# COLORADO DISCHARGE PERMIT SYSTEM (CDPS) FACT SHEET TO PERMIT NUMBER COG840002

# GREENBACK PRODUCED WATER RECOVERY, LLC. GREENBACK SHAEFFER RANCH FACILITY GARFIELD COUNTY

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## I. GENERAL PARAMETERS OF CONCERN

#### A. General Parameters of Concern

The general permit identified the general pollutants of concern to be addressed in each certification and these are listed in the certification.

#### **B.** Organic Parameters of Concern

#### 1. Oil and Grease

The federal effluent limitations guidelines (40 CFR 435, Oil and Gas Extraction Point Source Category) do not apply, since this facility is a centralized <u>commercial</u> treatment facility\* for receiving exploration and production wastes and is subject to regulation as a solid waste treatment facility. This facility is not subject to the jurisdiction of the Colorado Oil and Gas Conservation Commission. Therefore, the oil and grease requirement is based on Regulation No. 62.

\*On October 27, 2010, the CDPHE's Solid Waste and Materials Management Unit sent a letter to Garfield County Board of Commissioners stating the technical plan for the facility is approved, with conditions, and a recommendation for County may approve of the proposed this facility, with the issuance of a Certificate of Designation, or CD. On November 1, 2010, the County approved this facility and the CD.

The application included analyses of samples of untreated produced water (Table III-2). While an oil and grease determination was not reported, data for the following related analyses are provided: TEPH (total extractable hydrocarbons) and TVPH (total volatile petroleum hydrocarbons).

2. Other Measures of Petroleum-Related Hydrocarbons

To measure the continued efficient performance of the treatment process, measures of hydrocarbons are added. Because it may be anticipated that the limits for a parameter could not be met without treatment, and the treatment is not coincidental to the movement of water through the facility, limits may be included to assure that treatment is maintained.

This facility operates a treatment system primarily designed to treat store and recycle produced water received from oil and natural gas gathering operations in the South Piceance Basin region. Since the potential exists for organic compounds to be present in the discharged produced water discharged and exceed water-quality standards when treatment is inefficient, crude oil related limits are needed to assure that treatment is maintained, even if the subject parameter is at very low levels in treated effluent (see Facility Description).

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While the above state-based effluent limitation for oil and grease is a limit related to treatment performance, there are other organic compounds that are not included in this parameter and these should be included as limits.

<u>BTEX</u>. Soluble, lighter weight organic compounds such as benzene, toluene, ethylbenzene and xylene can be present in elevated concentrations in produced waters. Due to their high solubility, the organic solvent used in oil and grease analysis extracts virtually none of them and , therefore, they do not contribute significantly to the oil and grease measurements. The concentrations of these organic chemicals in the combined, untreated produced water sample are provided in Table III-2.

The aquatic life based standards for each of these four organic compounds are applied in this certification. The water supply based standards are not applied since the discharge does not reach West Mamm Creek and thus is not available to any downstream diversions for water supply.

<u>Methanol.</u> This alcohol is a common additive used in oil and gas exploration and development operations in Colorado. In the handling of incoming water, produced waters with methanol will be sent to separate ponds for this type of produced water and waters from these ponds will not be sent to the reverse osmosis unit for treatment and possible discharge through the outfall. Thus, there is no need to monitor this alcohol in the outfall flow.

<u>Volatile and Semi-Volatile Organic Compounds</u>. The list of priority pollutants includes many volatile and semi-volatile organic compounds (VOCs and SVOCs) which are included in the water quality standards. Since the GreenBack facility can accept untreated waters from a number of differing sources (i.e., formations), the concentrations of VOCs and SVOCs will be variable. The VOC and SVOC results for untreated produced water samples (Table III-2) were generally below detection levels, except for volatiles related to BTEX.

Quarterly monitoring of VOCs and SVOCs (approximately 85 compounds) is required to document the occurrence of this possible variability and any compound which are in concentrations approaching the water-quality standard. These data can be used in two ways: basis for monitoring reduction and rationale for imposition of additional monitoring of a specific compound present in elevated concentrations.

