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STATEMENT OF BASIS

GROUND WATER DISCHARGE PERMIT NO. UGW070003

Green River Resources, Inc. (GRR)
American Sands Energy Corp.
Bruin Point Mine
Carbon County, Utah

April, 2015

Purpose

Green River Resources, Inc. (GRR) proposes to mine tar sands from an underground mine and process them to extract bitumen at Bruin Point, northeast of Sunnyside, Carbon County, Utah. Details of the proposed mining operation are contained in GRR's Notice of Intent to Commence Large Mining Operations (NOI), submitted to the Utah Division of Oil, Gas and Mining in September, 2014. Surface disturbance for this operation will be within the area designated as the "Affected Area" shown on Figure 2 of GRR's ground water discharge permit application, revised April, 2015. The Affected Area is approximately 160 acres in size.

Mined tar sands will be hauled from the underground mine to a processing facility located at Bruin Point. Bitumen will be separated from the tar sands using a proprietary solvent. To fulfill compliance monitoring obligations of this permit, GRR has provided in its application a list of 12 organic chemicals which includes all constituents of its proprietary solvent. As discussed below, ground water at the tailings disposal site is likely Class IA as defined in UAC R317-6-3; and required background water quality information from GRR's permit application, as well as the Division of Water Quality's (DWQ's) sampling of North Spring, suggest that none of the 12 chemicals are present in the ground water in background concentrations. (Class IA ground water may not underlie the entire mine property, however.) Under the definition of Class IA ground water protection levels in UAC R317-6-4.2, if during operation of the permitted facility, compliance monitoring confirms the presence of any contaminants at detectable levels in the ground water down-gradient from the facility that were not present in a detectable amount as a background concentration, GRR would be out of compliance with permit conditions and appropriate corrective action would be required. (Contaminants that are present in detectable concentrations in the background may not rise greater than 1.1 times the background levels.)

To insure that all solvent constituents are contained in the list of 12 compounds, GRR submitted a sample of solvent, along with the list of 12 compounds, to an independent Utah-certified laboratory for analysis. The laboratory's statement of verification (TestAmerica Laboratories, 2015) is provided as part of the public record. This arrangement does not compromise DWQ's ability to write a protective permit as well as to determine whether ground water is being affected by potential releases of solvent from the site.

According to the Material Safety Data Sheet contained in Appendix E of GRR's ground water discharge permit application, the solvent is immiscible with, and denser than water. If released in sufficient

quantities, a liquid with these properties could act as a dense non-aqueous phase liquid (DNAPL), a class of ground water contaminant that would sink to the deepest possible level in an aquifer and slowly release contaminants into the ground water as a dissolved phase. Releases of DNAPL are very difficult and expensive to clean up, and should be avoided to the greatest extent possible. The risk of a release of a DNAPL will be minimized because GRR will reclaim the solvent following the bitumen extraction process, as described below, and only minimal levels of the solvent will remain in the dry sand tailings. This minimal quantity of solvent, less than 25 mg/kg, should adhere to the sand grains and should not be present in sufficient quantities to form a DNAPL phase in the subsurface. (GRR permit application, Appendix D, Tailings Quality Control)

If water enters the tailings and dissolves some of the residual solvent, it will be contained by the Best Available Technology required in this permit, and the containment will be evaluated and confirmed by ground water monitoring. To further minimize the potential for any gaseous phase accumulation GRR will construct venting in the cap of the dry tailings impoundment and is included in the permit as a compliance schedule item under Part II.G(2).

There is a possibility for migration of residual solvent by transport in the gaseous phase, although it is not likely in this case because the tailings will have been heated before disposal and most of the solvent driven off of them.

The ore will be wetted with the solvent in a settling tank, and bitumen will be dissolved in the solvent. The resulting mixture will be decanted from the tank and heated to reclaim the solvent and separate it from the bitumen product. Water will not be used in the process, and any water naturally contained in the tar sand ore will be separated from them in the process, and used for dust control in the underground mine workings. The solvent-wetted ore will be augured from the bottom of the settling tank and heated above the boiling point of water to dry the sands; the solvent boils at less than 175 F, so it will also be evaporated before any water is boiled off from the sand tailings and the solvent will be reclaimed. Residual levels of solvent in the tailings should be less than 25 mg/kg following sand drying. Tailings quality will be monitored during production to insure this level is not exceeded. (GRR permit application, Fate and transport evaluation of residual solvent in sand tailings; Tailings quality control, Appendix D)

GRR plans to eventually dispose of the residual sand tailings by backfilling them in the underground mine workings; however, tailings will initially need to be placed on the surface for disposal, due to the need to create space in the underground mine workings for tailings disposal and also because of the increase in volume when bitumen-impregnated sandstone is crushed before processing.

