR. OLSON: Mr. -- sorry, go ahead.

MR. WELLES: Go ahead.

MR. OLSON: Mr. Burron, with respect to your comment on paragraph (B), Naturally Irrigated Lands, your suggestion that you made to the last sentence, could it read something like this: Naturally irrigated lands may be identified by defensible scientific means that may include but may not necessarily be limited to...," and then we can go on with all of the things that were listed there? Would that be one of the ways that you would suggest that language?

MR. BURRON: Mr. Chairman, I think that would go a long way to resolving that issue. The concern is principally that as the sentence is currently constructed, it appears that that is the universe of information that can be considered, and there is certainly other scientific information that would make that determination. So yes, that would resolve it.

MR. WELLES: Mr. Burron, I had one further clarification. Your last statement that Williams used a soft approach, could you elaborate?

MR. BURRON: Well, I can, Mr. Chairman. This draft, obviously you have seen it many times in various forms through the last few years. We are up to six or seven drafts on this now. From PetroCanada's perspective we have commented at length on a number of issues related to this policy or rule, and, quite frankly, we've still got concerns about implementation. And that's why I think the fact sheet idea that Williams has proposed is a good one because it does provide or would provide some criteria that would be consistent from permit writer to permit writer. But when I say that Williams has used kind of a soft hand with this, I think you look at three very narrow changes that have been made that would make this policy - assuming interpretations of the policy are consistent with, I guess, some of the permit-writing practices that have been employed over the last couple of years, that this would be a workable document as opposed to, you know, making wholesale changes and starting all over.

MR. WELLES: You used the word "policy."

MR. BURRON: I did use the word policy,

recognizing that.
MR. WELLES: Is that what you meant?
MR. BURRON: That's a good question.
MR. WELLES: Do you have an answer?
MR. BURRON: My -
MR. WELLES: Seriously, I think that's an important point.
MR. BURRON: I agree with you. My sense is we have urged in the past that this be a policy and I think that is still maybe the better way to implement this, basically because we're implementing Section 20 of the regulations. And if we're writing another rule to implement a rule, then, you know, we're really rewriting the rule.
So I think it can work in either form as long as the interpretation has enough flexibility to accomplish, I guess, the range of or the spectrum of what we see in different permitting contexts.
MR. WELLES: Thank you.
CHAIRMAN SUGANO: Thank you, Mr. Burron.
MR. BURRON: Thank you.
CHAIRMAN SUGANO: Do we have someone else that would like to come forward?
Yes, ma'am.
MS. YETTER: Good morning, Mr. Chairman,

natural runoff, and coalbed methane produced water.

MR. JELLIS: Yes, sir.

MR. WELLES: And do you have just a ballpark figure as to what percentages?

MR. JELLIS: Somewhere our mixing ratio, what we had our engineers look at it, it is going to be somewhere between 8 to 10 to 1. It is going to be pretty light.

MR. WELLES: The 1 being the produced water?

MR. JELLIS: 1 being the produced water.

MR. WELLES: Great. Thank you.

MR. JELLIS: You're welcome. Thank you.

CHAIRMAN SUGANO: Thank you, Rich.

Next.

MS. SABEC: Mr. Chairman and members of the Board, my name is Margo Sabec. I represent Devon Energy today.

I want to talk about a few things that haven't been mentioned or discussed in detail yet this morning. But these issues and many other issues have been discussed and developed and commented on at great length in the record on the Section 20 policy/rule in its many iterations.

The reason the record related to Section 20, I believe, is still relevant is because the rule that is before you today is really very similar to the policy that was before you when we met last time to discuss this issue. In fact, I think that's one of the problems that we all face as we try to decide what comments are appropriate today and are not just repeating things that we have said many times before in the previous hearings. So I do encourage you to look at that record and refresh your memories and look and learn some of the comments that were made before. As you can see by the audience today, there are many fewer people than you have seen at prior hearings, and it is in part because what you have before you is what some people would say the same old thing. And they have made their comments and they would have an expectation that you have taken notice of the comments that were made because they're still relevant to this draft.

We're concerned that the current draft that is before you does not meet the parameters and the requirements that the EQC gave the DEQ in their remand order. The EQC directed DEQ to remove the livestock and wildlife watering issues from this policy or rule and start from scratch to write a rule that's limited to the protection of irrigation and agricultural lands.

