MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

FACT SHEET

Produced Water General Permit

FACILITY:	Oil and Natural Gas Production Operations
PERMIT NUMBER:	MTG310000
LOCATION:	Statewide
CONTACT:	Applicant
RECEIVING WATER:	Statewide Ephemeral Water Bodies

I. Status of Permit

The Produced Water General Permit (PWGP) for oil and natural gas operations (Montana Pollutant Discharge Elimination Permit (MPDES) Permit No.: MTG310000) was first issued by the Montana Department of Environmental Quality (DEQ) April 1, 1990. The 1990 permit was renewed on January 1, 1996. The 1996 permit expired on December 31, 2000, and was administratively extended pursuant to Administrative Rules of Montana Title 17, Chapter 30, Subchapter 13 (ARM 17.30.1313), until its renewal on March 1, 2002. The 2002 permit expired on February 28, 2007 and was administratively extended until its renewal on May 1, 2010. The 2010 permit expires on April 30, 2015.

II. Coverage

A. Area of Coverage

This PWGP applies to all areas of the State of Montana, except for Indian Lands, National Parks, and the state waters in Rosebud Creek, Tongue, Powder, and Little Powder River watersheds (ARM 17.30.670).

B. Description of Discharge and Discharging Facilities

This PWGP applies to oil and gas production operations in standard industrial classification (SIC) 1311 that discharge produced water into state waters in the aforementioned area. Specifically, this PWGP authorizes the disposal of produced water into ephemeral drainages (the drainage courses of ephemeral streams) and/or impoundments constructed in ephemeral drainages (impoundments) for beneficial uses only.

"State waters" are "any body of water, irrigation system, or drainage system, either surface or underground" (ARM 17.30.1304). This definition also includes lakes and ponds, both natural and man-made, and ephemeral drainage ways. An "ephemeral

stream" is a stream which flows only in direct response to precipitation in the immediate watershed or in response to the melting of snow and ice and whose channel bottom is always above the local ground water table [ARM 17.30.602(10)]. Under natural conditions, water in ephemeral drainages may only occur seasonally and not necessarily every year.

"Produced water" is the water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and may include formation water, injection water, and any chemicals added downhole or during the oil/water separation process [40 CFR (Code of Federal Regulations) Part 435.11(bb)]. The raw product pumped from oil and gas production wells generally contains water and crude oil or entrained natural gas. Various methods can be used to separate the oil and gas from the produced water including: heater treater, gravity separation, emulsion breaking chemicals, and skim ponds. After separation from the petroleum, the produced water is ready for disposal.

National Effluent Limitation Guidelines (ELGs) specify technology-based effluent limits for agricultural and wildlife water use of produced water in 40 CFR Part 435, Subpart E – Agricultural and Wildlife Water Use Subcategory. The purpose of this permit is to allow the discharge of produced water and ensure this discharge is beneficially used in conformance with Subpart E.

Facilities seeking coverage under this PWGP will need to apply to DEQ by submitting a complete Notice of Intent (NOI) package. Once a complete NOI package is received, DEQ will review the application and decide whether to deny or issue a confirmation letter for coverage under the PWGP, which is only valid when accompanied by the PWGP. Each confirmation letter for coverage under this PWGP will be specific to an owner and/or operator of a gas or natural gas production facility, only apply in the area(s) specified in the letter, and only allow discharge via specific outfall(s) to the receiving water. An outfall is the discharge location prior to produced water entering the receiving water and after all treatment has occurred.

C. Regulatory Authority

Montana Code Annotated (MCA) 75-5-605(2) prohibits the discharge of sewage, industrial wastes or other wastes into and state waters without a current permit from DEQ. "Other wastes" includes garbage, oil and grease, chemicals, and all other substances that may pollute state waters [MCA 75-5-103(24)]. Under this definition, any discharge of pollutants to state surface waters is subject to MPDES requirements.

Produced water is a by-product of the oil and gas production process and is therefore considered industrial process wastewater [ARM 17.30.1304(56); 40 CFR 401.11(q)] which is subject to MPDES permitting (ARM 17.30 Subchapters 12 and 13). Pursuant to ARM 17.30.1341(1)(f), the Montana Board of Environmental Review (BER) authorized DEQ to issue general permits for oil and gas well produced water discharges for beneficial use.

D. Maintain Permit Coverage under the 2010-Issued PWGP (Expires 2015)

During the history of the PWGP, DEQ has issued 34 authorizations to discharge produced water. Of these 34 authorizations, eight have been terminated and three have expired, resulting in a total of 23 currently effective authorizations under the 2010 PWGP. These 23 effective authorizations are permitted for a total of 26 outfalls.

