STATE OF COLORADO

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Colorado Department
of Public Health
and Environment

February 6, 2012

Mr. Daniel Packard, CEO
GreenBack Produced Water Recovery, LLC
1900 Grant Street, Suite 630
Denver, Colorado 80202

RE: Certification, Colorado Discharge Permit System – Produced Water Treatment Facilities
Permit Number COG84000 Certification Number: COG840002

Dear Mr. Packard:

Enclosed please find a copy of the amended permit certification, which was issued under the Colorado Water Quality Control Act. **Please read the enclosed permit and certification, including the fact sheet.** The Division holds the permittee legally liable for all permit requirements.

The Water Quality Control Division (the Division) has reviewed the amendment request for the Greenback Produced Water facility and amended the certification to increase the design flow. Because preparations are being initiated for a more continuous discharge plan, this amended certification no longer takes into account an intermittent discharge and complete infiltration prior to reaching downstream segments. Therefore the conditions of and the parameters that are being implemented in this certification are based off of continuous discharge that will reach downstream segments. This results in the addition of some parameters to the certification that were previously eliminated based on the discharge not making it to downstream water segments. Due to the more continual operating plan, the monitoring requirements have been increased for some parameters.

Additionally, because the Produced Water General Permit was recently amended, other changes have also been incorporated into this amendment and to the terms and conditions of the General Permit itself. Most notably, a change to the Division's WET testing guidance occurred in September of 2010, and these changes have been incorporated into this permit. This results in limitations for sublethality in chronic WET testing, determined by the use of an NOEC and an IC25 statistic. The operational descriptions have been updated to reflect current conditions and future plans.

Facility Information:

- **Industry Description**
  The Greenback Shaeffer Ranch facility (facility) is a commercial disposal facility which will receive produced water from oil and gas extraction operations in the Hunter Mesa region. The primary purpose of the facility is to treat, store, and recycle produced water generated from oil and gas gathering operations. The treated water may be returned to the oil and gas operators as treated waters and/or brines, or be discharged. This facility is subject to Colorado Department of Public Health and Environment regulations pertaining to solid waste sites and facilities and will operate under a Certificate of Designation. The facility is also subject to permitting by the Air Pollution Control Division. The discharge of treated water to adjacent surface waters requires a discharge permit from the Water Quality Control Division (WQCD).

- **Treatment Facility Description**
  The incoming produced water will be chemically screened, per requirement in the Certificate of Designation (Solid Waste Unit), to preclude entrance of hazardous materials. The facility is currently designed to accept and treat up to 5,000 barrels/day (0.21 MGD). However, plans are in the works to increase this capacity to 7500 barrels/day (0.315 mgd), subject to approvals from the Solid Waste Unit and the Air Pollution Control Division.

  Currently, the treatment system consists of mechanical solids removal, oil/water separation, clarification by dissolved air flotation, and air stripping. This treated water is then sent to one of three lined holding ponds, each having a combined capacity of 35,000 barrels (1.5 million gallons). This water may be sold back to the oil and gas operators for use in their operations. Currently the facility is accepting approximately 500 barrels of water per day as the treatment facility operations is in its start phase. Since the demand for the recycled water is currently low, the facility is moving forward with additional treatment plans and a proposal for additional surface water discharge.

  Under this plan, the produced water will additionally be treated with ultra filtration and a reverse osmosis (RO) system, following the above listed treatment. The water from the RO treatment will be routed in part to a 4000 gallon non-portable water holding tank for use in sinks, toilets, truck washing and other non-potable uses. The remaining water will be sent to the holding ponds where a determination of compliance with the permit limitations will be made prior to discharging to surface waters. Additional ponds may be needed as the facility moves toward accepting additional wastewaters and these additional ponds are in process of being approved by the Solid Waste Unit. The brine from the RO treatment system will be sent to another lined holding pond either for recycled use by oil and gas operators or for alternate disposal. The brine water is not eligible for surface water discharge under this permit.

  The facility includes a septic system for disposal of domestic wastewater. Since this system will operate at less than 2,000 gallons/day, only county authorization is necessary and this domestic wastewater discharge is not subject to a groundwater permit by the WQCD.

- **Chemical Usage**
  The application identified the following chemicals which are added to the water flow after dissolved air flotation and before entrance into the lined, storage pond. The MSDS documents for these chemicals were provided in the permit application. The MSDS sheets have been reviewed and the following chemicals are been approved for use.