Specifically, the council directed the

Department to develop more good science that would support this rule and clarify their definition of historical use, clarify what irrigation is and is not, and clarify the default limits for irrigation.

Again, I think one of the reasons that it is difficult to comment is we're really looking at slight revisions to the same concept that was proposed to you before. They started with that policy and they have made a few modifications, but not very many. And the clarifications we believe don't clarify, they just add new layers of uncertainty about how -- what they mean and how they would be applied.

So we would encourage the Board today to send the rule back to DEQ asking them to specifically comply with the order from the EQC before they bring another proposed policy or rule back to you.

I think the most basic question that needs to be answered today is whether the DEQ has done an adequate job of considering what we call the balancing criteria before they recommend and propose this rule.

The Wyoming legislature recognized when the Environmental Quality Act was passed that any rule or policy having the scope of being statewide and having considerable intended and possibly unintended consequences should be put through a reasonableness test, and that test

would balance the interests and values that are at stake.
And in my many years of work in these areas, I have never seen an issue like this one that involved so many diverse interests, so many diverse stakeholders and so much value at stake.
In representing industry we tend to be -- it is sometimes assumed that we don't care about agriculture and that couldn't be more true (sic). Companies work with landowners every day. They have agreements with landowners. They are charged with, they have a duty to operate with due diligence and taking care of the lands on which they operate.
In this case, however, I think the DEQ has been remiss in actually gathering and identifying all of the potential interests, social and economic interests that are at stake. I believe that they should have reported to you in great detail how this rule would affect those balancing criteria identified by the legislature.
For example, the first balancing criteria is that it should be evaluated and identified if this rule would affect the character and degree of injury to or interference with the health and well-being of the people, animals, wildlife, aquatic life and plant life affected.
Now, that's a tall order. But I don't believe it is adequate for the Department to just tell you

anecdotally that they considered those impacts. I believe the legislature intended them to actually consider, identify and evaluate those impacts. And the impacts are quite varied because in any case where you have an environmental investigation that has the potential of taking stock water off the surface of the lands in Wyoming, there are certainly grave interests in the state, both on the agriculture side and also on the side of industry.

For example, DEQ has not considered or identified, even, what the impacts to wildlife would be if the stock water is removed from the landscape. And there will be considerable impacts to wildlife. This water provides habitat for wildlife. It supports and sustains wildlife populations, including endangered species. And removing the water from the landscape creates, in my opinion, a greater harm than having the water there as it is today.

The DEQ should have identified and evaluated the economic viability of ranching operations without this water and also the economic impacts to industry, to mineral owners and the various stakeholders who have a very significant interest at stake in this issue.

If you will recall, the Department of Agriculture gave some testimony previously identifying the number of water rights that landowners hold in produced water in the Powder River Basin alone. In 2006, about a year ago, that number was 13,741 stock water permits. 3,491 stock reservoir permits, and 61 irrigation permits, and those numbers have gone up since that time.

The landowners are benefiting from water pipelines, stock tanks, reservoirs. It allows the distribution of wildlife and livestock across the range, increasing productivity and decreasing overgrazing.

So when you consider taking water off the range, there are environmental impacts from that action as well. And I think those were things that the DEQ is charged by law of quantifying, evaluating and considering and making recommendations to you so that you have that information before you before you make the decisions.

The second balancing criteria is to consider and evaluate the social and economic value of the source of pollution. There is considerable data available that would give the advisory board an idea of the value of mineral production in these production areas and also to the counties and states -- counties and municipalities that receive mineral royalty and tax revenues.

Oil and gas production provides tremendous benefits to counties and I think that one of the balancing criteria that must be considered is any reduction or loss of those revenues and the impact that that would have in local communities, cities and towns -- and counties.

The third balancing criteria is to evaluate and consider the priority of location of the area involved. In this case this proposed rule will affect produced water discharges statewide, and there are people all across the state, as you have heard from in previous hearings, who have an interest at stake in this water production.

The fourth balancing criteria is -- would require the DEQ to evaluate and consider the technical practicability and economic reasonableness of reducing or eliminating the source of pollution. This goes to the question primarily in the Powder River Basin, what are those other alternatives for the water, can it be reinjected? I believe you've heard considerable testimony in the past that the subsurface geology does not make reinjection economically viable.