The 2010 PWGP authorizations will expire upon the effective date of the new PWGP [ARM 17.30.1341(6)]. All existing facilities with effective coverage under the 2010 PWGP are eligible for coverage under the renewed PWGP unless they are excluded according to the conditions in Section I.B of the Permit. Eligible facilities seeking continued coverage must submit a complete NOI package 30 days prior to the expiration of the 2010 PWGP. A complete NOI package for renewal consists of:

- Produced Water Notice of Intent (NOI-31) Form;
- Produced Water-1 (PW-1) Form (Storage Capacity Self-Evaluation Worksheet) with supporting documents (required Attachment I, and optional Attachments II and III as necessary);
- Certification on the NOI that the discharged produced water meets the water quality requirements and the submission of a water quality analysis for the parameters specified in Section VIII.B within six months of the expiration date of the 2010 permit (sample date must be within two years prior to analysis submission date); and
- Applicable Fees as required under ARM 17.30.201 Schedule I.B.

Facilities that submit the above materials correctly 30 days prior to the expiration of the 2010 PWGP and a water quality analysis within six months of the permit expiration date may maintain coverage under the renewed permit unless notified by DEQ that the coverage has been terminated. Once a complete NOI package is received, DEQ will reissue a confirmation letter to each qualified facility. The facility is authorized to discharge upon receiving the confirmation letter, which must be accompanied by a copy of the PWGP to be considered valid.

E. Obtain Permit Coverage under the 2015-Issued PWGP

New dischargers seeking to obtain coverage to discharge under the PWGP must submit a complete NOI package at least 30 days prior to commencing operation, including:

- Produced Water Notice of Intent (NOI-31) Form;
- Produced Water-1 (PW-1) Form (Storage Capacity Self-Evaluation Worksheet) with supporting documents (required Attachment I, and optional Attachments II and III as necessary);
- A water quality analysis for the parameters specified in Section VIII.B (sample date must be within two years prior to NOI submission date); and
- Applicable Fees as required under ARM 17.30.201 Schedule I.B.

DEQ will review the application and decide whether to deny or issue a confirmation letter to the owner or operator of the PWGP facility after receiving a complete NOI package. The facility is authorized to discharge upon receiving the confirmation letter, which must be accompanied by a copy of the PWGP to be considered valid. If the facility does not meet the requirements of the PWGP and the coverage is denied, DEQ will start to process the NOI package as an MDPES individual permit once applicable fees for an individual permit are received [ARM 17.30.1341(5)], unless the applicant modifies the proposed discharge to meet the requirements of the PWGP, or withdraws the application. If the applicant withdraws the application, they must reapply with a full NOI package and applicable fees should coverage under the PWGP be sought in the future.

F. Termination of Permit Coverage

Permit coverage remains in effect until the expiration date of this PWGP or DEQ receives notice from the permittee that the point source discharge has been eliminated. To terminate the coverage, the permittee must submit a complete Request for Termination (RFT) Form to DEQ indicating the produced water discharge activity has ceased and will not continue in the future. The RFT must be signed and certified in accordance with ARM 17.30.1323 and all applicable fees must be paid. Permittees will continue to accrue annual fees until DEQ receives a complete RFT.

If an individual produced water MPDES permit is issued to the owner or operator of a facility already covered under the PWGP, coverage under the PWGP will be terminated on the effective date of the individual MPDES permit.

G. Transfer of Permit Coverage

The owner or operator of a facility covered under this PWGP may request to transfer coverage under the PWGP to a new owner or operator (ARM 17.30.1360). To transfer permit coverage, the permittee must submit a complete Permit Transfer Notification (PTN) Form to DEQ at least 30 days prior to the effective date of the proposed transfer. The PTN constitutes written notice to DEQ under the Montana Water Quality Act that the new owner or operator assumes responsibility and liability for all the terms and conditions in the permit, including permit fees. The PTN form may not be used to transfer permit coverage to a new or different site location or to modify the terms and conditions of the permit.

H. Sources Excluded from Coverage

The following facilities do not qualify for coverage under the PWGP.

1. Produced Water from Coal Bed Natural Gas Operations

The national ELGs specified in 40 CFR Part 435, Subpart E were promulgated for traditional oil and gas production, but not for coal bed natural gas (CBNG) production. If discharge is different in degree or nature from discharges reasonably expected from sources or activities with the category described in the general MPDES permit, then that discharge may be excluded from coverage [ARM 17.30.1341(4)(b)]. CBNG operations involve depletion of shallow alluvial and coal bed ground water aquifers resulting in potentially large volumes of effluent for discharge, as well as potentially different effluent quality from traditional oil and gas production. Therefore, CBNG discharges are different in degree and nature and are excluded from coverage under the PWGP. CBNG facilities seeking MPDES coverage must apply for an individual MPDES permit.

2. Excluded Produced Water from Oil and Gas Operations

40 CFR Part 435, Subpart E is applicable to produced water which has a use in agriculture or wildlife propagation. 'The term "use in agriculture or wildlife propagation" means that the produced water is of good enough quality to be used for wildlife or livestock watering or other agricultural uses and that the produced water is actually put to such use during periods of discharge"' [40 CFR 435.51(c)]. Therefore, drinking water quality requirements for livestock or wildlife must be considered when determining which specific produced waters are usable for beneficial uses.

