Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

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J.R. Simplot Company
P.O. Box 27
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Attention: Mr. Alan L. Prouty
Vice President, Environmental & Regulatory Affairs

Subject: Alternative Liner Demonstration, Expansion of the Rock Springs Phosphogypsum Stack System, J.R. Simplot Company, Rock Springs, Wyoming.

Gentlemen:

As requested, Ardaman & Associates, Inc. has prepared the following letter to demonstrate that for the specific physical and hydrogeological conditions present at the site of the proposed expansion of the Rock Springs Phosphogypsum Stack System, an HDPE geomembrane liner in contact with sedimented gypsum placed in slurry form provides an equivalent or superior degree of protection of human health and the environment.

As discussed below, the proposed liner for the expansion area consists of a compacted gypsum-geomembrane composite liner over an approximately 44-acre portion of the expansion and a sedimented gypsum composite liner over the remaining 120-acre portion of the proposed expansion area.

This report provides an analysis of the combined liner system that demonstrates that the potential leakage from the proposed liner system will be less than or equal to the potential leakage from the compacted gypsum-geomembrane alternative specified in Attachment C (Phosphogypsum Stack System Construction and Operational Requirements) of the proposed Consent Decree between the United States, the State of Wyoming, and the J.R. Simplot Company.

Background

Site Description

The Simplot Rock Springs phosphate plant (the “Site”) is located at 515 South Highway 430 approximately 4½ miles southeast of the city of Rock Springs in Sweetwater County, Wyoming (Figure 1). The Site occupies approximately 2,720 acres and includes all property currently under the ownership or control of J.R. Simplot. The main processing facility comprises a rock receiving plant, phosphoric acid plant, super phosphoric acid plant, sulfuric acid plant, granulation plant, fertilizer storage building, and rail yard. The phosphogypsum stack system includes the gypsum stack, groundwater collection ditch, auxiliary pond, process/decant pond, and cooling water pond.

The industrial facility siting permit was issued for the phosphate plant in 1982 (Chevron 1982b). Construction of the phosphate plant began in 1984 and operations commenced in 1986 (BLM 1983). Various other permits for air quality; permits to construct water supply facilities, wastewater facilities and sediment control features; and reservoir permits for the various evaporation and holding ponds were also obtained (BLM 1983).

Geology

The Site is located on the western flank of the Rock Springs Uplift in the Sweetwater Creek valley of the greater Green River Basin. Sweetwater Creek is an intermittent stream that flows generally north-northwest from the slopes of Aspen Mountain to its junction with Bitter Creek just west of Rock Springs. The topography of the Rock Springs Uplift consists of a central basin surrounded by ridges and mountains (Mason and Miller 2004). The uplift, an elongate anticline with a north-trending axis, is comprised of sedimentary rock strata with dips on the flanks between 3 and 15 degrees toward the adjacent structural lows. The highest point in the area is Aspen Mountain, at an elevation of about 8,700 feet. The Rock Springs area is characterized by cold winters and dry summers with an average annual precipitation of approximately 9 inches.

The Site is underlain by the Blair Formation which is approximately 900 feet thick and consists of thin bedded siltstones, claystones and fine-grained sandstones. The bedrock is mantled by a thin layer of alluvium comprised of windblown silts and sands (Woodward-Clyde 1982b). Groundwater flow at the Site is generally westward toward the Green River (Ardaman 1985). Recharge to groundwater aquifers occurs primarily by infiltration of precipitation in outcrop areas, infiltration of snowmelt runoff from the mountains, and leakage of stream flow (Mason and Miller 2004). Regional groundwater quality is described as relatively poor (Wyoming Water Development Commission [WWDC] 2010). Dissolved solids in groundwater are elevated due to the presence of naturally occurring soluble minerals such as trona, gypsum, and halite.

Phosphogypsum Stack System

Operation of the phosphogypsum stack system at the Site began in 1986. The entire footprint of the phosphogypsum stack system was provided with a 60-mil HDPE geomembrane bottom liner that was installed in phases as the size of the gypsum storage area increased with time. The total lined area currently covers just over 420 acres. As shown on Figure 2, groundwater flow beneath the phosphogypsum stack system is toward the west-southwest and is captured in a groundwater collection ditch that was constructed prior to beginning operation of the system. The water level in the groundwater collection ditch is maintained at an elevation that is lower than the elevation of the water table to the west-southwest, i.e., the groundwater collection ditch acts as a hydraulic barrier to seepage from the east-northeast.

The phosphogypsum stack is operated using wet stacking techniques wherein gypsum slurry is pumped at approximately 30 to 32 percent solids to sedimentation compartments (cells) located on top of the stack, where the solids can settle, and the clarified process water is decanted and pumped back to the phosphoric acid plant for reuse.

Figure 3 shows the present configuration of the Rock Springs facility. As noted, the storage area is currently divided into seven separate cells, five of which are located on the main body of the gypsum stack, while the other two are within the footprint of the most recently lined expansion area, located on the east side of the original gypsum stack footprint. Figures 4 and 5 provide topographic maps of the Rock Springs facility and phosphogypsum stack system.

The bottom elevation of the existing stack ranges from a low of about 6,580 feet (NGVD) beneath the west-southwest side of the original gypsum stacking area to a high of about 6,700 feet (NGVD) beneath the lined expansion area on the east-northeast side of the site. The elevations of the perimeter gypsum dikes on top of the gypsum stack vary from 6,790 feet (NGVD) on the west to 6,720 feet (NGVD) on the east.

Decanted process water from the stack currently flows by gravity through a perimeter ditch system to an existing lined process water surge pond and return water pump station located just south of the southwest corner of the gypsum stack. Return water is pumped from this pond back to the plant for reuse.

Site Investigation History

Several investigations had been conducted at the Site that have included characterization of hydrogeology and groundwater chemistry. The primary investigations are as follows:

Four site evaluations were performed by various consultants between 1981 and 1984 for Chevron at the proposed location of the gypsum storage facility to characterize geological, geotechnical, and hydrological subsurface conditions prior to construction of the facility (TRC 1982, Woodward-Clyde 1982 and 1982a, and Ardaman 1985). A series of deep monitoring wells, designated P-1 through P-15, were installed as part of these initial investigations. In 1985, four shallow groundwater monitoring wells (PZ-B1 through PZ-B4) were completed immediately downgradient of the groundwater collection ditch during construction of the gypsum storage impoundment (subsequently completed in 1986).