Chemical Name	Purpose	Constituents of Concern
Polyacrylamide	flocculant	acrylamide
Aluminum potassium sulfate	flocculant	aluminum
Ferric Sulfate	flocculant	iron, sulfate
Ferrous Sulfate	flocculant	iron, sulfate
Tramfloc 343, 344, 345	flocculant	acrylamide

  Chemicals deemed acceptable for use in waters that will or may be discharged to waters of the State are acceptable only when used in accordance with all state and federal regulations, and in strict accordance with the manufacturer's site-specific instructions.

Basis of Certification Limitations:

- **Stream Segment Information**
  The discharge is to an unnamed dry tributary of West Mamm Creek, within Segment COLCLC04A of the Lower Colorado River Sub-basin, Lower Colorado River Basin, found in the Classifications and Numeric Standards for the Lower Colorado River River Basin (Regulation No. 37; last effective update effective June 30, 2010). Segment 4A is reviewable and is classified for the following beneficial uses: Recreation Class N, Aquatic Life – Class 2 Cold, Water Supply, and Agriculture. West Mann Creek is tributary to Mann Creek, which is tributary to the Colorado River just above Rifle, CO.

- **Technology Based Standards**
  The limitations for oil and grease and total suspended solids are from Regulation 62, which apply to all discharges that would be covered under this General Permit.

- **Water Quality Standards**

  Limitations for metals and inorganics are based on the water quality standards specific to stream segment COLCLC04a. Note that for many of the metals, the standards relate to the hardness of the receiving stream. Since the initial receiving stream is a zero low flow stream, most times of the year the only water that is present will be the effluent discharge. Since the discharge is made up or RO permeate, it is clean water with a very low hardness (approaching zero). However, as some blending with the RO brine, or with the addition of other additives that will be needed to be done in order to meet the WET limitations (the organisms on which the WET testing is to occur cannot live in a pure, ionic imbalanced water) a zero hardness will not be seen in the discharge. Hardness data was obtained from the following stations:

  Colorado Riverwatch, 4017, West Mann Creek, 3/8/05 and 6/16/05, 332 mg/l and 276 mg/l respectively, average 304
  Colorado Riverwatch, 4016, Mann Creek North, 3/8/05 – 10/11/05 (10 data points), range 152 – 500 mg/l, average 320
  Colorado Riverwatch, 4018, Middle Mann Creek, 4/12/05 – 10/11/05 (3 data points), range 356 – 418 mg/l, average 385
  Colorado Riverwatch, 4019, East Mann Creek, 5/17/05 and 8/9/05, 264 and 234 mg/l respectively, average 249
  CDPHE Station 11149B, Mann Creek at Garfield Cty Airport, 3/16/00, 440 mg/l

  As there were only two data points on West Mann Creek, the Division looked at other nearby stations for comparison. The hardness data from West Mann Creek appears to be in line with other data on Mann Creek and therefore was used to determine the TVS values for metals. The hardness used in the equations was 300 mg/l, based solely on the data for West Mann Creek as it is the most direct receiving water. The calculations are provided below.

Parameter	***In-Stream Water Quality Standard***		***TVS Formula: Hardness (mg/l) as CaCO3 =*** **300**
Aluminum, Total Recoverable	Acute	10071 µg/l	$e^{(1.3695(\ln(\text{hardness}))+1.8308)}$
	Chronic	1438 µg/l	$e^{(1.3695(\ln(\text{hardness}))-0.1158)}$
Cadmium, Dissolved	Acute	7.1 µg/l	$[1.136672-0.041838\ln(\text{hardness})]e^{(0.9151(\ln(\text{hardness}))-3.1485)}$
	Chronic	0.97 µg/l	$[1.101672-0.041838\ln(\text{hardness})]e^{(0.7998(\ln(\text{hardness}))-4.4451)}$
Hexavalent Chromium, Dissolved	Acute	16 µg/l	Numeric standards provided, formula not applicable
	Chronic	11 µg/l	Numeric standards provided, formula not applicable
Copper, Dissolved	Acute	38 µg/l	$e^{(0.9422(\ln(\text{hardness}))-1.7408)}$
	Chronic	23 µg/l	$e^{(0.8545(\ln(\text{hardness}))-1.7428)}$
Lead, Dissolved	Acute	209 µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-1.46)}]$
	Chronic	8.1 µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-4.705)}]$
Manganese, Dissolved	Acute	4305 µg/l	$e^{(0.3331(\ln(\text{hardness}))+6.4676)}$
	Chronic	2379 µg/l	$e^{(0.3331(\ln(\text{hardness}))+5.8743)}$
Nickel, Dissolved	Acute	1186 µg/l	$e^{(0.846(\ln(\text{hardness}))+2.253)}$
	Chronic	132 µg/l	$e^{(0.846(\ln(\text{hardness}))+0.0554)}$
Selenium, Dissolved	Acute	18.4 µg/l	Numeric standards provided, formula not applicable
	Chronic	4.6 µg/l	Numeric standards provided, formula not applicable
Silver, Dissolved	Acute	13 µg/l	$\frac{1}{2}\, e^{(1.72(\ln(\text{hardness}))-6.52)}$
	Chronic	2.1 µg/l	$e^{(1.72(\ln(\text{hardness}))-9.06)}$
Uranium, Dissolved	Acute	8062 µg/l	$e^{(1.1021(\ln(\text{hardness}))+2.7088)}$
	Chronic	5036 µg/l	$e^{(1.1021(\ln(\text{hardness}))+2.2382)}$
Zinc, Dissolved	Acute	366 µg/l	$0.978e^{(0.8525(\ln(\text{hardness}))+1.0617)}$
	Chronic	317 µg/l	$0.986\, e^{(0.8525(\ln(\text{hardness}))+0.9109)}$