Produced water is ground water which is held in formation with oil and gas. Often, these formations have existed for thousands of years, and the chemical composition of the produced water results from the type of hydrocarbon product, the geological host formation, and the ground water origin, which can be fresh, brackish, or marine (Guerra et al., 2011; Van Voast, 2003; Viel et al., 2004). Therefore, produced water quality falls along a wide spectrum, with some waters suitable for beneficial use with minimal treatment, while other formation waters require intensive treatment before beneficial use.

Through the dissolution of minerals, produced water can have high concentrations of salts and total dissolved solids (TDS). The dissolution of sodium and chloride is generally the main source of salinity in produced water (Fakhru'l-Razi et al., 2009) and can lead to highly saline waters. However, livestock and wildlife have a certain tolerance to saline waters (Ayers and Westcot, 1994), often allowing the use of produced water for animal watering with minimal treatment (discussed in Section VIII.B). However, produced water TDS concentrations can vary from 1,000 to 400,000 mg/L (USGS, 2002), and water with extremely high TDS concentrations can impair the growth, lactation and/or pregnancy of animals (Bagley et al., 1997; Patterson and Johnson, 2003; Patterson and Epperson et al., 2004; Patterson and Ward et al., 2004; Tjardes et al., 2004). In addition to salinity and TDS, produced water can also include concentrations of other parameters, such as sulfate and fluoride (Guerra et al. 2011) that can be detrimental to livestock and wildlife (Ayers and Westcot, 1994; National Academy of Sciences, 1972; National Research Council, 1974). Therefore, only discharged produced water that does not exceed the water quality requirements for livestock and wildlife is considered "beneficial" and qualifies for coverage under the PWGP.

In the 2010 permit, livestock and wildlife drinking water quality requirements were established using recommendations from industry research and publications. These requirements are continued in the renewed permit and updated as needed. The specific parameters and associated water quality maximum allowable concentrations are discussed in Section VIII.B and summarized in Table 5. A special requirement for coverage under this PWGP is certification by the applicant that the produced water discharge meets the watering requirements and the submission of a lab analysis demonstrating this water quality.

Furthermore, as discussed in Section II.B, this PWGP only authorizes produced water discharge that can be contained in ephemeral drainages and/or impoundments constructed in ephemeral drainages. Discharge of produced water in excess of the storage volume of an ephemeral drainage and/or impoundment may lead to the runoff of produced water to intermittent or perennial streams. Discharges to intermittent or perennial receiving waters are subject to the water quality standards set forth in ARM 17.30.620-670 and in DEQ Circular DEQ-7. To protect the water quality of intermittent or perennial waters, a case-by-case analysis through the MPDES individual permitting process is required. It is the applicant's responsibility to identify available ephemeral drainages and/or impoundments and to evaluate their capacity for containing produced water volume to ensure qualification for coverage under this PWGP.

Therefore, produced waters which are not high enough quality for beneficial uses or which discharge to intermittent or perennial waters are excluded from coverage under the PWGP. For facilities which do not qualify for coverage under the PWGP, the owner/operator may apply for a MPDES individual permit.

3. Oil and Gas Produced Water in Rosebud Creek, Tongue, Powder, and Little Powder River Watersheds

ARM 17.30.670 specifies numeric standards for electrical conductivity (EC) and sodium adsorption ratio (SAR) for state waters in the Rosebud Creek, Tongue River, Powder River, and Little Powder River watersheds. While ephemeral drainages are generally not subject to the water quality standards in ARM 17.30.620-670, ARM 17.30.670(4) does specify numeric water quality standards for EC and SAR for all tributaries and surface waters in the above watersheds, which includes ephemeral waters. EC and SAR are parameters of concern (POC) for oil and gas produced water. Therefore, analysis is required to ensure the numeric standards for EC and SAR in the receiving waters are not exceeded through the development of water quality effluent limits [ARM 17.30.1344(2)(b)].

Water quality-based effluent limits (WQBELs) are calculated using receiving water and effluent water quality data to ensure numeric water quality standards are not exceeded. However, this analysis must be done on a case-by-case basis, which is not done under the PWGP. Therefore, facilities proposing to discharge produced water into the Rosebud Creek, Tongue, Powder, and Little Powder River watersheds are not eligible for coverage under this PWGP and must apply for coverage under a MPDES individual permit.

III. Description of Receiving Waters, Applicable Standards, and Effluent Characteristics

A. Description of Receiving Waters and Applicable Standards

As discussed in Section II.B, this PWGP only authorizes the discharge of produced water to ephemeral drainages and/or impoundments for the specific beneficial use of wildlife or livestock watering. No discharge to any other state waters besides ephemeral drainages is authorized by this permit. Ephemeral streams are not subject to the specific water quality standards of ARM 17.30.620 through 17.30.629 [ARM 17.30.637(4)]. However, ephemeral streams are subject to the general standards and prohibitions specified in ARM 17.30.635 through 637, 641, 645, 646, and 670 and the existing beneficial uses of the receiving water must be maintained pursuant to Montana Nondegradation Policies [MCA 75-5-303(1) and ARM 17.30.705(2)(a)].