GRR plans to develop a surface tailings disposal facility directly north of the processing facility, on the northeast side of the Bruin Point ridge, as shown in Figure 2 of GRR's ground water discharge permit application. This permit requires use of best available technology, appropriate to the nature of the waste, for the design of the tailings disposal facility. (Best available technology requirements for this permit are described in their own section below.)

Tailings characteristics will be monitored as the tailings are produced and before placement into the disposal area, according to Part II.D.4 of the permit, to insure that residual solvent content does not exceed the permit limit of 25 mg/kg. As part of the extraction process, GRR must monitor the water

content of the sand tailings to insure the sand will be dry enough to flow, with moisture content of 10% or less. This will serve as an indirect method to insure residual solvent content in the sands will be within permit limits. (GRR permit application, Tailings Quality Control, Appendix D) The permit also requires ground water compliance monitoring, to demonstrate that ground water protection levels in the aquifer underlying the site are not exceeded, consistent with the requirements of the Ground Water Quality Protection Regulations (UAC R317-6).

Geologic Description

The bitumen-impregnated sandstones to be mined are part of the Sunnyside tar sands deposit and occur in the Colter Formation and the Garden Gulch and Douglas Creek Members of the Green River Formation, all of Tertiary age. The Colter and Green River Formations intertongue in this area and are difficult to tell apart. The oil sands are overlain with approximately 400 feet of fine-grained rock. Strata in the Affected Area dip approximately 3 to 12 degrees to the northeast. A structural flexure, a northwest-trending monocline of strata that dip slightly less than surrounding rocks, is located northeast of the Affected Area near Range Creek, and may have affected the content of bitumen in sandstones, and may affect shallow ground water flow.

Hydrogeology

The existence of an aquifer underneath the tailings disposal site is revealed by the presence of a seasonally-variable flowing spring (North Spring) located immediately down-gradient of the site. GRR's site investigation, reported in Appendix B of their ground water discharge permit application, suggests that the aquifer is contained in near-surface fractures produced by stress relief that developed as the area was eroded to its present topography. GRR documented the presence of such fractures in the area, and DWQ's site visit on June 18, 2014 revealed the presence of thinly-bedded, fine-grained limestone with low primary permeability in the upper part of the tailings disposal area. Only fragments of the limestone were seen at the ground surface and shallow subsurface, suggesting that the limestone is highly fractured near the land surface. (Novak 2014) Recharge to the aquifer is probably due mostly to snowmelt, because of its slow release to the ground surface during the spring, as opposed to summer precipitation which would run off the land surface quickly.

GRR contends that the aquifer is present mainly in the upper 100 feet of the subsurface, based on the fact that ground water was not encountered in the deeper parts of exploratory drill holes in the area, including a series of over 50 borings completed by Amoco in the 1980s. A boring completed by GRR encountered ground water at 400-420 feet below ground surface flowing at less than 2 gallons per minute, but is believed to be shallower ground water trickling down the drill hole. Nearby Amoco borings did not report encountering ground water. GRR reports that deeper strata consist of shale, bitumen-impregnated sandstone and oil shale, which have low primary permeability and are not affected by stress-relief fractures because of their depth below the ground surface. These strata would tend to inhibit downward flow from the near-surface fractured rocks. Ground water flow appears to follow zones of near-surface fracturing. The slope that the tailings disposal area is located on slopes in the same direction that the rock strata dip, so stratigraphic control of zones of permeability may also affect ground water flow.

It should be noted that the proposed mine workings will be approximately 500 feet lower in elevation than the tailings disposal area, well below the shallow ground water system, and are located west of it. With present knowledge of subsurface conditions, there is no reason to suspect there would be significant ground water flow into the mine workings, and under these conditions, disposal of tailings into the workings would have a *de minimis* effect on ground water quality. As a permit condition, GRR will notify DWQ if significant ground water flow is observed as the mine is developed. In this event, plans for underground tailings disposal will be modified accordingly. Tailings disposal will not be permitted in the saturated zone.