Groundwater samples have been collected by the facility operator since 1985, just prior to the initiation of operation of the gypsum storage facility in 1986. From 1985 through 1990, quarterly samples were obtained from the groundwater collection ditch and from monitor wells PZ-B2, PZ-B3, and PZ-B4. In 1991, five additional wells were drilled in the vicinity of the gypsum storage impoundment (PZ-B5 through PZ-B9), although PZ-B5 and PZ-B7 were abandoned shortly thereafter. Monitoring wells PZ-B6, PZ-B8 and PZ-B9 were sampled only once and were not added to the scope of quarterly sampling.

In July 2012, after the RCRA 3013 AOC was signed, groundwater monitoring was expanded to all six existing functional groundwater monitoring wells: PZ-B2, PZ-B3, PZ-B4, PZ-B6, PZ-B8, and PZ-B9. From June to September 2013, 39 new monitoring wells were installed and sampled at 15 boring locations around the facility. Locations of all functional groundwater monitoring wells and the groundwater collection ditch are shown in Figure 6.

Groundwater samples have been analyzed for pH, specific conductance, chloride, fluoride, sulfate, aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, phosphorous, silver, thallium, vanadium, zinc, gross alpha, radium 226 & 228, and total dissolved solids as required by the permit to construct.

Groundwater level measurements have been collected monthly from the groundwater collection ditch and seven monitoring wells (PZ-B1, PZ-B2, PZ-B3, PZ-B4, PZ-B6, PZ-B8, and PZ-B9) and quarterly from all current monitoring wells since 2013.

Summary of Groundwater Characterization

The following groundwater characterization is a summary of the Groundwater Investigation Summary Report prepared by Formation Environmental of Boulder Colorado. The report is dated April 2016.

Stratigraphy

The Site is underlain by bedrock of the Blair Formation, which consists of approximately 900 feet of interbedded shales, siltstones, and fine-grained sandstones covered by a thin layer of alluvium. The alluvium is thickest in the Sweetwater Creek drainage and both historical and recent information indicate the alluvium supports limited unconfined groundwater flow. In many areas across the Site, there is little to no residual soil cover over the Blair Formation. The general dip of the Blair Formation mapped near the Site is approximately six to eight degrees to the west. Bedrock groundwater monitoring wells are completed in the middle Blair Formation, which appears discontinuous and of limited areal extent. The thin very fine grained sandstone layers encountered in borings during the SAWP investigation appear to be laterally discontinuous in cross section and both sandstone and shale strata contribute groundwater flow into the wells.

The alluvium of the Sweetwater Creek drainage consists mostly of silt and clay with fine-grained sand derived from weathering and transport of materials from the weathered portion of the Blair Formation. No previously completed test wells or monitoring wells have been installed exclusively in the alluvium. The residual soil encountered in the borings drilled in 2013 was typically very fine, loose, yellowish brown to brown clayey silt.

The weathered Blair Formation consists of residual strata of silts, clays, and fine grained sands closely resembling the lithology of the Blair Formation, but is less dense and with slightly higher hydraulic conductivities than competent rock below. The weathered Blair Formation was encountered in all the deeper borings completed across the Site and was generally less than 50 feet thick.

Previous investigations revealed the un-weathered Blair Formation to have very low hydraulic conductivity except where fractures and/or sandstone beds are present. The bulk properties of the Blair Formation gathered during previous investigations classify the formation as an aquitard with limited well yields of generally poor quality water. The lithology of the un-weathered Blair Formation is typical of the middle Blair Formation, with most individual strata not correlating directly from boring to boring across the Site. Some evidence of faulting was observed during drilling, specifically between wells PZ-B10 and PZ-B23, where a plastic, calcite rich clay with porous travertine was encountered while drilling the PZ-B23 boring.

Groundwater Occurrence

Based on the geologic, potentiometric and geochemical data, the groundwater encountered in the deeper portions of the Blair Formation likely originates from deep confined zones (Formation 2012b) which are recharged by infiltrating precipitation in sub-crop and outcrop areas on Aspen Mountain. Recharge for the shallow unconfined zone of the Blair Formation is from local infiltration of precipitation at the Site.

Groundwater at locations PZ-B2, PZ-B3, PZ-B4 and to an extent PZ-B6, PZ-B8, PZ-B10A and PZ-B10B is hydraulically connected to the collection ditch and responds to water levels within the collection ditch, which is periodically pumped.

Groundwater elevation measurements were collected during well development and sampling, including gauging of open boreholes in the Blair Formation. Water-bearing zones encountered during drilling were recorded, and the rate of water production was estimated. Water bearing zones were only observed in four borings (PZ-B10, PZ-B21, PZ-B22, and PZ-B23) during drilling. No groundwater was encountered in borings PZ-B1R, PZ-B12, PZ-B14, or PZ-B15 during or after drilling.

Because so few water bearing zones were observed during drilling, double and triple screened well nests were installed in many borings to intersect low-yielding groundwater in at least one screen interval. Several wells have remained dry since installation; therefore, these wells have not been developed or sampled. These wells include: PZ-B11A, PZ-B11B, PZ-12B, PZ-B13A, PZ-B13B, PZ-B17A, PZ-B19A, and PZ-B19B.

Many of the newly installed wells exhibited significant drawdown and very poor recovery while being purged dry or nearly dry during well development. However, wells PZ-B10A, PZ-B10B, PZ-B12A, PZ-B21C, PZ-B22B, PZ-B23B, and PZ-B23C exhibited little to no drawdown with moderate recoveries during development and are believed to have encountered a zone of secondary porosity such as a fault zone.

Groundwater General Chemistry

In general, groundwater encountered at the Site has high concentrations of sodium, sulfate, and TDS. The groundwater samples collected in the third quarter of 2013 had TDS concentrations ranging from approximately 1,000 mg/L to 26,000 mg/L. The high dissolved solids concentrations observed at the Site are likely associated with naturally occurring and relatively soluble minerals (e.g., trona [sodium carbonate], gypsum [calcium sulfate], and halite [sodium chloride]) found in the Blair Formation (WWDC 2010). Previous work by Mason and Miller (2004, p.62) indicated that groundwater within the Blair Formation becomes increasingly saline with distance downgradient from recharge areas. Most recharge occurs at the higher elevations associated with Aspen Mountain located south of the Site.