B. Effluent Characteristics

The 2010 permit required semiannual outfall monitoring for oil and grease, TDS, and sulfate; and impoundment monitoring for EC. The period of record (POR) for monitoring data is from May 1, 2010, to September 30, 2014. These data are summarized in Table 1.

Table 1. Discharge Monitoring Report (DMR) Effluent Characteristics of Authorized Discharges under the PWGP[1]

Parameter	Units	2010 Permit Limit	Number of Samples	Minimum Value	Maximum Value	Average Value	95th Percentile	Limit Exceedances
Discharge (Monthly Average)	gpm	[2]	167	0.0005	224	26.2	95.6	[2]
Oil and Grease (Maximum)	mg/L	10	129	ND[3]	19	4.8	10	9
Total Dissolved Solids (Monthly Average)	mg/L	5,000	164	440	18,300	3,359	4,760	6
Sulfate (Monthly Average)	mg/L	[2]	149	ND[3]	4,590	673	2,865	[2]
Electrical Conductivity (Maximum)	µS/cm[4]	[2]	99	ND[3]	12,640	5,225	8,730	[2]

Footnotes:
1. Discharge data from May 2010 to September 2014 for 23 facilities.
2. No effluent limit in previous permit, monitoring requirement only.
3. Non-Detection. Parameter not present at or above minimum detection level.
4. µS/cm – microSiemens/cm.

IV. Proposed Effluent Limitations and Conditions

Section 402(o) of the Clean Water Act (CWA) and 40 CFR 122.44(l) require that effluent limitations or conditions in reissued permits be at least as stringent as those in the existing permit, with certain exceptions. Also, 40 CFR 122.44 requires that permits contain the more stringent Technology-Based Effluent Limitations (TBELs) or Water Quality-Based Effluent Limitations (WQBELs) applicable to an individual pollutant.

The BER adopted general treatment requirements that establish the degree of wastewater treatment required to restore and maintain the quality of surface waters. This rule states that the degree of wastewater treatment is based on the surface water quality standards; the state's nondegradation policy; present and anticipated beneficial uses of the receiving water; the quality and flow of the receiving water; the quantity and quality of sewage, industrial wastes and other wastes to be treated; and the presence or absence of other sources of pollution on the same watershed [ARM 17.30.635(1)].

A. Technology-Based Effluent Limitations

TBELs represent the minimum level of control that must be imposed by a permit issued under the MDPES program, as stated in 40 CFR 122.44(a) and adopted by reference in ARM 17.30.1344(2)(b). DEQ must consider technology available to treat wastewater, and limits that can be consistently achieved by that technology. TBELs are based on currently available treatment technologies and allow the permittee the discretion to choose applicable controls to meet those standards.

The effluent limitations in this PWGP represent the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT) in produced water for agriculture or wildlife beneficial uses (40 CFR 435.52).

1. There shall be no discharge of waste pollutants into navigable waters from any source (other than produced water) associated with production, field exploration, drilling, well completion, or well treatment (i.e., drilling muds, drilling cuttings, and produced sands).

2. Produced water discharge shall not exceed the following daily maximum limitation: Oil and Grease: 35 mg/L.

B. Water Quality-based Effluent Limitations

As a process wastewater from oil and gas operations, produced water can contain high concentrations of oil and grease. In addition, produced water generally has elevated levels of TDS and sodium. Waters with high sodium levels often exhibit high SAR values, which is the ratio of the sodium ion concentration to the combined concentration of calcium and magnesium ions in the water.

Produced water discharged from onshore oil and gas operation must be of good enough quality to be used for wildlife or livestock watering or other agricultural uses (40 CFR 435.51). Due to the generally high concentrations of TDS and a high SAR, using produced water to irrigate agricultural or rangeland can be detrimental to crops and soil. High SAR in combination with elevated specific conductance and TDS in irrigation water can cause soils to become dispersed (deflocculation) and develop an undesirable soil structure with less permeability (Ayers and Westcot, 1994; Davis et al., 2012); which makes the soil prone to erosion. Therefore, produced water containing high SAR and elevated TDS is not considered suitable for irrigation uses by DEQ. The WQBELs herein have been developed in consideration of livestock and wildlife use.

Oil and Grease – The 2010 permit included a limit of 10 mg/L for oil and grease and required monitoring for this parameter. Water quality standards prohibit discharges that create a visible oil sheen, globules of grease or other floating materials, or oil and grease to be present in concentrations at or in excess of 10 mg/L [ARM 17.30.637(1)(b)]. Therefore, the 2010 permit limit for oil and grease of 10 mg/L will be continued in the renewed permit.

Total Dissolved Solids (TDS) –The 2010 permit included limits for TDS and required monitoring for this parameter. The 2010 TDS limit of 5,000 mg/L was based on livestock or animal drinking water safety recommendations made by National Academy of Sciences (1972) and National Research Council (1974). These sources suggest that waters with TDS concentrations below 5,000 mg/L are safe for animal watering, whereas waters with TDS levels between 5,000 mg/L and 7,000 mg/L are reasonably safe for adult ruminants but not appropriate for pregnant or lactating animals. These guidelines are cited by many industry and research extension publications (Hairston, 1995; Bagley et al., 1997; Looper and Waldner, 2002; Patterson and Johnson, 2003). Waters with TDS levels greater than 7,000 mg/L are unsafe, especially for old and young animals and should be avoided.