## C. Radionuclide Parameters of Concern

1. Radium

Radium is commonly present in produced waters from certain Colorado formations. The standard for Radium 226+228 is 5 pCi/l.

No measurements of this parameter were furnished in the application and the permittee believes the levels in the treated effluent will be below this value. The monitoring frequency is annually.. However, if the level exceeds 3 pCi/l in a sample, the Division will initiate an amendment to require quarterly monitoring.

#### **D.** Toxcity Measures

1. WET Chronic Test

This limitation is imposed per requirements of the general permit.

Since this is a new discharge, evidence of passing the WET chronic test must be provided in the application for the permit or before the first discharge. Since the discharge is intermittent and the facility can store the discharge until passage of a WET chronic test, this requirement can be met. The permittee will adjust the salt balance in the discharge, because it is permeate from a reverse osmosis treatment unit, to a suitable level before WET testing (see Facility Description). The concentrate (reject brine) is not discharged and is routed back to the storage lagoons. If the WET test is passed, then WET testing is required on a quarterly basis when a discharge occurs. Subsequently, if the WET test is failed, then an automatic compliance schedule applies (see Part I.C.2.c of general permit).

#### II. SITE-SPECIFIC PARAMETERS OF CONCERN

The discharges is to an unnamed dry tributary that to West Mamm Creek (WBID: COCRLCR04A) which has the following beneficial uses: Recreation N, Water Supply, Agriculture, and Aquatic Life (Cold 2). This receiving water is reviewable and subject to Antidegradation Review.

#### A. Recreation N

The Class N (Not Primary Contact Use) designation indicates that these surface waters are not suitable or intended to become suitable for primary contact recreation uses. This classification shall be applied only where a use attainability analysis demonstrates that there is not a reasonable likelihood that primary contact uses will occur in the water segment(s) in question within the next 20-year period. Since there is no source of bacteria related to domestic sewage (i.e., *E coli*) contributing to the produced water, there is no need for further consideration of a limit to protection the assigned recreational uses.

## B. Agriculture and Water Supply

As explained in Facility Description, the discharge is low volume, intermittent, and will infiltrate into the bed of the dry tributary within several hundred feet downstream from the discharge point. There are no diversions on the dry tributary and the discharge will not reach West Mamm Creek where downstream diversions may be present. Thus, there is no need for additional limitations based on these beneficial uses of West Mamm Creek.

However, since the periodic discharge may serve as source for livestock or wildlife watering, a Total Dissolved Solids (TDS) limit of 3,500 mg/l is imposed per Division practice to protect range cattle.

Also, since the discharge is within the Colorado River watershed, total dissolved solids (TDS) monitoring is needed since Regulation No. 61 requires TDS monitoring for all discharges to the Colorado River watershed. The above TDS requirement will serve this second purpose.

#### C. Aquatic Life (Cold 2)

The dissolved metal concentrations in the water released through Outfall 001 (Table III-2) are expected to be substantially below the chronic water quality standards for aquatic life. The untreated produced waters, for example, had dissolved copper, lead, zinc, silver, selenium, and nickel concentrations below 10 ug/l – the detection level of the analytical method. The reverse osmosis treatment will remove 98 to 99% of the dissolved solids and dissolved metals from the produced water before release through the discharge point.

Since this is a new discharger the limits for metals provided in the general permits are applied in this certification. These limits are aquatic life based and, where hardness equations are used, the hardness value is 400 mg/l based on the effluent quality.

## **D.** Antidegradation Review

Since this is a new discharge, anti-degradtion based limits are imposed for numeric water-quality-based-effluent-limitations and are equal to 15% of the chronic water-quality standard.

#### E. Outfall Conditions

Two narrative conditions imposed on the impact of the outfall on the immediate receiving environment. Details on the outfall arrangement are provided under Facility Description.