Ground Water Quality

North Spring was sampled by GRR in May, 2012 and by DWQ in November, 2014. (GRR permit application Tables 9.4.3.1 and 9.4.3.2; UPHL Sampling Results North Spring) Preliminary determinations of background concentrations for most of the parameters that will be used for compliance monitoring are listed in Table 1 of the permit. The analytical results reveal that the aquifer that feeds the spring has very high quality ground water, with total dissolved solids reported at 176 mg/l in the GRR sampling event and 210 mg/l by DWQ, and no potential contaminants detected greater than the ground water standards listed in Table 1 of the Utah Ground Water Quality Protection Regulations. Ground water in this aquifer likely qualifies as Class IA, as defined in the Regulations. A formal classification of ground water quality at all compliance monitoring points including North Spring will be made following the accelerated background sampling required by the permit. Background concentrations are not currently known for some monitoring parameters, but will be formally defined following accelerated sampling.

Protection levels for potential ground water contaminants are defined as follows for Class IA ground water:

"*When a contaminant is not present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed the greater of 0.1 times the ground water quality standard value, or the limit of detection.*

When a contaminant is present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed the greater of 1.25 times the background concentration, 0.25 times the ground water quality standard, or background plus two standard deviations; however, in no case will the concentration of a pollutant be allowed to exceed the ground water quality standard." (UAC R317-6-4.2)

Under the Regulations, levels of contaminants in the aquifer, as observed at compliance monitoring points, may not rise above the protection levels specific to each monitoring point due to the permitted facilities.

Compliance Monitoring Program

GRR will sample ground water monitoring wells, springs and surface water in Range Creek under this permit as a means to evaluate whether the processing facility and tailings disposal area are affecting ground or surface water quality. Five monitoring wells will be drilled at the tailings disposal area; three wells at the down-gradient edge and one well each at the northwest and southeast sides of the area.

Three wells will be drilled at the northeast, southeast and southwest corners of the land parcel near Bruin Point where the processing facilities will be located. These wells, along with North Spring, will be compliance monitoring points for this permit. GRR will also sample South Spring in the Range Creek drainage, Cliff Seep in the Water Canyon drainage, and Range Creek at a flume located approximately 1 mile downstream from the tailings disposal area, for informational purposes. Locations of these sampling points are shown on Figure 2-1 in Appendix H of GRR's ground water discharge permit application.

Sampling shall be done in the spring, summer and fall quarters. Sampling will not be done in the winter quarter because the sampling sites will be inaccessible in winter conditions. GRR shall collect at least eight samples in the first year from each compliance monitoring point to allow for a formal determination of background water quality and permit protection levels.

Parameters to be monitored in ground water samples for this permit include:

- General chemistry parameters
- Petroleum parameters
- Potential contaminants identified in SPLP testing of tailings
- Potential proprietary solvent compounds

GRR carried out analysis of tailings samples from bench-scale testing of the solvent extraction process using the Synthetic Precipitation Leaching Procedure (SPLP) extraction (EPA Method 1312) to identify which contaminants could potentially be leached from the tailings by precipitation. Results of this testing are reported in Appendix I of GRR's ground water discharge permit application.

Monitoring parameters are listed in Tables 1 and 2 of the permit. As explained above, because the solvent formula is proprietary, GRR will monitor for a list of 12 organic compounds which include the solvent components.

Best Available Technology

The Best Available Technology (BAT) standard for this permit was approved based on the assumption that the content of residual solvent in the tailings will not exceed 25 mg/kg. It is a permit condition that residual solvent content will not exceed this level, and tailings will be monitored before they are placed in the storage area to insure their solvent content does not exceed 25 mg/kg. (GRR permit application, Tailings Quality Control, Appendix D)

The tailings disposal area will feature a compacted base and cover, each made of 4 feet of clay material with a permeability of 1×10^{-7} cm/sec. The system will include a capillary barrier on top of the clay cover with 18 inches of growth media above the capillary barrier. A sloped weeping tile will be installed above the clay base and will run downhill from the highest point in the sand pile to a HDPE-lined retention basin. This system will serve 4 purposes:

- The clay cap and liner systems will seal the tailings pile from the environment and minimize the infiltration of meteoric water into the pile.

- The weeping tile system and lower clay liner will contain meteoric water, should it infiltrate the pile, collect it and deliver it to a lined containment pond for analysis and ultimate disposal.
- The capillary system will direct meteoric water deposited on the tailings pile off to the side of the pile into the Range Creek drainage, where it may enhance recharge to the aquifer feeding North Spring.
- The berm dividing the working and capped sections of the pile will serve to divert meteoric water deposited on the working section of the pile into the weeping tile system, minimizing its discharge to the environment.