Case studies further support these recommendations (Patterson and Epperson et al., 2004; Patterson and Ward et al., 2004). Results indicate that drinking water for livestock with TDS concentrations of 4,720 mg/L causes only performance reductions in growing steers, while waters with TDS concentrations of 7,268 mg/L of TDS caused marked reduction in steer performance and health risks (Patterson and Epperson et al., 2004; Patterson and Ward et al., 2004). Health risks associated with high levels of TDS include occurrences of the disease polioencephalomalacia, which can result in death.

During the POR, there were six exceedances of the TDS limit, and the 95th percentile for the data was 4,760 mg/L. Based on the POR data and livestock and wildlife water quality guidelines, a limit is still needed for TDS. Therefore, the 2010 permit limit for TDS of 5,000 mg/L will be continued in the renewed permit.

Sulfate – There was no limit for sulfate in the 2010 permit but monitoring for this parameter was required. Sulfate in produced water often occurs from geochemical dissolution with gypsum and anhydrite and can easily exceed concentrations of 1,000 mg/L (Guerra et al., 2011).

Water high in sulfates can reduce water and feed intake and impact livestock health and performance, and even cause neurological disorders (Patterson and Johnson, 2003; Patterson and Epperson et al., 2004; Patterson and Ward et al., 2004; Raisbeck et al., 2008; Tjardes et al., 2004; Weeth and Capps, 1972). While the adverse effects on livestock are well documented, the recommended maximum drinking water concentration for sulfate varies from 1,800 mg/L (Raisbeck et al., 2008) to 5,000 mg/L (Tjardes et al., 2004). Furthermore, grazing livestock potentially have a higher tolerance to sulfate levels compared to feedlot animals (Patterson and Epperson et al., 2004; Patterson and Ward et al., 2004) and anecdotal evidence indicates that animals can become acclimated to sulfate in water (Hairston, 1995; Raisbeck et al., 2008). Lastly, no maximum concentration has been recommended for sulfate by either the National Academy of Sciences or the Council for Agricultural Science and Technology.

While the 2010 permit did not include a limit for sulfate, the prerequisite water quality analysis did have a maximum allowable concentration for sulfate of 2,500 mg/L (discussed in Section VIII.B). This value was exceeded 9 times during the POR out of a total of 149

samples. The highest recommended maximum concentration from the literature of 5,000 mg/L was never exceeded. Lastly, the 95th percentile of the DMR data for the POR was 2,865 mg/L, which is near the middle range of recommended maximum concentrations for sulfate.

Given the lack of consensus for a maximum concentration for sulfate, the ability of livestock (especially grazing animals) to tolerate or adjust to high levels of sulfate, and the POR data, no limit for sulfate is included in the renewed permit. However, monitoring will still be required in the renewed permit. Furthermore, the maximum allowable concentration for sulfate of 2,500 mg/L in the water quality analysis will continue in the renewed permit, as waters containing 2,500 mg/L of sulfate have been shown to have no effects on cattle (Digesti and Weeth, 1976).

Electrical Conductivity (EC) – The 2010 permit had no limits for EC but monitoring was required for this parameter. EC is a POC in produced waters, as produced waters can have high concentrations of anions and cations, which conduct electricity. High EC is an indicator that the water has high levels of inorganic dissolved solids, such as chloride, sulfate, or sodium, which can be detrimental to animals consuming these waters.

In the previous permit, the prerequisite water quality analysis had a maximum allowable concentration for EC of 11,000 µS/cm. For the POR, this value was only exceeded twice, and the 95th percentile for EC = 8,730 µS/cm. Therefore, effluent discharge is generally below the maximum concentration for EC. Furthermore, many of the constituents that cause high EC and are harmful to livestock or wildlife have maximum allowable concentrations specified in the water quality analysis discussed in Section VIII.B. While high EC is an indicator of low water quality, it is more applicable to restricting water use for irrigation or in areas where receiving waters already have high levels of EC, as in the Rosebud Creek, Tongue, Powder, and Little Powder River watersheds. This PWGP does not allow discharge of produced waters for irrigation uses, nor does it allow discharges in the aforementioned watersheds. Therefore, no limit will be applied in the new permit, but monitoring will continue to be required and the maximum allowable concentration of 11,000 µS/cm will also be continued in the renewed permit.

The 2010 permit required impoundment monitoring for EC. However, facilities that discharge to ephemeral drainages do not necessarily have constructed impoundments, so the applicability of this monitoring was unclear. Therefore, in the renewed permit, EC monitoring will be required at the outfall location. This is the discharge location prior to discharge into receiving waters and after all treatment.