Note that there are no known drinking water intakes on Mann Creek or its tributaries, and although there are intakes on the Colorado River, the dilution factor would eliminate them from being applied in this certification. Therefore limitations for dissolved iron, sulfate, and manganese will not be applied. Note that limits for manganese based on aquatic life (above table) will be applied. Additionally, the 10 mg/l limit for nitrate will not be applied and the 100 mg/l limit based on agricultural uses will be substituted. For total recoverable arsenic, the 0.02-10 standard will not be applied, and instead the 100 ug/l limit for agricultural uses will be substituted.

For organic parameters, only the aquatic life limits will be applied.

- **Antidegradation**

Because the receiving water is reviewable, an antidegradation evaluation must occur. The facility was not in place as a discharger as of September 2000, and therefore any consideration of this discharge being present as of the antidegradation baseline date is not considered. The limitations based on the antidegradation review will be determined to be 15% of the water quality standard.

- **Narrative Standards**

Section 31.11(1)(a)(iv) of The Basic Standards and Methodologies for Surface Waters (Regulation No. 31) includes the narrative standard that State surface waters shall be free of substances that are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life.

Agricultural Protection

For the Ag Policy, with the move from a more intermittent lower volume discharge to a potentially more permanent discharge at a higher volume, the water can no longer be assumed to not reach West Mann Creek and other downstream waters and therefore any agricultural intakes. The interpretation of these conditions (i.e., "no harm to plants" and "no harm to the beneficial uses") and how they were to be applied in permits were contemplated by the Division as part of an Agricultural Work Group, and culminated in the most recent policy entitled Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops (hereafter the Narrative Standards policy)

Based on available information, the water in Mann Creek is used for irrigation water. The evaluation of the suitability (i.e., quality) of irrigation water is complex and involves the detailed understanding of the interactions of plant tolerances, soil types, and agricultural management practices. Irrigation water has two properties – salinity and sodicity – that can have concurrent impacts on the irrigated crop beneficial use. The Division has thus determined that two parameters, specifically electrical conductivity (EC) and sodium absorption ratio (SAR), are the best parameters to regulate in discharge permits to control levels of salts to minimize both the loss of irrigated crop yield and the sodium hazard.

In order to establish "standards" and limits for EC and SAR, the Division must: (1) determine the most sensitive crop usually grown in the area downstream from the discharge and determine the corresponding EC of irrigation water (ECw) threshold value for no reduction in yield below 100%; and (2) determine the SAR based on the ECw value, with consideration of existing water quality, to prevent the exceedance of the SAR.

Electrical Conductivity: The electrical conductivity (EC) is also known as specific conductance, conductance, conductivity, or specific conductivity. Crops have varying sensitivity to electrical conductivity. Studies have established the maximum conductivity in the water in the root zone that will result in no reduction of crop yield. This value is referred to as the EC saturation extract or ECe. However, the ECe is not the same as the EC of the irrigation water (ECw). The ECw is the maximum conductivity in the irrigation water that will result in no reduction in crop yield.

