

FORM 28 ATTACHMENT
Centralized Exploration & Production Waste Management Facility- 908 Permit Application
Walden Land Treatment Facility
Bonanza Creek Energy Operating Company LLC
Jackson County, Colorado

Bonanza Creek Energy Operating Company LLC (BCEOC) has prepared this Form 28 Attachment for the Walden Land Treatment Facility (Site) located in Jackson County, Colorado. This attachment documents how BCEOC has/will meet the requirements of the Colorado Oil and Gas Conservation Commission (COGCC) 900 Series Rules for Exploration and Production (E&P) Waste Management, Section 908 for Centralized E&P Waste Management Facilities. The property on which the Walden Land Treatment Facility is situated is owned by:

Bonanza Creek Energy Operating Company LLC
410 17th Street, Suite 1400
Denver, CO 80202

Primary Facility Contact:

Mr. Brian Dodek
Senior Environmental Specialist
410 17th Street, Suite 1400
Denver, CO 80202
720-225-6653

Upon receipt of an approved Form 28 Permit, BCEOC will operate the Site as a centralized E&P waste management facility designed for the treatment of petroleum hydrocarbon impacted soil, tank bottoms, drilling fluids, and associated drill cuttings. The petroleum hydrocarbon impacted soil and tank bottoms will be treated in the facility's existing land treatment area and the drilling fluids and cuttings will be applied to the facility's adjoining land application area. All E&P wastes accepted at the Site will be generated by BCEOC.

Site Description and History

The Site is located in Jackson County, Colorado, approximately 5 miles northeast of Walden, Colorado. The Site is located in the northeast quarter of Section 18, Township 9 North, Range 78 West and the southeast quarter of Section 7, Township 9 North, Range 78 West. The Site occupies approximately 4.5 acres, of which, approximately 1.4 acres is dedicated to the existing land treatment area. The proposed land application area will encompass approximately 2.2 acres and will be permitted as part of the centralized E&P waste management facility under Section 908. The remainder of the Site accommodates the associated access roads, stormwater controls, perimeter fencing, and buffer zone. A topographic Site Location Map is provided as Figure 1.

The Bourg Strip Mine, which operated from 1980 to 1987, was the first developed use of the Site. A portion of the former strip mine that includes the current land treatment area was backfilled, graded, and seeded in October 1988. The State of Colorado, Division of Minerals

and Geology released a Phase I bond to the mine owner, Flatiron Companies, in October of 1988, following reclamation of the strip mine. The Phase II and Phase III bonds were released to Flatiron Companies in January 2000.

BCEOC purchased the property from Nielson & Associates, Inc., an oil and gas producer, in May 2006 to support its limited oil and gas production operations in North Park, Colorado. Nielson & Associates, who had purchased the property from Flatiron Companies, constructed and operated an unpermitted land treatment (E&P waste) facility at the Site prior to BCEOC purchasing the property in May 2006. Nielson & Associates' use of the facility was reportedly limited to the treatment of petroleum hydrocarbon impacted soil and tank bottoms. At this time, BCEOC is seeking to permit the Site for use as a centralized E&P waste management facility under the COGCC Section 908 rules.

Site Characteristics (Topography, Geology, Hydrology)

There are no surface water bodies on or adjacent to the Site. The Site and adjacent land drain to the intermittent Mann Draw, which is located approximately 2,000 feet to the northwest of the Site. The Mann Draw has its confluence with the Canadian River approximately 1.8 miles to the north of the Site. The local topography is gently rolling. The Site is situated on a flattened hill top at an approximate elevation of 8,150 feet above mean sea level and slopes gently away to the east, north, and west (see Figure 1).