Sodium Absorption Ratio (SAR) – The 2010 permit had no limits for SAR nor was monitoring required. SAR is a POC in produced waters, as produced water generally has high sodium ion concentrations. As discussed in previous sections, waters high in SAR and TDS can lead to negative impacts when used for irrigation by causing soil dispersion and reducing soil permeability (Ayers and Westcot, 1994; Davies et al., 2012). For these reasons, irrigation with produced water is generally not feasible, and irrigation is not a

beneficial use covered under the PWGP. No maximum concentration for SAR for livestock or wildlife drinking water was found in reference literature, and the water quality analysis has maximum allowable concentrations for the specific parameters which compose SAR and are protective of beneficial uses (discussed in Section VIII.B and in Table 5). Furthermore, the numeric standards for SAR are only applicable in the Rosebud Creek, Tongue, Powder, and Little Powder River watersheds, and discharges in these watersheds are excluded from coverage under this PWGP. Therefore no limit or monitoring for SAR will be required in the renewed permit.

The proposed WQBELs for all outfalls approved under this permit are summarized in Table 2. An outfall is the discharge location prior to produced water entering the receiving water and after all treatment has occurred.

Table 2: Outfall Proposed WQBELs[1]

Parameter	Units	Average Monthly	Maximum Daily	Rationale
Oil and Grease[2]	mg/L	Not Applicable	10	ARM 17.30.637(1)(b)
Total Dissolved Solids (TDS)	mg/L	5,000	Not Applicable	Beneficial Use for Livestock and Wildlife

Footnotes:
1. See definition section at end of permit for explanation of terms.
2. EPA Method 1664A, 40 CFR, Part 136, Table IB.

V. Final Effluent Limitations

Outfall(s) – Beginning on the effective date of this permit and lasting through the duration of the permit, the discharge from all outfalls shall, at a minimum, meet the effluent limits presented below and in Table 3. All of the limits are applicable at the end of the pipe, prior to discharge to receiving waters.

There shall be no discharge of waste pollutants into state waters other than ephemeral drainages from any source (other than produced water) associated with production, field exploration, drilling, well completion, or well treatment (including but not limited to drilling muds, drilling cuttings, and produced sands).

Table 3: Final Numeric Effluent Limits[1]				
Parameter	Units	Average Monthly	Maximum Daily	Rationale
Oil and Grease[2]	mg/L	Not Applicable	10	ARM 17.30.637(1)(b)
Total Dissolved Solids (TDS)	mg/L	5,000	Not Applicable	Beneficial Use for Livestock and Wildlife
Footnotes: 1. See definition section at end of permit for explanation of terms. 2. EPA Method 1664A, 40 CFR, Part 136, Table IB.				

VI. Monitoring and Reporting Requirements

Regulations requiring the establishment of monitoring and reporting conditions in MPDES permits are found at 40 CFR 122.44(i) and 122.48, and ARM 17.30.1351. All analytical procedures must comply with the specifications of 40 CFR Part 136 and the analysis must meet any Required Reporting Values (RRVs) listed in Circular DEQ-7 unless otherwise specified. If no RRV is listed, 1/10 of the limit should be used.

Samples shall be collected, preserved and analyzed in accordance with approved procedures listed in 40 CFR Part 136. Monitoring of the effluent must be representative of the volume and nature of the discharge. Effluent quality will be monitored at the discharge location (outfall) after all treatment has occurred prior to produced water entering the receiving ephemeral drainage and/or impoundment. Monitoring is required semiannually, and samples must be collected at least 5 months apart.

Monitoring is only required during periods of discharge. If no discharge occurs, permittees shall indicate "no discharge" on the DMRs for the effluent. Monitoring requirements are presented in Table 4.

Table 4: Outfall Monitoring Requirements			
Parameter	Units	Frequency	Sample Type[1]
Effluent Flow	gpm	Semiannual[2]	Instantaneous
Oil and Grease, mg/L[3]	mg/L	Semiannual[2]	Grab
Total Dissolved Solids (TDS)	mg/L	Semiannual[2]	Grab
Sulfate	mg/L	Semiannual[2]	Grab
Electrical Conductivity (EC)	µS/cm[4]	Semiannual[2]	Instantaneous

Footnotes:
1. See definition section at end of permit for explanation of terms. Monitoring is only required during periods with discharge to the receiving water.
2. Monitoring must be conducted at least five months apart.
3. EPA Method 1664A, 40 CFR, Part 136, Table IB.
4. µS/cm – microSiemens/cm.

VII. Nondegradation

This PWGP only allows the discharge of produced water into ephemeral drainages, which are not considered high quality waters and are not subject to the specific water quality standards of ARM 17.30.620 through 17.30.629 [ARM 17.30.637(4)]. However, for all state waters, existing and anticipated uses and the water quality necessary to protect those uses must be maintained and protected [ARM 17.30.705(2)]. This MPDES permit imposes pollutant effluents limits and a prerequisite water quality analysis based on livestock and wildlife drinking water requirements. These requirements ensure the water quality necessary to protect the beneficial uses of this water.

This PWGP includes monitoring, reporting, and corrective action requirements to establish, confirm, and maintain compliance with the permit limitations.