There are also costs, environmental costs related to using alternate methods of water management. Those issues should not just be considered, but they should be evaluated and reported on by the DEQ.

The fifth balancing criteria requires DEQ to evaluate and consider the effect upon the environment. I believe this particular criteria could be summarized as whether or not there is a net environmental benefit from providing stock water. A net environmental benefit assumes that there may be some environmental harm, but that harm is outweighed by the benefits to the environment.

And I do think that what is at stake here is stock water, water that's suitable for use by livestock and wildlife. The reason that water is at stake is because of the naturally irrigated lands provision in this proposed rule. It would require crop standards -- crop water quality standards for discharges, eliminating and disregarding the net environmental benefit of combining stock water in these tributaries where it could be made available.

So I believe that it is the responsibility of DEQ not to tell you they considered that, but to provide to you all of the data that they have looked at, all of the data that they have evaluated and considered to come before you with a rule that they represent as not only necessary but that produces environmental benefits and not environmental harm.

Since the last board hearing there have been several things that have happened that do have an impact, I believe, on the protection of naturally irrigated lands or bottomlands and the application of this rule.

One of those things is that the district court in Campbell County heard a case in which a landowner alleged damages for the loss of trees along an ephemeral stream channel and the Court found in that case that the State has a water course easement across private and governmental lands, all of those lands in this state, for the purpose of flowing and managing the waters of the state.

They found that -- the Court found that that easement includes waters that augment natural flows, whether those waters come from oil and gas development or otherwise. The surface estate is burdened by the State's easement to flow waters of the State and the Court found that the landowner does not have exclusive possession of that land. That land is subject to the State's easement, nor does the landowner have the rights to have its physical condition unchanged.

One of the things I think that has been such a struggle with Section 20 in its many iterations and as it went forward to the EQC is the tension of the jurisdictions of the state engineer and the Department of Environmental Quality as it relates to water. The Attorney General has issued several opinions in another rulemaking matter in which the Attorney General made it very clear that it is the State engineer's province and not the province of the DEQ to regulate water quantity.

But the DEQ and the state engineer have concurrent jurisdiction over water and I think the water course easement is where those two jurisdictions or areas of authority most rub up against one another and have the potential of conflict. The water course easement that is owned by the State applies not just to the channel but to the water course itself, and that easement is the property of the State and the water that flows through that channel is also the property of the State. It is not the property of the discharger once it enters that water course.

Now, looking a little bit at Wyoming law, you will see that Wyoming law defines and has for decades defined the preferred uses of water, and it establishes the order of preference for these preferred uses. So, in other words, the law says we have identified these five uses as being the highest valued uses of water in the state, and the highest preferred use of water is water for drinking purposes for both man and beast. That is the number one highest priority for water use in the state.

The surface discharge of groundwater that meets water quality standards for livestock and wildlife is a preferred use of that water under state law. I submit that neither the DEQ nor any individual landowner has the right to prevent the flow of drinking water for livestock and wildlife in the State's easement through and across downstream lands.

The DEQ's proposed rule defines irrigation as a substantial acreage of naturally subirrigated pasture within a stream floodplain. The stream floodplain is within the State's water course easement and, therefore, it is used for the flow of waters of the State.

The DEQ defines naturally irrigated lands as those along stream channels. Again, these lands are within and burdened by the State's easement as a water course and with the right to flow water.

Were that not the case, landowners whose land and improvements are damaged by floods would have valid claims for compensation from the State and they do not.

Were that not the case, landowners whose trees die because there is no stream flow for one reason or another, whether it is drought related or other water users taking water out of the stream for irrigation, would have a claim against the State for compensation because they have property within that floodplain, water course easement that is harmed by the flow of water.

The State takes the position that -- the state engineer's office takes the position that within that water course there are no damages owed to landowners for the flow of the State's water. And that was the case in the PG Ranch versus Devon Energy case that was tried in the district court this year.

I think the challenge here is what is subirrigation and is subirrigation protected by taking flows of livestock water out of the stream. That really is the crux of the issue, I believe.

The use of groundwater in subirrigation is opportunistic. It is not recognized as a beneficial use of water and there are no water rights issued for it. Even if the State did grant water rights for the water used -- underground water used for subirrigation, that would not be a preferred use of water and that use of water would not trump the number one highest priority use of water in the state, which is wildlife, livestock, drinking water.

