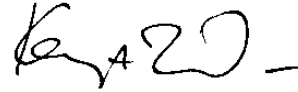


To: Gerald Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board

From: Kerry A. Rood, MS, DVM
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ADVS Department
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Date: November 23, 2012

**REG: EXTERNAL PEER REVIEW OF A PROPOSED BASIN PLAN
AMENDMENT TO ADDRESS MENEFICIAL USES FOR
GROUNDWATER AT THE ROYAL MOUNTAIN MINE SITE,
CALAVERAS COUNTY**

I received and reviewed the following documents (table 1) in respect to the amendment proposed for groundwater use at the Royal Mountain Mine Site (Calaveras, County).

Table 1. Files Sent for Peer Review November 2012.

| File Name | Document Title | File Date Created | Comments |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|
| Draft Staff Report_October.docx | AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS TO DE-DESIGNATE CERTAIN BENEFICIAL USES, ESTABLISH A SITE-SPECIFIC AGRICULTURAL OBJECTIVE, AND ESTABLISH A VARIANCE FOR GROUNDWATER AT THE ROYAL MOUNTAIN KING MINE SITE, CALAVERAS COUNTY | Oct 11, 2012 1:46 PM | Reviewed |
| Environmental Checklist.docx | Environmental Checklist | Oct 25, 2012 9:56 AM | Examined |
| Jan 7, 2009 Supplement Exhibit F.pdf | Supplement to Cal/EPA External Scientific Peer Review Guidelines - "Exhibit F" in Cal/EPA Interagency Agreement with the University of California | Apr 21, 2009 2:36 PM | Read |
| Revised Peer Review Request.pdf | REQUEST FOR EXTERNAL TECHNICAL PEER REVIEW OF A PROPOSED BASIN PLAN AMENDMENT TO ADDRESS BENEFICIAL USES FOR GROUNDWATER AT THE ROYAL MOUNTAIN KING MINE SITE, CALAVERAS COUNTY | Nov 5, 2012 9:26 AM | Reviewed |
| 05_1.7_CVRWQCB_Tech_Report_2003.pdf | Revised Technical Report, Royal Mountain King Mine, Calaveras County (2 April 2003) | 8/20/12 | Read |
| WQ_GW_May2012.xls | Spread Sheet with water reports | ? | Reviewed |
| R5-01-040.pdf | Order No. 5-01-040 | 11/19/12 | Read |

Peer Review

In section 3 (Water Quality Objectives) of the draft staff report, Central Valley Water Board (The Board) sets an upper TDS limit of 5,000 ppm (mg/L) for supporting livestock use and proposes a Basin Plan Amendment to include site-specific objectives for agricultural use. As reviewed, The Board is recommending alternatives that essentially create two areas; one that allows agricultural livestock use and another that does not based on ground water quality; in this case total dissolved solids ((TDS). The northwestern portion of the RMKM site is expected to be below 5,000 mg/L TDS and therefore this area's AGR use is maintained for livestock.

- **The reviewer agrees that high levels of TDS that range up to, and exceed 10,000 mg/L in the southwestern portion of the Site are harmful to livestock production and health (Patterson, Johnson et al. 2003, Brew, Myer et al. 2011, Morgan 2011).**
- **The reviewer agrees with the recommendation of The Board to amend the appropriate beneficial use for groundwater at the RMKM site.**
- **The reviewer agrees that groundwater with TDS levels < 5,000 mg/L support livestock AGR use (Carson 2000, Morgan 2011).**

The Board might consider other alternatives. One alternative is to allow grazing in all areas of the mine providing an external water source is provided. Ruminants are excellent at taking low quality forages and converting them to energy and protein. Has the board considered allowing AGR use in the area designated as having high TDS levels with the specification of providing an external water source(s)? In this example, the livestock owner would be required to either deliver external sourced water to livestock grazing this marginal area. The reviewer feels that this could be a possible additional AGR use for the land where the water quality exceeds TDS limits. It is very common on western ranges, where water quality is suspect, to provide off-sourced water to livestock. With modern technologies, providing water to livestock can be done very economically. For example, central tanks gravity feed water to troughs via over-ground laid, portable black polypropylene tubing that is removed at the end of each grazing season.

Water intake for livestock is a factor of the water content (moisture percentage or dry matter intake) of the plant material being consumed, maximum temperature, precipitation, and the percentage of dietary salt within the forages consumed. This formula (Morgan 2011) is:

Water intake (gallons/day) = $-4.939 + (0.1040 \times MT) + (0.2923 \times DMI) - (2.5971 \times PP) - (1.1739 \times DS)$
MT is the weekly maximum temperature in degrees Fahrenheit
DMI is dry matter intake in pounds fed daily
PP is weekly mean precipitation in inches
DS is the percentage of dietary salt in %

This formula suggests that when plant water content increases during periods of rapid plant growth and higher precipitation, a higher percentage of water needs are being met from the consumption of plant material. Are there periods of time where moisture is increased and plant growth is rapid, minimizing some of the need for water consumption? If there was a rainy season, limited grazing might be possible, especially if combined with an external water source.