VIII. Special Conditions

The applicant must meet the following prerequisites to be authorized to discharge under the PWGP:

A. Produced Water Storage Capacity Self-Evaluation

Completion of a storage capacity self-evaluation and submission of the results on DEQ Form PW-1 must be included in the application package.

As discussed in Section II, this PWGP only authorizes produced water discharges that can be contained within ephemeral drainages and/or impoundments. The PW-1 Form is designed to allow a permittee to evaluate the storage capacity of the receiving ephemeral drainage and/or impoundment to ensure adequate storage for their produced water discharge. Using the PW-1 Form, permittees must demonstrate adequate storage capacity for the discharged produced water as a prerequisite for authorization under the PWGP.

The PW-1 Form includes a water balance calculation where inflow – outflow = storage. The main components of this balance are comprised of: annual inflow volume (produced water discharged + precipitation); annual outflow volume (evaporation + seepage loss + beneficial uses); and annual discharge needed to be stored. This equation is solved for storage volume, which represents the amount of water that must be held within the ephemeral drainage and/or impoundment. Attached to the PW-1, DEQ has provided an evaporation map for Montana and an appropriate evaporation coefficient (U.S. Department of Commerce, 1959 and 1968; Potts 1988) and an Animal Water Use Estimation Worksheet.

Based on all the included inflows and outflows, the applicant must demonstrate that the storage capacity of the ephemeral drainage and/or impoundment is adequate to contain the volume of produced water to be discharged.

B. Livestock and Wildlife Drinking Water Requirements

40 CFR Part 435, Subpart E, specifies that produced water for beneficial use must be "good enough quality to be used for wildlife or livestock watering or other agricultural uses." Therefore, as a prerequisite for coverage under this PWGP, the applicant must demonstrate the produced water is of high enough quality for beneficial use through a water quality analysis. Since this PWGP only considers the beneficial use of produced water for wildlife and livestock watering, a water quality analysis for the POC for produced water and wildlife and livestock watering is required.

These POC are summarized below and in Table 5, which provides the the maximum allowable concentration for any POC. The applicant must certify and demonstrate with a water quality analysis that the discharged produced water meets the beneficial use requirements as a prerequisite for coverage under this PWGP.

The Table 5 parameters and maximum allowable concentrations are based on recommended maximum concentrations from the National Academy of Sciences (1972) and National Research Council (1974), and recommendations and guidelines from the livestock industry and university research extension publications (Ayers and Westcot, 1994; Council for Agriculture Science and Technology, 1974; Digesti and Weeth, 1976; Raisbeck et al., 2008; Veenhuizen and Shurson, 1992). Only a universal maximum allowable concentration is set for each parameter, since it is not reasonable to set species-specific maximums in this general permit, and many wildlife drinking recommendations are based on livestock drinking recommendations (Raisbeck et al., 2008; Rosenstock et al., 2004).

Boron, copper, fluoride, and zinc are toxic parameters often found in produced water (Ramirez, 2002). Analyzing for these parameters will continue to be required in the renewed permit. The maximum allowable concentration for these parameters will remain the same in the renewed permit as in the 2010 permit.

Oil and grease, sodium, and TDS are parameters also found in produced waters. Analyzing for these parameters will continue to be required in the renewed permit. Except for sodium, the maximum allowable concentration for these parameters will remain the same in the renewed permit as in the 2010 permit.

The 2010 permit had no maximum allowable concentration for sodium, but high concentrations of sodium (>5,000 mg/L) can lead to serious health effects, even livestock death (Raisbeck et al., 2008). While some sources recommend a maximum concentration for sodium of 1,000 mg/L (Raisbeck et al., 2008), other studies have shown that livestock can tolerate acute levels up to 4,000 mg/L, particularly beef heifers in cooler climes, which easily tolerated levels around 2,000 mg/L (Weeth et al., 1968). More recent reviews have recommended a maximum concentration of 3,500 mg/L (Syracuse Research Corporation, 2008). The goal of these maximum allowable concentrations is to ensure the safe use of water for beneficial uses; however, the value must be reasonable and scientifically defensible. Therefore, since the National Academy of Sciences (1972) and the National Research Council (1974) have not recommended a maximum concentration for sodium, nor is there a consensus in the literature, a maximum allowable concentration which is the average of the maximum concentrations from the *Raisbeck et al., 2008* and *Syracuse Research Corporation, 2008* will be applied. Therefore, in the 2015 permit, a maximum allowable concentration for sodium of 2,250 mg/L will be applied.

Arsenic, nitrate, nitrite, selenium, and sulfate, are common parameters which are listed as toxic to livestock or wildlife and have recommended maximum concentrations. Analyzing for these parameters will continue to be required in the renewed permit. The maximum allowable concentration for these parameters will remain the same in the renewed permit as in the 2010 permit.