#### **III. FACILITY DESCRIPTION**

A.	Colorado Business ID	Greenback – Produced Water Recovery, LLC Colorado Secretary of State ID: 20081623595
A.	SIC Code:	13000 Commercial Disposal Facility

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B.	Facility Classification:	Class C per Section 100.6 Operator Certification Re	2 of the <u>Water and Wastews</u> quirements	ater Facility
		Category 07 - General Pe Subcategory <u>17</u> Coal Dega 0.1 MGD. (Annual Fee <u>\$</u> 2	rmits asification-Process Water M 2 <u>.150,</u> effective July 1, 200	ore Than 7)
		The plant operator (Gregg Wastewater Operator and	Z. Neuhohr) is a Certified ( Certified Water Professiona	#13836) Class C Industrial l.
C.	Facility Location:	5.5 miles southeast of Rifl NE NE Section 12 – T7S-	e, Colorado 81650 R93W 6 <sup>th</sup> P.M.	
D.	Permitted Feature:	Outfall 001, after treatmer 39° 27' 59.11" N Latitude The location provided abo permit and is appropriate a to the receiving water.	at but prior to entering receiv , 107° 42' 52.84" W Longiti ve will serve as the point of as it is located after all treatm	ving water ude compliance for this nent and prior to discharge
E.	Facility Flows:	0.065 MGD		

#### F. Industry Description

The GreenBack Shaeffer Ranch facility (GreenBack facility) is a commercial disposal facility which will receive only produced water from more than one oil/gas extraction operation in the Hunter Mesa region. 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 intermittent discharge of treated water to adjacent surface waters requires a discharge permit from the Water Quality Control Division (WQCD). The general location, site features, and process diagrams are provided in Figures 1 through 7, which are located at the end of this Fact Sheet.

The primary purpose of the GreenBack facility is to treat, store, and recycle produced water generated from oil and gas gathering operations. The majority of the treated water will be returned to the oil and gas operators as treated waters and/or brines.

In contrast, there are several centralized, noncommercial produced water disposal facilities in the Hunter Mesa Federal Unit operated by EnCana Oil and Gas. The GreenBack facility is located next to the Hunter Mesa Centralized E&P Waste Management Facility (Figures 2, 3, and 4) which provides water disposal (evaporation, injection wells) in addition to beneficial reuse of produced water. The injection well can handle up to 4,000 bbls/day. Also, produced waters are handled at the Centralized E&P Waste Management Facility located off Dry Creek Road and at the Fox Lake Centralized E&P Waste Management Facility (on adjacent Grass Mesa Federal Unit).

#### G. Sources to the Treatment Plant

There are hundreds of oil and gas extraction operations (i.e., Williams Production Company, EnCana Oil and Gas, Bill Barrett Corporation) within several miles of the GreenBack facility (Figure 2) which may be sources to the Green Back facility. Since these facilities are extracting from basically the same formation, the produced waters should be comparable in water quality.

#### H. 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.

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#### Table III-1 – Chemical Additives

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.

#### I. Treatment Plant Description

The features of the plant description discussed below are provided in Figures 5, 6, and 7.

#### Screening of Incoming Produced Waters

The incoming produced water will be chemically screened, per requirement in the Certificate of Designation, to preclude entrance of hazardous materials. The GreenBack facility is designed to accept and treat up to 5,000 barrels/day (0.21 MGD).

#### Treatment for Recycling Produced Water

The produced water will treated with oil/water separation, mechanical solids removal, clarification by dissolved air flotation, and air stripping before release into the lined, storage ponds. The three ponds have a combined capacity of 35,000 barrels (1.5 million gallons) which is seven times the above daily maximum inflow.

There is no physically provision for water stored in these lined ponds to be released to Outfall 001 for discharge to surface waters.

Before the treated water (permeate) is released from the 4,000 gallon storage tank for discharge, the treated water will be tested for the parameters listed in the certification. If required, the treated water will be amended with potassium chloride to increase to specific conductivity to between 200 and 600 uS/cm to afford passage of the WET test , which is the recommendation of the analytical laboratory that will perform the WET testing. Once the testing documents compliance with the limitations, the stored water will be discharged along with outflow from the reverse osmosis unit which is assumed to be of the same quality.

#### Treatment for Potable Water Supply

To meet the on-site needs for potable water (i.e, toilet flushing, sink use, truck washing, washing exterior surfaces), additional treatment is provided to a diverted portion of the flow to the storage ponds through reverse osmosis and possibly selective ion exchange. This highly treated water is piped to a 4,000 gallon storage tank for use as the potable water supply.