On September 20 and 21, 2011, five soil borings (SB01 through SB05) were advanced at the Site using a hollow stem auger drilling rig. Soil borings SB01 through SB04 were advanced around the perimeter of the Site and soil boring SB05 was advanced through the existing land treatment area. The soil borings were used to evaluate the geologic and hydrogeologic conditions at the Site. The soil borings were continuously sampled using a 5-foot long stainless steel split spoon sampler. The soil samples were screened for volatile organic compounds using a photoionization detector (PID). The PID headspace readings and soil descriptions were recorded in the field on soil boring logs. Copies of the soil boring logs are presented in Appendix A.

The soil samples indicate that subsurface soil consists of medium-grained to fine-grained sand with gravel and silt from ground surface to depths of approximately 11.5 feet to 37 feet below ground surface (bgs). These unconsolidated materials are underlain by weathered claystone and sandstone. Narrow seams of coal (approximately 1 foot in thickness) were encountered in soil borings SB02 and SB03 at depths of 20.5 feet and 10.5 feet bgs, respectively. Soil borings SB01 through SB04 were advanced to refusal within the claystone or sandstone bedrock at total depths ranging from 34 feet to 59 feet bgs. Soil boring SB05 was advanced to a total depth of 10 feet bgs within the land treatment area. To assess for the presence of groundwater, soil borings SB01 through SB04 were completed as monitoring wells MW01 through MW04, respectively. A Site Map showing the soil boring and monitoring well locations is presented as Figure 3.

Groundwater was not encountered in any of the monitoring wells upon their completion or upon observation 12 days following installation. A summary of the monitoring well depths, attempted sample dates, and survey data is provided in Table 1. To eliminate the risk of adjacent conduits

to the subsurface, the monitoring wells will be abandoned per Colorado Division of Water Resources regulations.

PID headspace readings greater than 6.0 parts per million (ppm) were not recorded in soil borings SB01 through SB04. A PID headspace reading of 201 ppm was recorded at a depth of 3 feet bgs in soil boring SB05. However, a PID headspace reading of 0.6 ppm was recorded at a depth of 7 feet bgs in soil boring SB05, which indicates prior use of the Site as a soil treatment facility had not resulted in significant migration of petroleum hydrocarbons into the subsurface.

One soil sample was collected from each soil boring at a depth of 10 feet bgs for laboratory analyses of total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and total xylenes (BTEX) by Environmental Protection Agency (EPA) Methods 8015 and 8260B. A second soil sample was collected from soil boring SB05 at a depth of 3 feet bgs based on the elevated PID reading recorded at that depth. TPH and BTEX concentrations were below COGCC Table 910-1 allowable levels and below the laboratory reporting limits in all of the soil boring samples. The soil boring soil sample analytical results are summarized in Table 2.

Adjacent Land Use

The land surrounding the Site is generally undeveloped Bureau of Land Management (BLM) rangeland. The vegetative cover is primarily sagebrush and native grasses consistent with the high desert ecology. Land uses include cattle grazing (leases), oil and gas production (leases), and limited recreation on the BLM land. The closest structure (single family residence) is located approximately 1.6 miles to the southeast of the Site.

Waste Profile

The Site is designed to accept petroleum hydrocarbon impacted soil, tank bottoms, drilling fluids, and drill cuttings generated as a result of BCEOC's exploration and production activities in North Park, Colorado. These wastes meet the definition of Resource Conservation and Recovery Act (RCRA) exempt E&P waste. The petroleum hydrocarbon impacted soil and tank bottoms will be treated in the facility's existing land treatment area. Drilling fluids and associated drill cuttings will be applied to the facility's proposed land application area as a beneficial soil amendment. The proposed facility layout is presented in Figure 3. The amount of waste to be received and managed at the Site will be dependent on the phase and extent of BCEOC's oil and gas operations; however, it is estimated that less than approximately 500 cubic yards (yd³) of petroleum hydrocarbon impacted soil and 50 yd³ of tank bottoms will be treated in the land treatment area on an annual basis. In 2016, BCEOC has plans to drill one new oil and gas well in North Park, Colorado. Approximately 500 yd³ of drill cuttings and fluids will be applied to the land application area as a result of the new well.