We believe the State must recognize the State's water course easement and the DEQ must -- as an agency of the State must recognize it as well. And the DEQ must recognize that the highest preferred use of the state's water is drinking water for the state's livestock and wildlife. The use and management of the water course easement lies within the jurisdiction of the state engineer and the law expressly prohibits DEQ from taking any action which would limit or interfere with the state engineer's jurisdiction, duties and authority.

My concern and my client's concern is that in identifying lands within the floodplain which are clearly within the water course easement for protection from water that needs the highest preferred use of water in the state, which is livestock and wildlife drinking water, the DEQ has encroached upon the authority of the State engineer and is taking that action in defiance of the legislature's clear mandate that drinking water for man or beast is the highest use of water. The protection of subirrigated lands within that water course easement encroaches upon the rights of the State to flow water of the State and produced water when discharged and meeting livestock quality standards is water of the State.

So we would encourage the Board to delete from the proposed rule any references to subirrigated lands and floodplain, naturally irrigated lands along stream channels. We believe that is outside of the authority of DEQ.

I would be happy to answer any questions.

CHAIRMAN SUGANO: Questions.

Bill.

MR. WELLES: Margo, one question. There's always an exception to the rule, and that is what do you do with a situation like Kenny Clabaugh's ranch based on what you've just given us in your interpretation?

MS. SABEC: Mr. Chairman, I'm glad you

asked me that because I forgot to mention that in my comments. Thank you.

There is always -- there are always situations where the velocity of runoff water has been diminished by manmade improvements in the stream channel and the water course and/or just purely a lack of runoff. And the water -- and the channel within the water course easement can fill with sediment and debris and otherwise become obstructed so the flow of the State's water cannot make its way through that property. It actually acts as a dam and pushes the water up out into the floodplain.

In recognition of the State's water course easement and of the State's interest in preserving and maintaining that easement, the state engineer has proposed new legislation to the CBM water task force, and that proposal is limited in its current form to discharges of coalbed methane water from coalbed methane operations.

But this proposed language would say that discharges from CBM operations are limited to the channel carrying capacity of the channel within the water course. And where there is a circumstance that the channel bed and banks have become diminished for any reason, then the state engineer can order that channel to be cleaned and maintained.

Now, this draft is just the first stab at this by the state engineer's office, but I believe that that concept has the potential of resolving circumstances where there is no channel for one reason or another and would open up that channel, restore its carrying capacity and allow flows of produced water through those properties.

So that is, to my knowledge, the latest development in that arena that might address the problems on Mr. Claybaugh's property.

MR. WELLES: Thank you.

CHAIRMAN SUGANO: Thank you, Margo.

Do we have someone else that wants to approach?

MR. ROBITAILLE: Mr. Chairman, if it is all right, I will just give the court reporter my card because my name is a little complicated. I might be here a while if I had to spell it.

Thank you, Mr. Chairman. My name is John Robitaille. I represent the Petroleum Association of Wyoming. Briefly, I would like to just suggest, given the amount of data that you have gotten today, maybe it would behoove you to take a little bit of time and review it prior to making a decision today mainly because there's a great deal of information and it is my understanding that you're seeing it today for the first time. I just think it may be wise.

What we have submitted to you is a report by

Penny Hunter, and what we have done is we looked at specifically in this report we looked at the level of arsenic that is in the proposed rule as it is today. And we just weren't really quite sure that that was a correct number, so we asked Penny to go back and review some of the literature out there and just make sure that we got this thing right.

What we have come up with is we believe we have a typo, typically, is really what we're looking at. If you turn to page 4, you notice Colorado State, Montana State, North Dakota State and Utah State all are at 200 while New Mexico is at 20. You kind of wonder if maybe they just missed a zero there and didn't really have it correct.

Also, it is important to note that the 200 is also supported by the Food and Agricultural Organization of the United States: National Academy of Sciences, U.S. EPA, National Research Council, and the Canadians. And so even the Canooks believe that 20 may not be right.

Just something to chew on for you. And I realize that we're waiting for a report from the university as well, but if they're looking at the same thing we are, we think that number may be just a little low, maybe a quick typo on New Mexico's part.