Best Available Technology Performance Monitoring

Tailings quality will be monitored as the tailings are produced, prior to placement into the tailings disposal area and the compliance of the tailings with the maximum water content (10% before any addition of water for compaction) and maximum allowable solvent content (25 mg/kg) as detailed in the permit will be confirmed. The tailings quality will be confirmed through four programs of monitoring:

1. A moisture probe will be used to inspect and record the moisture content of each load of sand moved from the plant to the tailings pile. In this way, an inspection will be performed on no less than every 60 tons of sand produced resulting in 166 such inspections being performed each day. Moisture is not to exceed 10%, if moisture content exceeds this level, operational conditions of the sand drying system will be adjusted. Actual moisture readings will be recorded as observed. All records of tailings quality monitoring shall be made available to DWQ personnel during regular business hours upon request.
2. The sand will be inspected by operations personnel hourly. The observed quality of the sand will be recorded in the plant operating logs.
3. Gas detection equipment will collect solvent vapor concentration readings above the sand pile and archive those to a server for at least a year. At time of permit issuance, solvent vapor detection is based on gas chromatography and can detect solvent vapors in the air down to 50 ppm in air with a minimum sampling time of 5 minutes. Using this form of detection, if a solvent if found in the air at the minimum detectable concentration, an alarm will sound and operators will intervene to reestablish proper sand drying practices. All plant alarms will be logged electronically.
4. A sand sampling and analysis program will be established prior to startup to provide a statistically relevant analysis of the sand quality and provide a record of the solvent deposited to the disposed sand. GRR anticipates that upon startup the sand will be sampled and analyzed daily Operating data will also be collected daily and recorded against the results of the analysis of each sample thereby establishing a correlation between the sand quality and operating conditions. If these operating conditions are more stringent than those outlined in the tailings control document, they will be adopted as the new operating conditions for the process. Following the completion of that work, the program will revert to a second tier of testing frequency. GRR anticipates that at that point, a series of samples will be taken from the sand pile every quarter and subjected to analysis for the presence of solvent by an independent laboratory. The sampling and analysis program will be designed to collect samples in a pattern and

quantity in order to produce a statistically significant addition to the quality assurance program. The details of this program will be documented and submitted to DWQ for approval prior to the startup.

BAT performance will be monitored after the tailings disposal facility is closed under the plan which will be developed as a Compliance Schedule item, under Part II.G.3 of the permit. Ground water monitoring shall continue for at least 10 years post-closure. There is an unlikely possibility for transport of solvent vapors downward through the lower clay liner, where the vapors could affect ground water quality. The weeping tile drain system would be a preferential flow path for downward migration of any solvent vapors, as opposed to the low-permeability clay liner. Accordingly, operational and post-closure monitoring will include sampling of air from the weeping tile system and analysis for solvent vapors. If vapors are not present in the weeping tile system, it is extremely unlikely that vapors or non-aqueous liquids would penetrate the lower clay liner. This air sampling shall be done at least annually; however, four quarterly samples with no detectable solvent vapors would be a reason to discontinue post-closure ground water sampling, after the mandatory 10-year period is over.

Potential Impacts to Ground Water

Potential impacts to ground water from pollutants dissolved in water that may come in contact with the tailings have been minimized by the best available technology required under this permit, which will minimize infiltration of rain and snowmelt into the dry tailings. Impacts to ground water will be evaluated by ground water monitoring. GRR must meet very stringent protection levels for Class IA ground water in the aquifer under the tailings disposal site.

Potential impacts to ground water from dense non-aqueous phase liquids used in the bitumen extraction process are minimized by GRR heating the tailings to above the boiling point of water to dry the tailings sand. The boiling points of the solvent components are significantly lower than that of water; therefore drying the tailings by heat will also remove all but trace amounts of the solvent from the sands before disposal. Residual solvent content of the tailings will be monitored according to the provisions of Part II.D.4 of the permit.

Potential impacts to ground water quality in any deep aquifers or saturated zones that may be encountered by mine workings will be minimized by the permit requirement that GRR prevent tailings disposed underground from coming in contact with any inflowing ground water. Underground tailings disposal will take place after year 5 of operation and will likely not happen until after this permit is renewed.

References

Novak, 2014; June 18, 2014 Site Visit Memo DWQ-2014-008803

TestAmerica Laboratories, 2015 Verification Statement DWQ-2015-2015-005360

UPHL Sampling Results, North Spring, American Sands, 11/05/14 DWQ-2014-016100

Utah Ground Water Discharge Permit Application, American Sands Energy Corp. Bruin Point Mine, Carbon County Utah, April 2015 DWQ-2015-005130

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