Facility Design and Engineering

The Site is designed to accommodate a 100-year, 24-hour storm event, as defined by the National Oceanic and Atmospheric Administration (NOAA) Atlas 2 Precipitation Frequency for 11 Western States. Additional drainage swales and culverts will be installed to transport stormwater run-off from the Site and prevent erosion. The locations and sizing of the surface

water diversion structures (berms, swales, and culverts) are depicted on the Survey Plan provided as Figure 4.

The facility is designed with run-on and run-off control systems capable of containing the water volume from a 25-year, 24-hour storm event. The existing containment berm will be repaired, raised, and compacted, as necessary, to achieve the proper dimensions, as detailed in the engineered Survey Plan provided as Figure 4. In addition to the existing earthen berm that surrounds the land treatment area, an earthen containment berm will also be constructed around the proposed land application area as depicted on Figure 4. The earthen containment berms are designed to prevent both the run-on and run-off of surface water to or from the active treatment areas at the Site. Since the topography generally slopes away from the Site in all directions, the potential for surface flow to run on to the Site during a storm event is minimal. The design calculations used to engineer the facility for a 25-year, 24-hour storm event are included as Appendix B.

A 10-foot wide buffer zone will be cleared around the perimeter of the land treatment area. This buffer will consist of a grubbed vegetative strip. An access road will be added around the active land treatment area, inside the perimeter berm and fence, to facilitate vehicle and equipment access to the treatment pods. A 10-foot wide fire lane is not included in the facility design. Mr. Jeff Benson, the Fire Chief for the North Park Fire Rescue Authority (NPFRA) met BCEOC personnel at the Site and concluded that, based on the size and layout of the facility, a fire lane will not inhibit or prevent NPFRA personnel or equipment from extinguishing a fire at the facility. A letter from the NPFRA Fire Chief to BCEOC dated June 15, 2015 is provided in Appendix C.

Operating Plan (Land Treatment Facility)

BCEOC will employ land treatment and composting techniques to enhance biodegradation of petroleum hydrocarbons via the naturally-occurring microbes present at the Site. As described above, the Site will be used to treat only non-hazardous, RCRA exempt wastes generated as a result of BCEOC's exploration and production activities in North Park, Colorado. The materials to be treated include;

- Petroleum hydrocarbon impacted soil from spills at wells, tank batteries, drilling pads, production pit closures, and other site decommissioning and reclamation activities;
- Unsaturated, hydrocarbon impacted sedimentation cleaned from the bottom of production tanks, and;
- Drill cuttings and drilling fluids generated during oil and gas well drilling.

The land treatment facility will not receive any materials that are listed or defined as hazardous wastes under Subtitle C of RCRA, saturated soil, frac sand or fluids, or liquid petroleum hydrocarbons.

The E&P exempt waste will be applied to the surface of the active land treatment area (pods) in lifts no greater than 18 inches thick. Tank bottoms will be mixed with petroleum hydrocarbon impacted soil during the application process.

BCEOC proposes to utilize the naturally-occurring, in situ bacteria to degrade the hydrocarbons and augment microbial reproduction and metabolism through additions of oxygen, water, and nutrients. The impacted soil, when present, will be disked at least once a month to aerate the soil and enhance aerobic biodegradation of the hydrocarbons. Fresh water will be applied by water truck as needed to maintain adequate soil moisture to support microbial growth. A granular chemical fertilizer containing nitrogen, phosphorous and potassium may be applied to the soil to promote microbial growth and biodegradation of the petroleum hydrocarbons, as necessary, to achieve COGCC allowable levels for TPH and BTEX. As a result of the high altitude weather, the soil working season is comparatively short at this location. If soil remediation or operational issues are impacted by weather, BCEOC may evaluate use of additional remedial products such as bacteria or chemical oxidants to supplement the land treatment activities discussed above.