The 2010 permit required analyzing for total alkalinity, but no maximum allowable concentration was applied. Total alkalinity seldom limits the use of water quality for livestock watering, and establishing guidelines for this parameter has been difficult (Olson and Fox, 1981). However, excessive alkalinity can cause harmful effects, and a few sources have recommended a maximum concentration of 1,000 mg/L (Sigler and Bauder, 2012). However, neither the National Academy of Sciences (1972) nor the National Research Council (1974) has recommended maximums for this parameter, and little research exists currently. Therefore, no maximum allowable concentration is set for this parameter, nor will analysis be required in the renewed permit.

The 2010 permit also required analyzing for pH, EC, and SAR. These parameters are commonly measured in produced waters and they are indicators of general water quality; therefore, analyzing for these parameters will continue to be required in the renewed permit. The maximum allowable concentration for these parameters will remain the same in the renewed permit as in the 2010 permit.

Lastly, the 2010 permit required analyzing for calcium, magnesium, and TSS. No maximum concentration was established in the previous permit for these parameters, and

these parameters are represented in other constituents (calcium and magnesium are components of SAR). Therefore, no maximum allowable concentration is set for these parameters, nor will analysis be required in the renewed permit.

Table 5: Wildlife and Livestock Drinking Water Requirements

Parameter	Units	Type[1]	Maximum Allowable Concentration	Source
Arsenic, total recoverable	mg/L	Grab	0.5	Council for Agriculture Science and Technology, 1974
Boron	mg/L	Grab	5.0	National Academy of Sciences, 1972.
Copper, total recoverable	mg/L	Grab	0.5	National Academy of Sciences, 1972; National Research Council, 1974.
Electric Conductivity (EC)	µS/cm[2]	Grab	11,000	National Academy of Sciences, 1972; Ayers and Westcot, 1994.
Fluoride	mg/L	Grab	3.0	Council for Agriculture Science and Technology, 1974
Lead, total recoverable	mg/L	Grab	0.1	National Academy of Sciences, 1972; National Research Council, 1974.
Nitrate, as Nitrogen (N)	mg/L	Grab	100	National Academy of Sciences, 1972.
Nitrite, as Nitrogen (N)	mg/L	Grab	10	National Academy of Sciences, 1972.
Oil and Grease	mg/L	Grab	10	ARM 17.30.637(1)(b).
pH	s. u.	Grab	6.0 – 9.0	--
Selenium, total recoverable	mg/L	Grab	0.05	National Academy of Sciences, 1972.
Sodium	mg/L	Grab	2,250[3]	Raisbeck et al., 2008; Syracuse Research Corporation, 2008.
Sodium Adsorption Ratio (SAR)	None	Calculated	NA[4]	--
Sulfate	mg/L	Grab	2,500	Veenhuizen and Shurson, 1992; Digesti and Weeth, 1976.
Total Dissolved Solids (TDS)	mg/L	Grab	5,000	National Academy of Sciences, 1972; National Research Council, 1974.
Zinc, total recoverable	mg/L	Grab	25.0	National Academy of Sciences, 1972; National Research Council, 1974.

Footnotes:
1. See Definition section at end of permit for explanation of terms.
2. µS/cm – microSiemens/cm.
3. No maximum allowable concentration in previous permit, one included in renewed permit.
4. NA – Not applicable. No maximum allowable concentration in permit.

C. Compliance Schedule

The permittee shall meet and report on the following milestones by the dates specified in Table 6. Table 6 summarizes the dates by which renewing and new dischargers must submit a water quality analysis of the parameters outlined in Table 5.

Table 6: Compliance Schedule Requirements

Applicant Type	Compliance Event	Due Date
2010 Dischargers Renewing	Submission of a water quality analysis for the parameters specified in Table 5, ensuring that none of the maximum allowable concentrations are exceeded.	Within 6 months of the expiration date of the 2010 PWGP; sample date must be within two years prior to analysis submission date.
New Dischargers	Submission of a water quality analysis for the parameters specified in Table 5, ensuring that none of the maximum allowable concentrations are exceeded.	Included with NOI package; sample date must be within two years prior to NOI submission date.

IX. Other Information

On September 21, 2000, a U.S. District Judge issued an order stating that until all necessary total maximum daily loads under Section 303(d) of the Clean Water Act are established for certain water quality limited segments, the State is not to issue any new MPDES permits or increase permitted discharges for such segments. The order was issued in the lawsuit Friends of the Wild Swan v. U.S. EPA, *et al.*, CV 97-35-M-DWM, District of Montana, Missoula Division. The renewal of this permit does not conflict with the order because the permitted discharge does not represent a new or increased source of pollutants under the MPDES program and no discharge to state waters other than ephemeral drainages is authorized by this general permit.

X. Information Sources

Administrative Rules of Montana Title 17 Chapter 30 - Water Quality
Subchapter 12 – MPDES-Effluent Limitations and Standards, Standards of Performance, and Treatment Requirements.
Subchapter 13 – MPDES Permits.
Subchapter 2 – Permit Application, Degradation Authorization, and Annual Fees.
Subchapter 5 – Mixing Zones in Surface and Ground Water.
Subchapter 6 – Surface Water Quality Standards and Procedures.
Subchapter 7 – Nondegradation of Water Quality.

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Prepared by: Adam McMahon
December 2014