The major-ion compositions of groundwater samples collected during the third quarter 2013 sampling event indicate at least three distinct groundwater types, as well as groundwaters with intermediate compositions that lie between the three end-member types. Piper and ternary diagrams included in the Sampling and Analysis Report [SAR] (Formation 2014) illustrate the water-type classifications determined during the RCRA 3013 investigation, which include:

- Sodium-Sulfate to Magnesium-Sulfate Groundwater characterized by relatively low chloride and moderate TDS encountered at PZ-B9, PZ-B12A, PZ-B13C, PZ-B15A, PZ-B15B, PZ-B17B, PZ-B17C, PZ-B18A, PZ-B18B, PZ-B20A, PZ-B20B, PZ-B20C, PZ-B22B, PZ-B2, PZ-B3, PZ-B4, and the collection ditch (CD, CD Inlet)

- Bicarbonate Groundwater characterized by relatively low chloride and TDS but intermediate sodium and magnesium concentrations encountered at PZ-B6, PZ-B10A, PZ-B10B, and PZ-10C

- Sodium-Chloride Groundwater characterized by relatively high chloride and very high TDS concentrations encountered at PZ-B11C, PZ-B16A, PZ-B16B, PZ-B16C, PZ-B23A, PZ-23B and PZ-B23C

Hydrostratigraphic Units and Groundwater Potential

Hydrostratigraphic units (HSUs) were identified using the lithologic data obtained from boreholes drilled in the study area, groundwater potentiometric data collected from wells, groundwater chemistry data, and interpretation of regional geological structural information. Because hydrologic and chemical data indicate that groundwater is not laterally continuous across the Site and geologic data indicate that the local fracture systems and related faulting may control groundwater flow in separate HSUs, three main hydrostratigraphic units were identified at the Site.

The major-ion compositions of groundwater samples indicate that there are at least three distinct groundwater types present at the Site, as well as groundwater with intermediate compositions. The existence of chemically distinct groundwater types is consistent with other Site-specific evidence for multiple, separate hydrostratigraphic units (HSUs) with varying degrees of hydraulic communication. Three major HSUs were delineated during the RCRA 3013 investigation: HSU-1 (Sulfate-type Groundwater), HSU-2 (Sodium Chloride-type Groundwater) and HSU-3 (Bicarbonate-type Groundwater). Each of these HSUs is described in the following paragraphs. The extent of each of the HSUs and groundwater potential in each is shown in Figure 4.

HSU-1 comprises a sulfate-type groundwater and is the most prevalent geochemical classification of groundwater found at the Site. There is chemical variation within this water type, specifically within cation concentrations, and groundwater potentiometric data indicate that groundwater within HSU-1 is limited in vertical and lateral hydraulic connection. Groundwater potentiometric and stratigraphic/structural geologic data indicate that not all wells within this HSU are in direct hydraulic communication. Wells PZ-B12B, PZ-B13A, PZ-B13B, PZ-B17A, PZ-B19A, and PZ-B19B are dry and delineate a zone in which no groundwater was encountered.

Sources of groundwater in this area appear to be recharge or upward leakage of confined groundwater in the vicinity of the PZ-B18 well nest and artesian groundwater in the vicinity of the PZ-B20 and PZ-B21 well nests. Northwest of the gypsum stack, there is a downward hydraulic gradient at the PZ-B18 monitoring well nest and a lateral hydraulic gradient toward the location of the PZ-B17 well nest.

Groundwater potential decreases from northeast to southwest and there are no apparent facility influences on the hydraulic gradient or groundwater flow direction other than the groundwater collection ditch. Pre-construction site investigation indicates that groundwater was present in the area now beneath the gypsum stack. Since no current data can be obtained on groundwater conditions directly beneath the stack, it is assumed that this groundwater is still present and correlates with groundwater in HSU-1. Potentiometric contours beneath the gypsum stack are shown as estimated in Figure 2. General chemistry data indicate that there is significant variation in analyte concentrations with no apparent pattern that correlates with potential source areas at the facility. TDS concentrations measured in the HSU-1 wells are within the range detected in the monitoring wells prior to the operation of the gypsum stack. Groundwater within the Blair Formation generally has a high concentration of TDS due to naturally occurring minerals within the formation.

The constituent concentrations observed in groundwater within HSU-1 indicate that the Wyoming

Class IV(A) classification is appropriate for this unit. Total phosphorus concentrations that occur in the surface water samples collected within the collection ditch are not found within groundwater from nearby monitoring wells PZ-B2, PZ-B3, PZ-B4, and PZ-B8. Variations in total phosphorus concentrations in the collection ditch water samples suggest that phosphorus may be sourced from naturally occurring phosphorus within soils. The concentrations of phosphorus reported for the off-facility soil samples ranged from 645 mg/Kg to 1,260 mg/Kg with an average concentration of 972 mg/Kg (Formation 2014). The greatest concentration was detected in the 1.0 to 1.5 foot sample collected from upwind location OSB-03. Total phosphorus concentrations in the collection ditch water samples vary considerably due to seasonal algal growth patterns, vegetation growth and decomposition along the ditch, and pumping of water from the ditch.

HSU-2. West and southwest of the gypsum stack along the bluff capped by the Rock Springs Formation, a zone of sodium-chloride type water is encountered in seven wells: PZ-B11C, PZ-B16A, PZ-B16B, PZ-B16C, PZ-B23A, PZ-B23B, and PZ-B23C. Except for PZ-B23B, all of these wells have very high concentrations of dissolved solids. Groundwater potentiometric and stratigraphic/structural geologic data indicate that all the wells within this HSU are in hydraulic communication. Groundwater potentiometric data indicate that the source of this type of groundwater is from a deep artesian source aligned with the locations of these wells, possibly along a fracture zone.

Both the hydrologic and chemical data indicate that groundwater is not laterally continuous across the entire Site. Geologic data indicate that the local fracture systems and related faulting may control groundwater flow in separate HSUs and that the Site is generally located in an area of groundwater discharge. Groundwater potential is related to surface topography and the degree of confinement of artesian pressure developed in higher elevation recharge areas (i.e. Aspen Mountain). Results of investigations support the concept that the Blair Formation does not provide a continuous groundwater flow system: the relatively low hydraulic conductivity of the Blair Formation only allows for wells to achieve significant water yields when located in areas where secondary porosity is evident and controlled by the presence of faults. Locations and depths at which no groundwater was encountered also aid in the understanding of the continuity of each unit.