To limit dust emissions, disking will not be performed when wind speeds exceed 25 miles per hour. Excess watering will be avoided to prevent pooling, ponding, runoff, and/or infiltration. Excess moisture can also retard growth of the bacteria and inhibit aerobic hydrocarbon biodegradation. The pH level in the land applied soil will be monitored periodically in an effort to maintain the soil pH between 6.5 and 9.0, which is the optimal range for bioremediation.

Upon arrival at the Site, E&P waste deposited in the land treatment area will be spread evenly across the western-most treatment pod (see Figure 3). As the TPH concentrations are reduced and new soil arrives at the facility, the soil in treatment pod 1 will be moved to the east and processed through treatment pods 2 and 3, as needed. Once field observations (staining and odor) and field screening measurements (PID headspace readings) suggest TPH concentrations in the treated soil are below the COGCC allowable level of 500 milligrams per kilogram (mg/kg), confirmation soil samples will be collected for laboratory analysis. One three-point composite sample will be collected from each treatment pod being sampled. Treated soil confirmed to have TPH and BTEX concentrations below COGCC Table 910-1 allowable levels will be stockpiled in treatment pod 4 until the soil can be removed from the land treatment area for beneficial reuse at another BCEOC facility located in North Park, Colorado. Beneficial reuse may consist of berm and lease road construction/maintenance or backfill.

The land treatment facility is identified by a posted sign near the Site entrance that includes emergency contact information. Unauthorized use and access to the facility by wildlife or livestock is restricted by a new barbwire perimeter fence and a locked cattle gate at the entrance to the land treatment area. The Site will not have regular hours of operation, but shall be accessed by BCEOC personnel on an as-needed basis. However, Site operations will only occur during daylight and normal business (8 AM to 6 PM) hours. The volume and origin of E&P waste entering the Site will be tracked using internal BCEOC manifesting procedures. These records will be maintained for a minimum of three years.

Operating Plan (Land Application Area)

Drilling fluids and cuttings applied to the proposed land application area, will be applied in lifts no greater than 3 inches thick. The drilling fluids and cuttings will be incorporated into the sandy soil as a beneficial soil amendment as soon as practicable using a disk harrow.

Drill cuttings and fluids delivered to the proposed land application area will be spread and incorporated within 10 days or as soon as Site conditions will permit. The land application area will be sampled on an annual basis, if the land application area was utilized in the preceding year. A four-point composite soil sample will be collected and submitted for laboratory analysis of TPH, BTEX, pH, EC, and SAR and the analytical results will be compared to COGCC Table 910-1 allowable levels.

Local Government Notification

BCEOC contacted Jackson County and received verbal approval to operate the Site shortly after taking possession of the North Park leases and the pre-existing land treatment facility from Nielson & Associates, Inc. A copy of an email that summarizes a recent conversation between BCEOC and the Jackson County Administrator, Mr. Kent Crowder, is included in Appendix C. Mr. Crowder indicated use of the Site as a centralized E&P waste management facility has been approved by Jackson County and additional permitting is not necessary.

In addition, a copy of this permit application will be mailed to Mr. Crowder and the Jackson County Commissioners, at the following address:

Jackson County
Attn: Kent Crowder, Jim Murphy, Ben Clayton, and Lanny Weddle
404 4th St
P.O. Box 1019
Walden, CO 80480-0337

Groundwater Monitoring

Groundwater was not encountered in the four soil borings (SB01 through SB04) completed as monitoring wells MW01 through MW04. The continued absence of groundwater in the monitoring wells indicate shallow groundwater is not present beneath the Site to a minimum depth of 59 feet bgs. Groundwater monitoring, as required by COGCC Rule 908b(9) is therefore impracticable. Furthermore, the potential for the petroleum hydrocarbons in the unsaturated E&P wastes that will be treated on the surface of the Site to migrate through the subsurface to a depth where groundwater is present (>59 feet bgs) is highly improbable. This is supported by the boring log for soil boring SB05, which was advanced through the land treatment area and indicated that soil with detectable petroleum hydrocarbon concentrations (below COGCC allowable levels) did not extend more than 3 feet bgs. Based on the depth to groundwater (>59 feet bgs) and absence of groundwater in monitoring wells MW01 through MW04, BCEOC proposes that these wells be properly abandoned upon approval of the 908 permit to eliminate a potential conduit to the subsurface.