The GreenBack 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.

#### Option for Discharge to Surface Water

There is an option to release water from the potable water tank for discharge, through Outfall 001, to surface water. This will be an infrequent action and would only occur as a waste minimization process should the large, holding ponds become full.

## H. Produced Water

<u>Flows</u>

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In the permit application, the maximum rate of water discharge at Outfall 001 is listed as 0.150 MGD (3,571 bbls/day). The discharge to the dry tributary would only occur as a waste minimization process should the holding pond become full. About 10% of the produced water off-loaded (0.105 MGD) to the GreenBack facility will be treated. With a permeate discharge from the Reverse Osmosis unit (45 gallons per minute), the schedule is to discharge 226,800 gallons over a period of 3.5 days with an average flow of 0.065 MGD. This rate is 43% of the above maximum flow rate provided in the application.

There is control on the timing of this intermittent discharge to limit the discharge to comply with the exemption for WET chronic testing, including - no further discharge when this time period is reached, no discharge during precipitation, and no discharge when snow melt flow is present in the normally dry tributary at the location of Outfall 001. The operator can be selective in the timing of the discharge since the volume of pond storage is large compared to the incoming produced water volumes. Further, as a best management practice, the operator will visually monitor the discharge flow to ensure that the water does not encroach within 0.5 mile of Mamm Creek.

The permit application included a conveyance loss assessment for the discharge in the dry tributary. At the site, the documented infiltration rate is 30 inches/inch. After discharge, the water can easily traverse over a 10 foot area in the in the swale bottom of the tributary. At a 00.0028 ft/minute infiltration rate the resulting volume per 10 sq/ft would be 0.21 gpm. This value divided into the above 45 gpm expected discharge flow yields 217 sq/ft of dry tributary to infiltrate all of this discharge. This estimate neglects ponding (which increases infiltration), evaporation, and other consumptive losses. Since the length of the tributary from the discharge point to the entrance into West Mamm Creek is approximately 2.3 miles (12,000 feet), the possibility of the discharge reaching the creek is extremely unlikely unless excessive precipitation or snow melt runoff occurs during the intermittent discharge. As noted above, the GreenBack facility would not schedule a discharge area based on a geotechnical investigation performed by the permittee. Further, the surface soils in the vicinity of the periodic discharge will be protected with 8-inch riprap to prevent erosion. Views of the dry swale in the area of the proposed discharge point are provided in Figures 8 and 9.

#### Water Chemistry

Since the GreenBack facility is not in operation, there are no actual samples of the discharge for chemical characterization. However, the permit application included chemical analyses of local produced water samples that are expected to be delivered to the GreenBack facility for treatment and data on the performance of the reverse-osmosis treatment step (i.e., generation of permeate which may be be discharged through Outfall 001). These data are listed in Table III-2 for the following samples:

- 01- Untreated produced water: DLHC3FB source collected 07/16/2008
- 02- Untreated produced water: NOB4PRODW source collected 07/16/2008
- 03- Untreated produced water: NOB5AGPOLFD source collected 07/16/2008
- 04- Untreated produced water: Composite of above mixed on 07/16/2008
- 05- RO Model- Feed water (i.e., treated produced water before discharge to ponds)
- 06- RO Model Concentrate (i.e., can be recycled as brine to oil/gas operations)
- 07- RO Model- Permeate (i.e., intermittent discharge through Outfall 001)

Table III-2. Chemical Data for Untreated Produced Water and RO Water	rs
----------------------------------------------------------------------	----

	Chemical Data							
Parameter	Untreated Produced Water				RO Waters			
Name	Units	01	02	03	04	05 Feed Water	06 Brine	07 Permeate
General Parameters								
Flow	MGD							0.15
Temperature	C							
Total Suspended Solids	mg/l							
Total Dissolved Solids	mg/l	48,420	16,020	27,990		11,037	27,281	207
pH	s.u.	6.88	7.98	7.49		7.7	8.0	6.2
Chlorides	mg/l	26,388	9,461	15,043		5,730	14,187	93
Sulfates	mg/l					252	629	1