Both groundwater potential and geochemical data indicate that these wells are in hydraulic connection probably resulting from a fault or fracture zone that allows connection with deep artesian groundwater. The constituent concentrations observed in groundwater within HSU-2 indicate that the Wyoming Class IV(A) classification is appropriate for this unit.

The groundwater potential indicates that groundwater flow direction within HSU-2 is dominated by upward vertical movement (groundwater potential is higher in the deeper monitoring wells) with only a minor lateral gradient. The concentrations of COPCs in shallow groundwater in this zone (PZ-B16A and PZ-B23A) are similar to that in deeper groundwater (PZ-B11C, PZ-B16C, and PZ-B23C) and potentially due to the upward leakage of the deeper groundwater.

HSU-3. Bicarbonate is the dominant anion in the groundwater encountered in four wells located in the Sweetwater Creek drainage southeast of the gypsum stack: PZ-B6, PZ-B10A, PZ-B10B, and PZ-10C. Groundwater collected at these locations is characterized by relatively low TDS concentrations typical of the effects of local recharge (incident precipitation/runoff water). Groundwater potentiometric and stratigraphic/structural geologic data indicate that wells within this HSU are in direct hydraulic communication. The groundwater in PZ-B10C, which contains relatively high sodium and chloride with bicarbonate, indicates that the source of this type of groundwater is derived from a deep confined zone with that may align with a fracture zone.

Both groundwater potential and geochemical data indicate that these wells are in hydraulic connection probably resulting from a fault or fracture zone that allows connection with deep artesian groundwater. The groundwater potential and general chemistry data do not indicate that this unit is influenced by the gypsum stack. Upward flow of groundwater in this area is partially under the influence of the collection ditch and results in a shallow groundwater flow path that trends toward the northeast from PZ-B10A toward PZ-B6. The constituent concentrations observed in groundwater within HSU-3 indicate that the Wyoming Class III classification is appropriate for this unit.

The groundwater potential indicates that groundwater flow direction within HSU-3 is dominated by upward vertical movement (groundwater potential is higher in the deeper monitoring wells), with only a minor lateral gradient. The concentrations of constituents of potential concern (COPCs) in shallow groundwater in this zone (PZ-B10A and PZ-B6) are similar to that in deeper groundwater (PZ-B10C) and potentially due to the upward leakage of the deeper groundwater. The considerable difference in groundwater quality between groundwater samples collected from HSU-3 and the nearby wells completed in the HSU-2, both of which are dominated by upward flow of groundwater, illustrates the complexity of the Blair Formation groundwater flow patterns.

Summary of Groundwater Data Analyses

The following groundwater data analyses is a summary of the Groundwater Investigation Summary Report prepared by Formation Environmental of Boulder Colorado. The report is dated April 2016.

Water quality samples were collected at 23 groundwater monitoring wells and two locations within the groundwater collection ditch over the period from September 2013 to April 2015 (eight consecutive quarters) under the expanded analyte list required by the RCRA AOC. Over this period water level measurements were made approximately quarterly at all 45 monitoring well locations and the collection ditch. Prior to September 2013 water level measurements and water quality samples were only collected from the monitoring wells installed in 1985 and 1996. The recent data were evaluated using some of the same methods that are used to evaluate background conditions in the Baseline Groundwater Conditions Report [BGWCR] (Formation 2016) to characterize spatial, temporal and statistical variations in groundwater chemistry within the facility and identify chemically distinct groundwater that may be present due to chemical releases from the facility, if any. The historic monitoring data (data collected prior to July 2012) was analyzed separately prior to the RCRA order and presented in the Groundwater Data Analysis Report (Formation 2012). A summary of the results of these analyses is provided in the following paragraphs.

<u>General Considerations in the Evaluation of the Groundwater Quality Data</u>

Groundwater quality within the Blair Formation, which underlies the facility, is typically poor due to naturally occurring salts, and the concentrations of some chemical constituents that are associated with the facility, such as sulfate, are naturally elevated in groundwater from the Blair Formation. Based on the high sulfate and TDS concentrations found in groundwater samples obtained prior to facility operation, groundwater at the Site classifies as Class III (TDS from 2000 mg/L to 5000 mg/L) and Class IV(A) (TDS from 5000 mg/L to 10,000 mg/L) according the Wyoming groundwater quality standards. The high dissolved solids concentrations observed at the Site are likely associated with naturally occurring, relatively soluble minerals, such as trona (sodium carbonate), gypsum (calcium sulfate), and halite (sodium chloride), that are found in the

Blair Formation (WWDC 2010). Previous work published by Mason and Miller (2004, p.62) indicated that groundwater within the Blair Formation becomes increasingly saline with distance downgradient from recharge areas. Most recharge occurs at the higher elevations associated with Aspen Mountain located south of the Site.

Based on the data analyses provided the SAR and BGWCR, groundwater conditions in the vicinity of the facility are best described as naturally heterogeneous, variable and of generally poor quality. The potential influence of facility operations was assessed by evaluating spatial distribution of constituent concentrations in groundwater, concentration trends over time, and influence on groundwater hydrology (changes in groundwater level due to facility influence). The assessment also considered the chemistry of potential sources at the facility and the influences on groundwater sample chemistry resulting from sampling conditions.

As initially recognized in the SAR, a potential transport pathway to groundwater considered in the investigation was the infiltration and/or leaching of source materials and vertical migration to underlying shallow and possibly deeper groundwater as indicated by elevated concentrations of COPCs in subsurface soil and groundwater. This potential pathway is constrained by the arid climate, which results in limited infiltration potential, and the chemistry of the subsurface soils and bedrock materials, which are alkaline and have a high acid neutralizing potential; if any release of phosphoric acid or sulfuric acid takes place, the acid has a high potential to be neutralized before migrating downward to groundwater. Vertical migration from the main processing area is limited by the depth to saturated groundwater and the low permeability of strata above the saturated zone. Groundwater elevation and chemistry data demonstrate that operations at the facility do not affect groundwater potential or concentrations of COPCs in groundwater. As a result, the conceptual site model shows no transport of COPCs to groundwater.