One other thing I thought I would mention, and

Margo did a nice job of presenting to you a question that's been rambling around in my mind for a little while. We are currently reviewing a proposal by the state engineer and essentially in a nutshell what he's saying is this is the state's water as granted by the constitution of the State of Wyoming. We have this easement of the channel and the floodplain.

What he's proposing is that produced water will have the ability to use the carrying capacity of the channel, whatever it may be. And while he has not put any standards on it, Margo brings up an interesting point, that the law for the state engineer states that number one priority is drinking water for man or beast.

So then we have this potential conflict. We have the state engineer saying, "Yes, you can use the channel to whatever its carrying capacity may be." My number one preferred use of that water would be drinking water for man or beast, which would include livestock and wildlife. And then we have the DEQ saying, "Well, now wait a minute. We need to protect it for whatever the most sensitive plant out there is."

The EQA says nothing in this act will prohibit anything that the state engineer says. So is there a potential conflict there? I don't know. I don't know the answer to this question. It is just rattling around in my brain and I'm not sure how to resolve it. I just wanted to mention it to you and let you think about it for a little bit because I'm still unclear on it myself. But it is an interesting question and it could be an interesting dynamic as we go forward with something like this.

The other thing that I want to keep in mind - and I feel like I keep beating this drum -- while we are mostly focused on the number one gas field in the state of Wyoming, Powder River Basin -- number one gas field in the state of Wyoming, right now we're having a problem in the number one gas field, and throughout the state really. We have seen a dramatic rig count decline, about 25 percent down from last year. That's big. That's big, folks.

In the Powder River Basin last month there were ten rigs running. Ten. That's not very many. When we produce from reservoirs, the second you start producing it, when gas starts showing up, you start to see a production decline. In order to keep the decline curve from dropping dramatically you have to go find new sources. We're having a problem.

Right now production in the Powder is on the rise thank you to the Big George, but that could change very quickly without new sources coming online. We all are very dependent on mineral production in the state of Wyoming. We very much enjoy the revenue. We have enjoyed a surplus for a number of years and I'm afraid that we have become quite dependent on it.

I don't know how this policy is going to affect new production in the future. There's a big field that was just approved around the Rawlins area. I don't know if it will affect that or not. I have no idea. It certainly is not going to be an historic discharge if they get one, as currently stated. If they get a discharge permit down there -- they need one -- how is this going to affect it? What is going to happen? What is going to happen to new production anywhere else in the state? I don't know that either but it is some food for thought, some things to chew on, some things to consider and things that I have been wrestling with, just thought I would leave you with some of those thoughts.

Be happy to answer any questions you might have.

CHAIRMAN SUGANO: Questions from the Board?

MR. ROBITAILLE: Thank you.

CHAIRMAN SUGANO: Thank you, John.

Anyone else that wants to approach?

MS. LOWE: Thank you. Mr. Chairman, members of the advisory board, my name is Wendy Lowe, and that's spelled L O W E. I live here in Casper and I have a government relations consulting firm.

For some reason I cannot seem to not comment on this subject whenever I hear it. I was assistant director of the Petroleum Association for nearly ten years back in the 1980s, and as the staff at DEQ knows, I was very involved in that position in the development of the NPDES program when we were first getting it into place. And that was a hard-fought process. That was something that I think EPA probably wondered about Wyoming at the time.

The NPDES program has been very carefully crafted in Wyoming to meet the demands of the arid West, and I'm a little fearful that we're forgetting that. Some of the things that we managed to get put into the program as far as monitoring, testing, the usage of the water from the discharge were quite contrary and new to EPA at the time. Wyoming's program, I think, can be said to be somewhat unique in the country. And we fought hard to get the NPDES program in place, primarily for the use of stock, wildlife and agricultural beneficial uses.

And I know that DEQ has probably given you the history of the program in the past, but I hope we don't forget it. We don't always have a water year like we're having right now, at least in parts of the state. After June 1st, June 15th, we're frantically looking for water, as are the wildlife, the cattle on the range and the sheep and the downstream users, whether or not they be fish or somebody catching those fish.

So I just wanted to remind you that there had been an awful lot of work done by -- both by the DEQ staff, some of who are still there, and myself and a lot of other people in the oil and gas industry, many who are still working here in the state to get an NPDES program in place that was to the benefit of everybody.