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Organic Parameters								
Oil and Grease	mg/l							
Total Extractable Petroleum								
Hydrocarbons (TEPH)	mg/l							
Total Volatile Petroleum								
Hydrocarbons (TVPH)	mg/l							
Benzene	ug/l				4,580			
Toluene	_ug/1				8,040			
Ethylbenzene	ug/l				711			
Xylenes, Total	ug/l				5,570			
Methanol	mg/l							
VOCs and SVOCs			Due to lar	ge numbe	r of entrie	es, placed a	t end of tab	le
Metal Parameters								
Aluminum, Dissolved	ug/l	300	680	<10				
Antimony, Dissolved	ug/l	<10	<10	<10				
Arsenic, Dissolved	ug/l	<10	<10	<10				
Barium	mg/l	131	63.6	2.8		0	0	0
Beryllium	ug/l	<10	<10	<10				
Boron	mg/l	6.9	2.3	7.4		7.95	12.36	5.0
Cadmium, Dissolved	ug/l	<10	<10	<10				
Chromium, Dissolved	ug/l	<10	<10	<10				
Cobalt	ug/l	<10	<10	<10				
Copper, Potentially Dissolved	ug/l	<10	<10	<10				
Iron, Dissolved	ug/l	<10	<10	<10				
Lead, Potentially Dissolved	ug/l	80	40	<10				
Manganese, Dissolved	ug/l	480	100	420				
Mercury, Dissolved	ug/l	<2	<2	<2				
Molybdenum	ug/l	<10	<10	<10				
Nickel, Potentially Dissolved	ug/l	<10	<10	<10				
Potassium, Dissolved	mg/l	2,010	269	1,330		707	1,745	15.2
Selenium, Dissolved	ug/l	<10	<10	<10				
Silver, Potentially Dissolved	ug/l	<10	<10	<10				
Strontium, Dissolved	mg/l	125	21.1	31.3		27	67	0.097
Thallium, Dissolved	ug/l	<10	<10	<10				· · · · · · · · · · · · · · · · · · ·
Vanadium	ug/l	<10	<10	<10				
Zinc, Potentially Dissolved	ug/l	<10	<10	<10				
Radionuclide Parameters	1	<b></b>					I	
Radium 226+228	pCi/l	1						· · · ·
Toxicity Measures								
WET Acute								······
Pimephales Lethality	NA							
WET Acute	-							
Ceriodaphnia Lethality	NA							
Other Measurements: Nutrient	ts and Oth	er Non-M	letal Inorg	ganics				
Acetate	mg/l	182	48.2	194				
Bromide	mg/l	244	85.7	161				
Fluoride, Total	mg/l	< 0.05	1.1	< 0.05		12	30	0.4
Nitrogen, Total Ammonia N	mg/l					0	0	0
Nitrogen, Nitrate	mg/l	< 0.05	< 0.05	< 0.05		125	291	15
Nitrogen, Nitrite	mg/l	< 0.05	< 0.05	< 0.05				
Phosphate, (as P)	mg/l	< 0.05	5.3	< 0.05				
Sulfide, as Hydrogen Sulfide	mg/l	0.8	1.1	318		252	629	1
Other Measurements: Paramet	ters from	Policies (P	rotection	of Irrigat	ted Crops	s) .		
Sodium, Dissolved	mg/l	13,100	5,660	7,590		3,650	9,029	63
Calcium, Dissolved	mg/l	923	126	308		5	12.5	0.018
Magnesium, Dissolved	mg/l	124	21.4	48.7		5	12.5	0.018
Sodium Absorption Ratio	NA	101	123	106		276	432	79
Hardness, as CaCO3	mg/l	1,000+	400	961		33	83	1.2