Groundwater Potential

Groundwater potential at the Site is related to surface topography when unconfined and the degree of confinement and artesian pressure developed in higher elevation recharge areas. Most recharge occurs at the higher elevations associated with Aspen Mountain located south of the Site. Groundwater potential decreases from northeast to southwest, as shown in Figure 2. There are no apparent facility influences on the hydraulic gradient or groundwater flow direction other than the groundwater collection ditch. The collection ditch intercepts the groundwater table and since it is pumped down periodically, the ditch generates a low in the potentiometric surface.

Geologic data indicate that the local fracture systems and related faulting may control groundwater flow in HSUs and that the Site is generally located in an area of groundwater discharge.

The RCRA 3013 investigation supports the concept that the Blair Formation does not provide a continuous groundwater flow system and the relatively low hydraulic conductivity of the Blair Formation only allows for wells to achieve significant water yields when located in areas where secondary porosity is evident and controlled by the presence of faults. Previously observed aquifer transmissivities were very low (Ardaman 1985) except in areas where fractures and/or sandstone beds were present (Woodward-Clyde 1982b). Observed drawdown and recoveries during the RCRA 3013 investigation indicate that the Blair Formation acts as an aquitard except in localized areas where secondary porosity is present.

As described in the BGWCR, no spatial pattern of chemical concentrations in groundwater is evident at the Site, except for elevated concentrations of nitrate+nitrate and selenium between wells PZ-B12A, PZ-B22B and PZ-B4 (upgradient to downgradient, respectively). An apparent groundwater pathway exists in this area as evidenced by observed nitrate+nitrate and selenium concentrations measured at these wells and the possible presence of a fracture zone. As described in the BGWCR, the groundwater travel time between PZ-12A and PZ-22B is estimated to be about 13 years (assuming an effective porosity of 1%).

Hydrographs showing trends in groundwater elevation are included in Appendix A. The water level within the groundwater collection ditch is managed to achieve groundwater capture by maintaining a lower level than that of the shallow unconfined groundwater down gradient of the ditch. Groundwater elevations in wells near the groundwater collection ditch (PZ-B2, B3, B4, B6, B8, B10A, and B10B) are hydraulically connected and fluctuate corresponding to the water level in the groundwater collection ditch, which is periodically pumped down as a source of plant makeup water. Steadily increasing groundwater elevations have been observed for several years at well PZ-B9. Well PZ-B9 is situated in an arroyo that was dammed as a result of the construction of the Gypsum Stack. This causes storm water runoff to pool and infiltrate in the vicinity of the well. Increasing trends in groundwater elevation have also been observed in a number of other monitoring wells including PZ-B11C, PZ-B12A, PZ-B12C, PZ-B14, PZ-B15A, PZ-B15B, PZ-B16A, PZ-B16B, PZ-B16C, PZ-B17C, PZ-B18B, PZ-B18C and PZ-B20C. These groundwater level trends are the result of very slow groundwater yield from the very low hydraulic conductivity Blair Formation, in which almost all the monitoring wells are installed. All the recently completed monitoring wells were installed in a nested arrangement within a single boring and most of these borings were dry upon the completion of drilling. Groundwater at initially dry locations has taken many months to years to equilibrate to static conditions resulting in a trend of significant groundwater level increase.

Groundwater Quality

The groundwater data analysis presented in the BGWCR generally confirms the investigation findings documented in the SAR. Time series charts showing concentration trends for each analyte are included in Appendix B. Post plots showing concentrations in groundwater samples are included in Appendix C. The high concentrations of major ions (calcium, magnesium, sodium, sulfate and chloride) are typical of the groundwater of HSU-1 and HSU-2. Most metals are detected at very low concentrations or are not detected above analytical method limits. The major ions and most metals do not show any spatial correlation with potential sources within the facility or groundwater flow paths from those sources. The exceptions are nitrate, selenium and phosphorus.

Concentrations of nitrate and selenium are elevated in samples from wells PZ-B4, PZ-B22B, and PZ-B12A. Nitrate is typically not detected in groundwater samples and selenium is typically present in concentrations of less than 0.005 mg/L. Selenium is also elevated in samples from the groundwater collection ditch. Selenium is not detectable in ore processed at the facility. While sources of these constituents are unknown, the distribution and concentration of nitrate and selenium was recognized and described in the SAR and BGWCR and suggest transport along a groundwater flow path that connects these wells and terminates at the groundwater collection ditch.

Phosphorus is detected in groundwater samples in concentrations of less than 1.0 mg/L and frequently in concentrations of less than 0.1 mg/L. The sample collected from the collection ditch in April 2015 had a concentration of 39.3 mg/L. The concentration at a seepage face referred to as the CD Inlet was 2.82 mg/L. The elevated concentrations of phosphorus were described in the SAR (Formation 2014) and the source of phosphorus in the collection ditch is attributed to phosphorus that is available within native materials then concentrated by bioaccumulation.

As part of the analyses conducted in the BGWCR, trend tests were performed for each analyte at each monitoring well - this resulted in a total of 792 tests. The Mann-Kendall test, which is non-parametric and independent of the data distribution, indicated that, of the analyte concentration trends with a detection rate of 70% or greater, a total of 189 had a decreasing (D) or probably decreasing (PD) trend; 54 had an increasing (I) or probably increasing (PI) trend; and the remaining 310 had either a stable trend (S) or no trend (NT). Most of the increasing trends were observed in samples obtained from the monitoring wells that were installed in 1985 or 1997 in which dedicated sampling equipment had been installed. Most of the decreasing trends were observed in the monitoring wells that were installed in 2013. As described in the BGWCR, some of the decreasing trends may be due to the turbidity of the samples obtained.

Poor yielding monitoring wells installed during the RCRA 3013 investigation initially yielded groundwater samples with high turbidity. After several rounds of purging and sampling, turbidity decreased indicating that well development had been enhanced. In addition, sampling methodologies were refined based on the difficult conditions encountered during the investigation (i.e. utilizing the no-purge bailer method versus volumetric purging). Samples obtained from wells became less turbid due to lower degree of disturbance to the water column. Even though some upper outliers were removed based on high turbidity, the decreasing trends in the recently installed monitoring wells may be attributed to the slow recovery of the monitoring wells from the disturbed conditions resulting from installation in strata that yield very low groundwater flow to the well. Due to the very slow groundwater movement, trend tests over a two year period may be insufficient to capture true natural variability in the older established wells and are not sufficient to delineate trends in the recently installed wells where water quality is likely influenced by the disturbance caused by the installation of the monitoring well. Some analytes, such as nitrate which is not present in the native media, should be independent of the well installation/sampling effect and trend analysis could therefore be valid.