Scientific Review

The recommendations for water quality and livestock health used in the Proposed Amendment are based largely on a 1974 National Academy of Sciences (NAS) report that designates cutoffs for total dissolved solids (TDS). The NAS report is summarized in table form (Bagley, Amacher et al. 1997). Table 2 from that report is included here.

Table 2. A Guide to the Use of Saline Waters for Livestock and Poultry

| Total Soluble Salts Content of Waters(mg/L or ppm) | Comment |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Less than 1,000 ppm (1670 umhos/cm) | These waters have a relatively low level of salinity and should present no serious burden to any livestock or poultry. |
| 1,000-2,999 ppm (1670-5008 umhos/cm) | These waters should be satisfactory for all classes of livestock and poultry. They may cause temporary and mild diarrhea in livestock not accustomed to them, or watery droppings in poultry (especially at the higher levels), but should not affect their health or performance. |
| 3,000-4,999 ppm (5010-8348 umhos/cm) | These waters should be satisfactory for livestock, although they may cause temporary diarrhea or be refused at first by animals not accustomed to them. They are poor waters for poultry, often causing watery feces and (at the higher levels of salinity) increased mortality and decreased growth, especially in turkeys. |
| 5,000-6,999 ppm (8350-11688 umhos/cm) | These waters can be used with reasonable safety for dairy and beef cattle, sheep, swine and horses. Avoid the use of those approaching the higher levels for pregnant or lactating animals. They are not acceptable waters for poultry, almost always causing some type of problem, especially near the upper limit, where reduced growth and production or increased mortality will probably occur. |
| 7,000-10,000 ppm (11,690-16,700 umhos/cm) | These waters are unfit for poultry and probably for swine. Con 7,000-10,000 ppm (11,690-16,700 umhos/cm considerable risk may exist in using them for pregnant or lactating cows, horses, sheep, the young of these species, or for any animals subjected to heavy heat stress or water loss. In general, their use should be avoided, although older ruminants, horses, and even poultry and swine may subsist on them for long periods of time under conditions of low stress |
| More than 10,000 ppm (16,700 umhos/cm) | The risks with these highly saline waters are so great that they cannot be recommended for use under any conditions. |
| 35,000 ppm (58,450 umhos/cm) | Brine |

This has been more recently validated for beef cattle. Researchers found negative effects on production and health when TDS increased above 4,800 ppm TDS and 7,268 ppm TDS, respectively (Patterson, Johnson et al. 2003). This research did include sulfates and reported that polioencephalomalacia to be the most common (48%) health affect when TDS increased above 7,000 ppm.

In a 2011 summary of the current water quality recommendations for cattle, the above table was again cited (Morgan 2011). The author also agrees with the recommendation that TDS >5,000 should be avoided.

In the US there does not seem to be a clear delineation on water quality while in Canada the recommendation is 3,000 ppm TDS (Carson 2000). Multiple livestock extension recommendations also suggest this level (Bagley, Amacher et al. 1997, Faries Jr, Sweeten et al. 1998, Wright 2007, Raisbeck and Sciences 2008). The EPA has published (EPA 2004) recent guidelines for water reuse but largely allow states to set standards with regards to agricultural use.

References:

Bagley, C. V., et al. (1997). "Analysis of water quality for livestock." AH/Beef **28**: 1.

Brew, M. N., et al. (2011). "Water intake and factors affecting water intake of growing beef cattle." Livestock Science **140**(1-3): 297-300.

Carson, T. L. (2000). "Current knowledge of water quality and safety for livestock." The Veterinary clinics of North America. Food animal practice **16**(3): 455-464.

EPA, U. S. (2004). "Guidelines for Water Reuse.!" Environmental Protection Agency, Municipal Support Division Office of Wastewater Management Office of Water Washington, DC. Agency for International Development Washington, DC, EPA/625/R-04/108, Cincinnati, OH US EPA/625/R-04/108.

Faries Jr, F. C., et al. (1998). "Water quality: Its relationship to livestock." Available electronically from <http://hdl.handle.net/1969.1:87665>.

Morgan, S. E. (2011). "Water Quality for Cattle." Veterinary Clinics of North America: Food Animal Practice **27**(2): 285-295.

Patterson, H. H., et al. (2003). Effect of total dissolved solids and sulfates in drinking water for growing steers. PROCEEDINGS-AMERICAN SOCIETY OF ANIMAL SCIENCE WESTERN SECTION.

Raisbeck, M. F. and U. o. W. D. o. V. Sciences (2008). Water Quality for Wyoming Livestock & Wildlife: A Review of the Literature Pertaining to Health Effects of Inorganic Contaminants, University of Wyoming Department of Veterinary Sciences.

Wright, C. L. (2007). "Management of Water Quality for Beef Cattle." Veterinary Clinics of North America: Food Animal Practice **23**(1): 91-103.