The ECw that is used in the development of permit limits is determined based on the most sensitive of the ECw's for the crops grown in the area. Based on information from the Colorado Decision Support Systems (CDSS) website, there are active intakes on Mann Creek that are used to irrigate grass fields. Although the specific grasses are not identified, the lowest allowable EC for various grasses, as listed in the Ag Policy, is 1.5 dS/m. This value also corresponds to the ambient condition of Mann Creek (CDPHE station – 1 sample – 1.56 dS/m). Therefore the limitation for EC will be added to the permit at this value.

SAR – SAR means Sodium Adsorption Ratio, which is a representation of the relative proportion of sodium cations to calcium and magnesium cations (also known as the "sodium hazard"). The equation for SAR follows:

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

The values for sodium (Na+), calcium (Ca++) and magnesium (Mg++) in this equation are expressed in units of milliequivalents per liter (meq/l). Generally, data for sodium, calcium and magnesium are reported in terms of mg/l, which must then be converted to calculate the SAR. The conversions are:

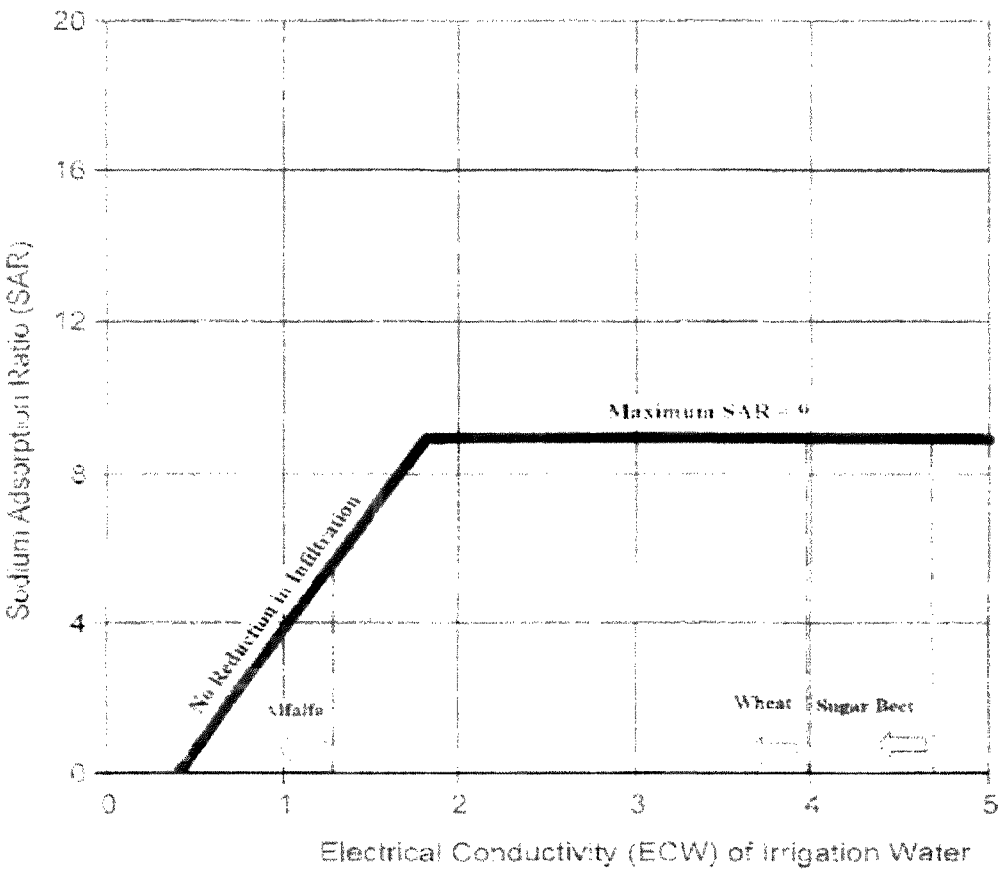
$$\text{meq/l} = \frac{Concentration\ in\ mg/l}{Equivalent\ weight\ in\ mg/meq}$$

Where the equivalent weights are determined based on the atomic weight of the element divided by the ion's charge:

Na+ = 23.0 mg/meq (atomic weight of 23, charge of 1)
Ca++ = 20.0 mg/meq (atomic weight of 40.078, charge of 2)
Mg++ = 12.15 mg/meq (atomic weight of 24.3, charge of 2)

The SAR standard is established using the SAR/EC equation, shown graphically in the figure below, which is reproduced herein from the Narrative Standards Policy. Specifically, the WQBEL calculated for ECw was used to establish a SAR standard of 8.17. Since the allowable SAR value is tied to the actual EC of the effluent, the EC/SAR equation (SAR = (7.1 * EC) – 2.48) will be the SAR limit in the permit, however the allowable SAR of the effluent will be capped at the value above or at 9, whichever is less. Due to the effect of bicarbonate on the available calcium and magnesium, limitations will be expressed as adjusted SAR, which accounts for bicarbonate. This is explained in more detail in the fact sheet and permit documents.