In summary, the available monitoring data are sufficient to identify specific chemical constituents that can serve as indicator parameters for facility releases. The data also indicate that groundwater chemistry is consistent with that expected for the Blair Formation based on regional investigations and there is no spatial pattern indicative of substantial facility releases. The data also indicate that initial groundwater samples in newly installed monitoring wells have high constituent concentrations related to the disturbed conditions resulting from drilling. As a result, statistical analyses of the available data must consider these potential influences on the data set.

Alternative Liner Demonstration

The liner system beneath the original phosphogypsum stack and all the lateral expansion liners constructed since 1985 consist of a 60-mil HDPE geomembrane liner underlain by a 16-oz. geotextile. The geotextile was installed to minimize stress concentrations in the liner resulting from near surface weathered rock fragments that may be present in the liner subgrade. Almost the entire lined area is covered with up to 200 or more feet of sedimented gypsum. The only uncovered liner is in the return water ditch that runs along the northeast and southeast sides of the phosphogypsum stack. The top of the phosphogypsum stack is kept ponded for sedimentation of the fine silt-sized phosphogypsum crystals and for evaporative cooling.

As described in the previous sections of this report, no evidence of liner leakage has been measured in groundwater samples obtained from the groundwater collection ditch or in monitor wells constructed around the lined phosphogypsum stack system. Either there are no defects in the geomembrane liner or the sedimented gypsum above the geomembrane is acting as the non-synthetic component of a composite liner.

This is not unexpected. The hydraulic conductivity of sedimented phosphogypsum is relatively low even at initial sedimented densities and decreases substantially as the thickness of the gypsum above the liner increases. For example, sedimented Rock Springs phosphogypsum has a vertical hydraulic conductivity of less than $4x10^{-4}$ cm/sec at a depth of 1 foot and a vertical hydraulic conductivity of less than $7x10^{-5}$ cm/sec at a depth of 100 feet. Furthermore, the diameter of the gypsum crystals (less than 0.06 mm) is much smaller than the diameter of a typical defect (2 to 3.56 mm) in the geomembrane and would fill the defect during initial sedimentation. This was demonstrated by the tests performed by Garlanger et al (1994) during development of the Florida Phosphogypsum Management Rule (17-763 FAC).

Paragraph VI (4) of Attachment C (Phosphogypsum Stack System Construction and Operational Requirements of the proposed Consent Decree between the United States, the State of Wyoming, and the J.R. Simplot Company specifies that the non-synthetic component of the composite Liner shall consist of either of the following:

b.iii. a A layer of compacted soil at least eighteen (18) inches thick, placed below the Geomembrane, with a maximum hydraulic conductivity of 1×10^{-7} centimeters per second, constructed in six-inch lifts; or

b.iii. b A layer of mechanically compacted Phosphogypsum at least twenty-four (24) inches thick, placed above the Geomembrane, with a maximum hydraulic conductivity of 1×10^{-4} centimeters per second.

b.iii. c Slurry discharged into the expansion area allowing the phosphogypsum to sediment in to reach a maximum hydraulic conductivity of 1×10^{-4} centimeters per second.

It also states that the non-synthetic component of a Phosphogypsum Stack composite Liner will not be required for vertical expansions under the following conditions:

b.iv. a. where it has been demonstrated to and approved by the STATE or EPA that a synthetic Liner alone or in contact with sedimented gypsum placed in slurry form will be equivalent or superior to a composite Liner designed and installed in accordance with the requirements of this Section VI (Phosphogypsum Stack System Construction Requirements); or

b.iv. b. where it has been demonstrated to and approved by the STATE or EPA that a synthetic Liner in contact with sedimented gypsum placed in slurry form is equivalent or superior to a composite Liner with twenty-four (24) inches of compacted Phosphogypsum placed above the Geomembrane;

In addition, the proposed language in the current draft of Attachment C states that

b. v where it has been demonstrated and certified by a third-party engineer and approved by the STATE or EPA that a synthetic Liner in contact with sedimented gypsum placed in slurry form, and with consideration of the physical and hydrogeological setting of the specific lateral expansion, provides an equivalent or superior degree of protection for human health and the environment.

Simplot proposes to use both compacted phosphogypsum and sedimented phosphogypsum as the non-synthetic components of the composite liner. The compacted phosphogypsum will be used over permanently exposed areas, e.g., slopes of the earthen perimeter dike, and within the initial 44-acre sedimentation area. The sedimented gypsum will be used in the remaining 120 acres.

Because of the topography of the proposed expansion area, gypsum slurry will be introduced along the northeast side of area and flow to the low area along the southwest side of the area. Process water will accumulate in this low area until the overflow elevation of the outfall structure is reached, and process water is discharged to the return water ditch. This will take approximately one month. Gypsum slurry will continue to discharge into the low area for approximately three additional months at which time, there will be no process water ponded above the uncovered geomembrane.

Gypsum will continue to be introduced from the northeast and be deposited on a phosphogypsum beach moving away from the overflow weir. Any defect in the geomembrane will be filled with sedimented gypsum as soon as the moving beach reaches the defect.

The leakage through the composite liner system, q, as the thickness of phosphogypsum increases with time can be computed for sedimented phosphogypsum and compacted gypsum using the following equations from Garlanger et al (1994):

$$q = \frac{4\sqrt{k_h k_v} h_w r_d}{1+\frac{4\sqrt{k_h k_v} t}{\pi r_d k_v}}, \qquad (1)$$

$$q = 4\sqrt{k_h k_v} h_w r_d, \qquad (2)$$

where k_h and k_v are the horizontal and vertical hydraulic conductivities of the sedimented gypsum, h_w is the height of gypsum/water above the liner, r_d is the radius of the defect in the geomembrane, and t = 1.5 mm is the thickness of the liner. The computed seepage rates through the proposed liner system for increasing thicknesses of gypsum above the liner using an anisotropy ratio of 2, two 3.56-mm diameter defects per acre for the sedimented gypsum and four 3.56-mm diameter defects per acre for the compacted gypsum is provided in Figure 7. Also shown for comparison is the predicted leakage when the non-synthetic component over the entire area is compacted phosphogypsum with a saturated hydraulic conductivity of 1×10^{-4} cm/sec. The hydraulic conductivity of the Rock Springs sedimented gypsum was computed from the following equation:

$$k_v = 1.16 \times 10^{-4} \mathrm{e}^{2.455},$$

where the void ratio, e, was computed from the expected dry density corresponding to the thickness of Rock Springs gypsum above the liner.