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Alkalinity, as CaCO3	mg/l	780	1903	1927				T
Sodium Absorption Ratio SAR		107	261	106				
Volatile and Semi-Volatile Org	anic Com	ounds (V	OCs and	SVOCs)			_L	1
Benzene	110/l	<u>/////////////////////////////////////</u>	O CD unu	51005	4 580		Constant of the second s	
Bromobenzene	119/1				<0.5			
Bromochloromethane	<u>ng/l</u>				<0.5			
Bromodichloromethane (HM)	<u>ug</u> /1 11g/1				<0.5			
Bromoform (HM)	110/1				<0.5			
Bromomethane	110/1				<0.5			
Carbon Tetrachloride	110/1				<0.5			
Chlorobenzene	$\frac{ug}{n\sigma/l}$				<0.5			
Chlorodibromomethane (HM)	<u>ug/1</u> 110/1		·		<0.5			
Chloroethane	<u>ng/1</u>				<0.5		1	
Chloroform (HM)	110/1				<0.5			
Chloromethane	<u>ug/1</u> ng/1				<0.5			
4-Chlorotoluene	<u>ug/1</u> ug/1				<0.5			
2-Chlorotoluene	<u>ug/1</u> 110/1				<0.5			
Dibromomethane	ug/1 10/1				<0.5			
Dichlorobenzene 1.2	ug/1 ug/1				<0.5			
Dichlorobenzene 1.3	ug/1				<0.5			
Dichlorobenzene 1.4	<u>ug/1</u> ug/1				<0.5			
Dichloroethane 1.2	ug/1				<0.5			
Dichloroethane 1,1	ug/1				<0.5			
Dichloroethylene 1,1	$\frac{ug/1}{ug/1}$				<0.5			
Dichloroothylono 1.2 cic	ug/1				<0.5			
Dichloroethylene 1,2 cis	ug/1				<0.5			
Dichloropropage 1.2	ug/1				<0.5			
Dichloropropane 1,2	ug/1				<0.5			
Dichloropropane 2.2	$\frac{ug/1}{ug/1}$				< 0.3	· · · · · · · · · · · · · · · · · · ·		
Dichloropropane 1, 1	ug/1				<0.5			
Dichloropropene 1, 1					<0.5			
Dichloropropene 1,3 trans	ug/1				<0.5			<u> </u>
Ethylbenzene	ug/1				711			
Ethylone dibromide EDP	ug/1				$\frac{711}{5}$			
Heyachlorobutadiene	$\frac{ug/1}{ug/1}$				<0.5			
Isopropylbopzepe	ug/1				<u> </u>			
Isopropylbenezene	ug/1				05.7			
Isopropyltoluone	ug/1				70.1			
Mathyl ablarida	ug/1				/0.1			
Nonhthalena	ug/1				<0.5			
Sturono	ug/1				<0.5			
Trichlorofluoromethane	$\frac{ug/1}{ug/1}$			<b></b>	<0.5			
Themoronation and the second s	ug/1				<0.5			
Tetrachloroethylone (DCE)	ug/1				<0.5			
Teluano	ug/1				<u> </u>			
Trichlorchongene 1.2.4	ug/1				<u>8,040</u>			
Trichloroothoro 1,1,1 (TCA)	ug/1				<0.5			
Trichlaroothana 1,1,1 (TCA)					<u> </u>			<u> </u>
Trichlangethylang (TCE)	ug/1				<0.5		+	
Inchloroethylene (ICE)					<u> </u>			<u> </u>
Tring at health and a second second					1,404			
Trimethylbergene 1,2,4	ug/1				1,219			+
Vinet ablanida	ug/1				1,011			
V myl chloride	ug/1				<0.5			
Ayienes, Iotal	ug/1				5,570	I		1

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# J. PERFORMANCE HISTORY

Since this is a new discharge, there is no information or data concerning performance history.

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# FIGURE 1. LOCATION MAP



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# FIGURE 2. AERIAL PHOGRAPH OF SITE ENVIRONS



< West

The facility in the center of the photograph is Encana's Hunter Mesa Compressor Station.

The proposed location of the GreenBack Shaeffer Ranch Facility is adjacent to the western boundary of the compressor station.

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# FIGURE 3. AERIAL PHOTOGRAPH OF VACANT, FACILITY SITE



< West

The location of the proposed facility is immediately south of the compressor station.

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# FIGURE 4. AERIAL PHOTOGRAPH WITH PROPOSED FACILITY



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# FIGURE 5. PROPOSED SITE PLAN





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FIGURE 8. Proposed Discharge Point to Dry Swale Area (NW View)



Dry Tributary Looking NW Near Discharge Point

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Looking SW in Dry Tributary