Relative Rate of Water Infiltration as Affected by ECw and SAR with Modification to Show Upper Limit for SAR = 9



Note that due to the implementation of the limits for SAR and EC, limitations for TDS based on agricultural protection are no longer necessary. However, as the discharge is to the Colorado River basin, overall limits for TDS are required at either 500 mg/l, 1 ton per day, or 350 tons per year. As meeting the EC and WET limits will require low TDS concentrations, it is assumed that these criteria will be met. Reporting requirements will be required during this permit term.

Whole Effluent Toxicity

For WET testing, although the proposed treatment would remove almost all pollutants from the wastewater, this in fact may be toxic to aquatic life as the discharge water will be too clean to support aquatic life due to ionic imbalances. The permittee will likely need to adjust the RO system to allow for some pass through of salts to maintain a suitable ionic balance, or may have to blend some of the RO brine back into the effluent or add some salts back into the discharge water prior to release. This will need to be done in order to have a chemically balanced discharge that will pass a WET test, but also maintain compliance with other permit limitations. Because of the zero low flow condition of the receiving stream, and a more permanent discharge scenario, chronic WET testing will be required.

General Information:

- **Permit Action Fees** : The Annual Fee for this certification is $ 2,150 and is invoiced every July. The fee for the amendment for this permit, based on the increase in flow and the need to assess for a more permanent discharge scenario, is 55% of the annual fee. Do Not Pay This Now. An invoice will be sent shortly.

- **Changes to the Certification** – Any changes that need to be made to the certification page – changes in outfalls, monitoring requirements, etc., must be submitted using the "Permit and Certification Modification form" available on our website: coloradowaterpermits.com, and signed by the legal contact.

- **Discharge Monitoring Report (DMR)** forms will be mailed out within the next month. Reports must be submitted **monthly** as long as the certification is in effect. The permittee shall provide the Division with any additional monitoring data on the permitted discharge collected for entities other than the Division. This will be supplied to the Division within 48 hours of the receipt of the data by the permittee. If forms have not been received, please contact the Division at 303-692-3517.

- **Sampling Requirements** Sampling shall occur at a point after treatment, or after the implementation of any Best Management Practices (BMPs). If BMPs or treatment are not implemented, sampling shall occur where the discharge leaves control of the permittee, and prior to entering the receiving stream or prior to discharge to land. Samples must be representative of what is entering the receiving stream.

- **Termination requirements** This certification to discharge is effective long term, even though construction and dewatering discharge are only expected for approximately three months.

- **Certification Records Information** The following information is what the Division records show for this certification.

For any changes to Contacts – Legal, Local, Billing, or DMR – a "Notice of Change of Contacts form" must be submitted to the Division. This form is also available on our web site and must be signed by the legal contact.

Facility: GreenBack Produced Water Recovery, LLC — Garfield County
Industrial Activities : Commercial Disposal Facility (for Produced Water) — SIC Code : 13000

Legal Contact *Receives all legal documentation, pertaining to the permit certification. [including invoice; is contacted for any questions relating to the facility; and receives DMRs.]*

Daniel Packard, CEO
GreenBack Produced Water Recovery, LLC
1900 Grant Street, Suite 630
Denver, Colorado 80202

Phone number: 303-887-8387
Email: DanPackard@aol.com

Facility Contact *Contacted for general inquiries regarding the facility*

Glen Jones, Operator
PO Box1489
Fort Collins, CO 80522

Phone number: 970-817-4119
Email: Gjones@cgrs.com

Billing Contact

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Phone number: 303-887-8387
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DMR Contact

Glen Jones, Operator
PO Box1489
Fort Collins, CO 80522

Phone number: 970-817-4119
Email: Gjones@cgrs.com

If you have any other questions please contact me at 303-692-3655.

Sincerely

Andrew Neuhart
Assessment Based Permits Unit Manager
WATER QUALITY CONTROL DIVISION

Enclosures: Certification page; General Permit

xc:

Garfield County, Local County Health Department
Permit File: 840002

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