As can be seen by the results presented in Figure 7, the proposed liner system is superior to a composite Liner with twenty-four (24) inches of compacted Phosphogypsum placed above the Geomembrane.

Because the groundwater monitoring data, including the water quality data associated with samples obtained from the groundwater collection ditch over the past 33 years, shows no evidence of groundwater impacts from the existing phosphogypsum stack system, which has only sedimented phosphogypsum above the geomembrane, and because the results presented in Figure 7 indicate that the proposed liner system is superior to the composite liner specified in Attachment C, the proposed liner system should be approved by the US EPA and the State of

Wyoming.

If there are any questions, please contact the undersigned.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Andy Singletary, P.E.
Senior Project Engineer

John E. Garlanger, Ph.D., P.E.
Senior Consultant

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Wyoming Department of Environmental Quality (WDEQ) 2011b. Operating Permit No. 3-2-135, Rock Springs Coal Calcining Plant, P4 Production, LLC., WDEQ Air Quality Division, Chapter 6, Section 3, Operating Permit 3-2-135. August 22, 2011.

Appendix 8

Initial Closure Plan for the Facility

Initial Closure Plan and Closure Cost Estimate for the Rock Springs Phosphogypsum Stack System

J.R. Simplot Company
Rock Springs, Wyoming

March 25, 2020

Ardaman & Associates, Inc.

CORPORATE HEADQUARTERS
8008 S. Orange Avenue, Orlando, FL 32809 - Phone: (407) 855-3860 Fax: (407) 859-8121

Branch Office Locations
Florida: Bartow, Cocoa, Fort Myers, Miami, Orlando, Port St. Lucie, Sarasota, Tallahassee, Tampa, West Palm Beach
Louisiana: Baton Rouge, Monroe, New Orleans, Shreveport

CONFIDENTIAL

This document contains financial and other information pertaining to plant operations, production rates and life expectancy. J.R. Simplot Company considers the enclosed information to be confidential and proprietary and requests that WDEQ and EPA maintain this document in a confidential file, not subject to release to the general public.

CONFIDENTIAL

Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

March 25, 2020
File Number 16-13- 0070B

J.R. Simplot Company
P.O. Box 27
Boise, Idaho 83707

Attention: Mr. Alan L. Prouty
Vice President, Environmental & Regulatory Affairs

Subject: Revised Initial Closure Plan and Closure Cost Estimate for the Rock Springs Phosphogypsum Stack System, J.R. Simplot Company, Rock Springs, Wyoming.

Gentlemen:

As requested, Ardaman & Associates, Inc. has prepared an initial closure plan and closure cost estimate for the current footprint and expected configuration of the existing phosphogypsum stack system at the J.R. Simplot Company, Rock Springs facility in Rock Springs, Wyoming assuming closure at the end of calendar year 2024, i.e., 5 years in the future, prior to constructing the next lateral expansion. The gypsum stack configuration utilized for the cost estimate contained herein includes the lined footprint of the existing gypsum storage compartments, associated perimeter process water conveyance ditches and the lined process return water pond and pump station. The closure design and cost estimates contained herein meet the requirements of Attachment D (Closure of Phosphogypsum Stacks/ Phosphogypsum Stack Systems/Components) to Appendix 1 of the proposed Consent Decree between the United States, the State of Wyoming, and the J.R. Simplot Company. Closure in 2024 is considered to represent the condition when the cost for closure, water management/treatment, and long-term care for the current lined footprint of the Rock Springs phosphogypsum stack system would be the most expensive.

The closure cost estimates, water management and long-term maintenance costs provided herein are based on recent experience with similar ongoing and completed projects in the Central Florida area, using recently updated 2018 construction cost unit rates and 2018 unit rates for long-term care. The estimated unit construction costs were compared to costs incurred for ongoing construction activities at other facilities and adjusted as necessary for site-specific construction cost information, and with a regional correction factor based on conventional cost estimating standards (2018 RS Means, Heavy Construction Cost Data). The closure cost estimates included in this report have been prepared and will be used as the basis for establishing proof of financial assurance, as required by the U.S. Department of Environmental Protection (EPA) based on recent negotiations with J.R. Simplot relative to the proposed consent decree. The estimated closure, water management and long-term maintenance costs contained in this report are based on December 2018 dollars.

Contained in this report is a general overview of the existing facility with a conceptual closure plan and schedule of closure. Also included is an estimate of closure construction costs, water management costs and long-term maintenance and operating costs for the closed phosphogypsum stack system, based on the existing facility footprint and expected 2024 configuration. In preparing this closure plan and related cost estimates, we have relied on information supplied by J.R. Simplot and made assumptions relative to plant operating schedules, production rates, adjacent land and facility uses, gypsum stack growth and management, etc. All of these assumptions are listed in Section 3 of this report. The assumptions were made for cost estimating purposes and are subject to change.

Relative to closure and post-closure water management, this plan deviates from the way treatment and consumption of process water is handled at phosphoric acid plants in wet climates. Because of the dry climate in Rock Springs, J.R. Simplot will be able to evaporate ponded and drainable process water at this facility. A portion of the process water will be partially evaporated and permanently retained in the lined phosphogypsum stack. The remaining drainage water will be treated using conventional limestone-lime neutralization. The treated water and treatment residue will be evaporated/stored in lined ponds constructed on top of the phosphogypsum stack. No treated water will be discharged into adjacent surface waters.

Utilization of this treatment and disposal method will require that completion of closure construction activities for portions of the existing facility be extended beyond the closure period that would be required for an unlined phosphogypsum stack system. However, because the Rock Springs phosphogypsum stack system was constructed above a 60-mil HDPE geomembrane bottom liner, the additional closure period will not increase the potential for groundwater discharges from the facility.

This report has been prepared in accordance with generally accepted geotechnical engineering practices for the exclusive use of the J.R. Simplot Company, for specific application to the above referenced project. No other warranty, expressed or implied, is made.