Ironically, the water that we were fighting to be able to discharge in the '80s is not near -- was not nearly as good a quality as the water that we're seeing from the CBM production right now. I think back and I am sort of astounded that there are objections to the use and the discharge of CBM water when the types of water that we were fighting to be able to discharge at the time were not nearly as good in many different qualities.

I hope your actions do not eliminate the discharge option by imposition of overly restrictive standards, and I'm afraid as I listen here that that's possibly where you may be headed. As I indicated, we are arid West, we're very high elevation in many cases. We only get five to 11, 12 inches of rain a year and when water is available we like to be able to use it.

The Wyoming NPDES program was a program developed in recognition of the scarcity of water in Wyoming and I hope you do not negate that program. The landowners and oil and gas operators have been very creative and I think you've heard some examples today, very creative at finding ways to work together. Please do not eliminate the options to them so that they can continue to work to each other's benefit.

In particular, the companies and the individuals, the ranchers and the farmers, have invested a lot of time, a lot of money and a lot of effort into finding ways to use the produced water through creative facilities, reservoirs, pipes, pivots. They have found a lot of ways to use this water, and I hope you will be able to continue to allow them to do that. Please do not make changes in the rules that would make these cost and time investment unusable.

I'm particularly concerned about the permit renewals that we're looking at in the Basin right now. Coalbed methane production started in '97, '98. Many of the operations are now up for renewal for their NPDES discharge permits and some of -- some are being held, some are not sure if they're going to be able to meet a standard. And I'm very fearful that a roll that seems to be headed down the path as this one would put standards into place that would prevent those existing permits from being renewed and that would not be a benefit to the landowners using the water, the wildlife using the water, the sage grouse use the water, and of course to the oil and gas operator who might be able to continue to operate.

So I just thought I would give you a little bit of historical perspective. I normally work in the legislative realm, but I have had some regulatory experience and quite often these regulatory issues end up down in Cheyenne so I try to keep on top of them. And I would be happy to answer any questions you may have.

CHAIRMAN SUGANO: Thank you. Do you have any questions, comments?

Take the next commenter, please.

MR. GORDON: Hi. I'm Mark Gordon. And, like Wendy, I find myself drawn to having to comment on this. I'm a rancher in the Powder River Basin. I work for Apache Oil Company.

And I'm prompted to make these comments on something Margo said and maybe I misunderstood her. Margo Sabec pointed out that the Environmental Quality Council had asked you to disregard the wildlife and livestock standards, if I understood her correctly.

Until March when I was voted off the island, I was the chair of the Environmental Quality Council.

MS. CAHN: Can you speak more directly into the microphone? I'm having a hard time hearing you.

MR. GORDON: I was Chair of the

grandfathering in that context. But once you have passed this law, the State made it clear that it wants to have clean streams and reduce pollution after that point. So there really shouldn't be any grandfathering that occurs after the passage of this act at all. And just because you've had pollution that might be -- might be killing streams for ten years or 20 years or 30 years, that's no reason for it not to be cleaned up.

And so each -- you know, this is the purpose for having a permit, a discharge permit that's reissued every five years is that let's take a look at what's been happening and, you know, has that -- has that permit and the discharge that's been occurring under that permit - has it affected the environment negatively or not. And the Department is entitled to take a look at that and so is the public every time these permits are issued.

So I tend to think that the whole notion of historic discharge ought to be discarded and that the same rules ought to apply to all discharges.

I think that's all I have. And I would be glad to answer any questions, as I hold this microphone here.

CHAIRMAN SUGANO: Questions?

Thank you, Steve.

Do we have another commenter, please?

MR. MURPHREE: My name is Phil Murphree,

M U R P H R E E, senior hydrologist with Powder River Coal, L.L.C. in Gillette. I didn't come here with any prepared speech today but I did want to restate some comments and reiterate some comments that I made for the Wyoming Mining Association, friend, foe and interested bystander with respect to CBM, and thanks to our friends at CBM we have received a number of changes to our rules over the years. Been with Powder River coal for 15 years and seen our NPDES permits change quite a bit as CBM has become a significant industry.

CBM in the Powder River Basin and near our mines has coincided with a long-term drought, and you have seen the situation where normally ephemeral and intermittent stream channels have turned temporarily perennial and have extremely dry outputs. We study our drainages and we have over 20 years of data in most of our drainages, stream data, alluvial well data and deep well data.