In addition to the absence of shallow groundwater in the monitoring wells completed at the Site, Colorado Department of Natural Resources, Division of Water Resource's well permit records indicate there are no permitted water wells located within one mile of the Site.

Closure Plan

As noted in the Operating Plan above, treated soil with TPH and BTEX concentrations confirmed to be compliant with COGCC Table 910-1 allowable levels will be stockpiled in the easternmost treatment pod (4). Once all the soil remaining on Site has been treated and stockpiled in treatment pod 4 (or removed from the facility for reuse), BCEOC will conduct pre-closure soil sampling. Soil samples will be collected from native soil in each treatment pod from 0 to 5 feet bgs and screened using a PID. The soil sample interval with the highest PID headspace reading will be submitted for laboratory analysis of TPH and BTEX. The analytical results will be compared to COGCC Table 910-1 allowable levels and additional soil treatment will be undertaken, as needed, until confirmation soil sample results indicate allowable levels have been achieved in both the residual land treated soil and the native soil underlying the treatment pods.

Following pre-closure confirmation soil sampling, any treated soil remaining in pod 4 will be incorporated into the Site during grading activities that will contour the Site to blend with the surrounding native grade. The perimeter fencing, gate, and signage will be removed from the Site. The earthen containment berms will be graded out and incorporated into the surrounding topography during final reclamation. Following final incorporation and completion of the grading activities, a final round of representative soil samples will be collected for pH, electrical conductivity (EC) and sodium adsorption ratio (SAR) analysis and the results will be compared to COGCC Table 910-1 allowable levels. If needed, soil amendments will be added to the top soil to bring the soil pH, EC, and SAR levels to within allowable levels prior to seeding.

Once the Site has been graded and is fully compliant with COGCC Table 910-1 allowable levels, the Site will be seeded with a native blend of sagebrush and desert grasses consistent with the adjacent plant community. A site-specific stormwater management plan will be created, stamped by a registered P.E., and added to the BCEOC field-wide stormwater management program for North Park, Colorado. Post-construction stormwater inspections will be conducted on a monthly basis until the vegetative cover reaches 70 percent of that present on the surrounding land. Best-management practices (BMPs) will be installed, as needed, to prevent erosion and sediment runoff prior to stabilization.

A Form 4 closure report, summarizing the field activities and confirmation soil sample analytical results and requesting Site closure will be submitted to the COGCC for approval. A summary of the estimated reclamation costs for the tasks described above is provided in Table 3.

Financial Assurance

A copy of BCEOC financial assurance information (as documented on the COGCC website) is presented in Appendix D.

References

Western Regional Climate Center, *Average Annual Precipitation Map*,
<http://www.wrcc.dri.edu/pcpn/co.gif>

Western Regional Climate Center, *Average Annual Pan Evaporation Table*,
<http://www.wrcc.dri.edu/htmlfiles/westevap.final.html>

National Oceanic and Atmospheric Administration, *Atlas 2 Precipitation Frequency Estimates for 11 Western States*, <http://www.nws.noaa.gov/oh/hdsc/noaaatlas2.htm>

FIGURES

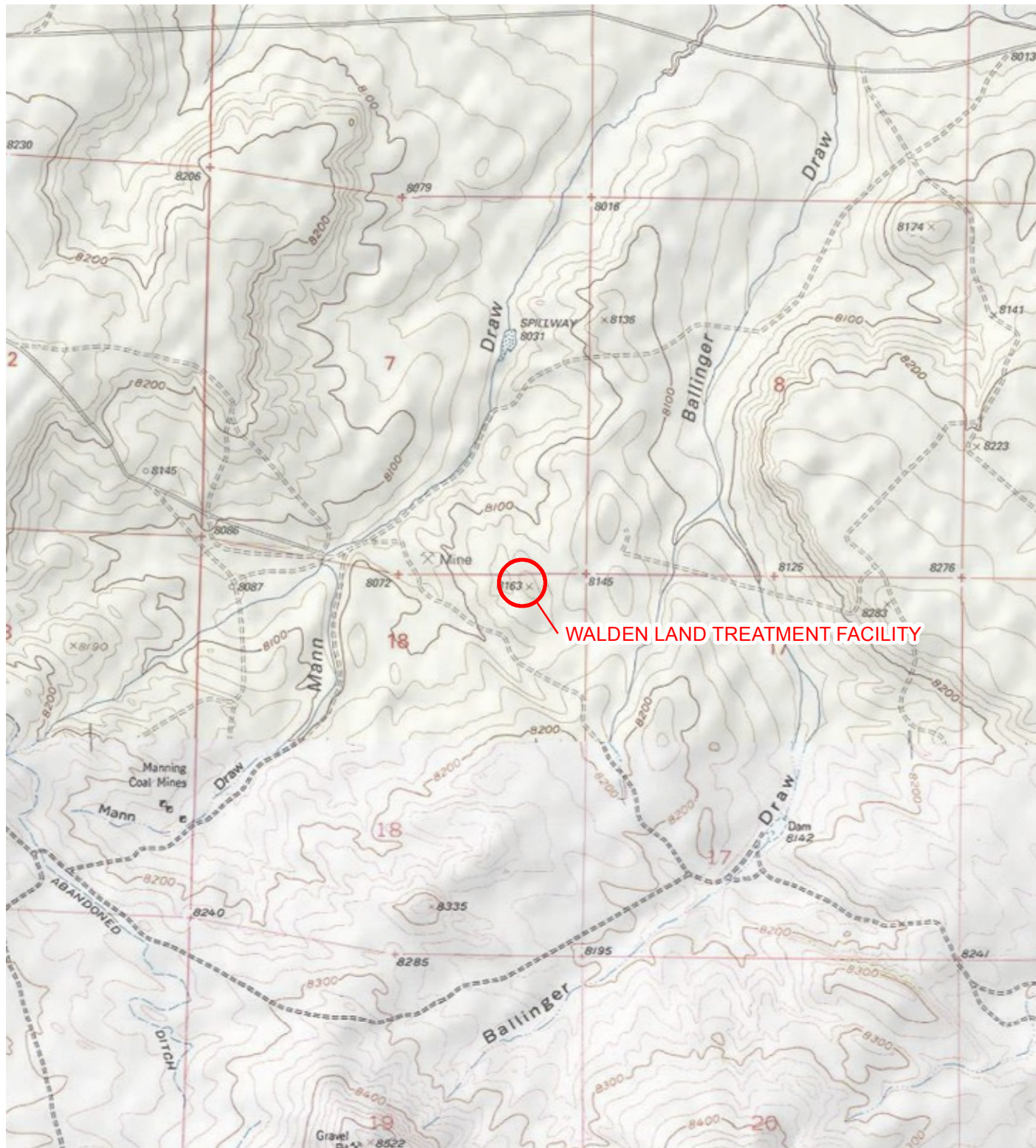


IMAGE COURTESY OF ESRI/USGS

LEGEND

○ SITE LOCATION

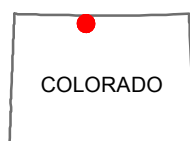
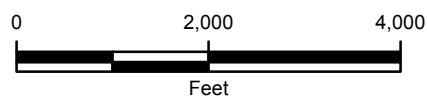


FIGURE 1
 SITE LOCATION MAP
 WALDEN LAND TREATMENT FACILITY
 SESE 7-T9N-R78W
 NENE 18-T9N-R78W
 JACKSON COUNTY, COLORADO
 BONANZA CREEK ENERGY OPERATING COMPANY LLC