And Porcupine Creek is a drainage with a drainage area of 92 square piles but only produced 10 acre-feet a year prior to CBM. Now it produces 10 acre-feet in about three days during the spring through the winter. During the summer alluvial uptake is enough to dry that channel up.

Prior to CBM TDS in that stream channel and pools of that stream channel would be 7 to 10,000 milligrams a liter. After CBM it started off about 2,000 milligrams a liter and has progressed upwards towards 3500 milligrams a liter as CBM near the mine are shut off and alluvial and alluvial salts are picked up by -

MS. CAHN: I'm getting signals from the back of the room. If you could bring the microphone closer.

MR. MURPHREE: Yes. So we've seen that water considerably changed. SAR in the stream channel prior to CBM was 3 to 6; these days, probably 6 to 10.

One of the things I saw was that anywhere there's irrigation that the discharger would be responsible for proving no effect on irrigation downstream. And downstream of our mines our irrigators may be -- or nearest irrigators may be 20 to 30 miles downstream.

There is potential we could see changes to our permits based on -- and we don't discharge that much - based on irrigation standards for waters that if our water ever got to those irrigators, it would probably be less than a tenth of a percent of the irrigation water. And irrigation on the Cheyenne River, for instance, is practiced only during periods of high flow.

With respect to reinjection of water, potential reinjection of water, we don't feel that's the best option in our area. We have used that water for -- the CBM water coming down Porcupine Creek with the approval of the irrigators on the Cheyenne River to keep that water from entering Antelope Creek and the Cheyenne River and have either used that water for dust control or to put on our reclamation for reclamation improvement, wetland improvement.

We have also calculated that we have saved about 330,000 kilowatt-hours per year of electricity by using CBM water rather than pumping that water from deep wells which is a higher quality water.

That's all I have to say today. And take any questions.

CHAIRMAN SUGANO: Go ahead, Bill.

MR. WELLES: Phil, just on that last point, you saved how much?

MR. MURPHREE: 330,000 kilowatt-hours.

MR. WELLES: And how does that relate to how you used that?

MR. MURPHREE: Well, we pumped that water around the mine for use in dust suppression operations or for putting on our reclamation, and that water displaces water that we would have to pump out of a deep well.

MR. WELLES: Thank you.

CHAIRMAN SUGANO: Thank you, Phil.

Do we have another commenter, please?
MS. KRAMER: Good morning. My name is Nicole Kramer, K R A M E R. I am an attorney with Williams, Porter, Day and Neville, and I also represent Devon Energy.
I would just like to offer a few clarifications on what our comments were. Basically the simple statement is that in the DEQ's proposed rule they have made a choice of protecting naturally irrigated bottomlands that are within the State's water course easements, so they're protecting for those uses and sacrificing the opportunity for other landowners on the drainage and wildlife to use water for livestock watering.
And that -- the State's policy has been for a hundred years or more that the highest preferred use of the water is for livestock watering, for water for man and beast.
And our point is that DEQ should consider that more carefully because that is a huge shift from what the State's policy has been in the past. We are not saying that this is due to water rights in the wells, but once that water enters the drainage, then it is part of waters of the State and subject to the State engineer's jurisdiction over surface rights.
So DEQ is going to effectively deprive the

landowners on the drainage and the wildlife in the area of
the opportunity to have that drinking water which the
State has said is a higher preferred use than irrigation.
That's all.
CHAIRMAN SUGANO: Thank you, Nicole.
Does someone else want to come forward, please?
I think this is pretty much the end of the
public comment period -- the public comments, then.
John, did you want to jump in here at this time?
MR. WAGNER: No, Mr. Chairman. I'm just
getting ready.
CHAIRMAN SUGANO: Okay. I think this is
the time now that we can have a Board discussion of the
whole matter. What's the pleasure of the Board? Do we
want to break for lunch?
MS. CAHN: Just a ten-minute break and
continue.
CHAIRMAN SUGANO: And then continue so
that we can just let everyone go?
All right. Let's have a ten-minute break.
(Recess taken 11:55 a.m. until 12:03 p.m.)
CHAIRMAN SUGANO: We are reconvening our
meeting. Joe Olson had to leave. He had an emergency
that he needs to take care of. So the rest of us will
carry on.