It has been a pleasure assisting you with this project and we look forward to assisting you with the detailed closure plan and closure permit application in due time. If you have any questions about this report or would like to discuss the proposed closure plan or cost estimates in greater detail, please do not hesitate to contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. E-0013

Bill E. Jackson, P.E. (FL)
Principal Engineer

William A. Singletary, P.E. (FL)
Senior Project Engineer

3/25/20
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Senior Consultant
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BEJ/JEG/ed

cc:

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Attachment 1 Aerial Imagery and Topography of Phosphogypsum Stack System

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Section 1

1.1 Site Location

The phosphogypsum stack system for the J.R. Simplot Company, Rock Springs fertilizer complex is located approximately 4.5 miles southeast of Rock Springs, Wyoming (see Figure 1). The facility occupies portions of Sections 8, 9, 16 and 17 of Township 18 North, Range 104 West in Sweetwater County, Wyoming. The site location, superimposed on a reproduction of the United States Geological Survey quadrangle map of Rock Springs, Wyoming, is shown in Figure 1.

1.2 Background

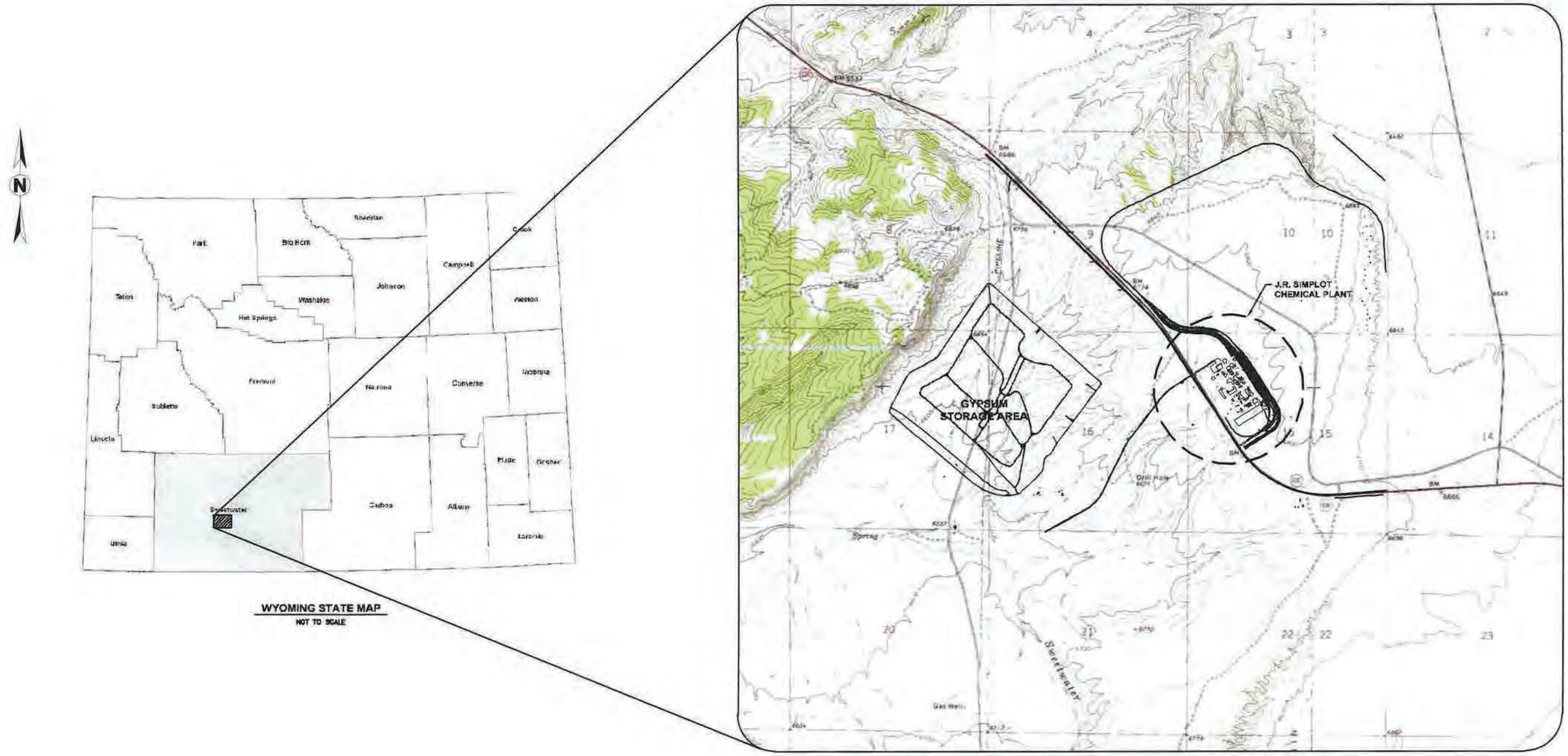
Operation of the phosphogypsum stack system at the Rock Springs Phosphate Fertilizer Complex began in 1986. The entire footprint of the phosphogypsum stack system has been provided with a 60-mil HDPE geomembrane bottom liner that was installed in phases as the size of the gypsum storage area increased with time. The total lined area at this time and at the assumed time of terminal closure covers just over 420 acres. The phosphogypsum stack is operated using wet stacking techniques wherein gypsum slurry is pumped [redacted] to sedimentation compartments (cells) located on top of the stack, where the solids are allowed to settle, and the clarified process water is decanted and pumped back to the phosphoric acid plant for reuse. The gypsum stack is raised by the upstream method of construction using rim ditch techniques for hydraulic distribution of the gypsum slurry around the perimeter of the various sedimentation compartments. Figure 2 shows the present configuration of the Rock Springs facility. As noted, the storage area is currently divided into seven separate cells, five of which (Cells 1 through 5) are located on the main body of the gypsum stack, while the other two (Cells 6 and 7) are within the footprint of the most recently lined expansion area, located on the east side of the original gypsum stack footprint (relative to the Plant coordinate system). Figures 3 and 4 provide topographic maps of the Rock Springs facility and phosphogypsum stack system.

The bottom elevation of the existing stack ranges from a low of about 6,580 feet (NGVD) beneath the west side of the original gypsum stacking area to a high of about 6,700 feet (NGVD) beneath the lined expansion area (Cells 6 and 7) on the east side of the site. Relative to surveyed spot elevations obtained in November 2018, the elevations of the perimeter gypsum dikes on top of the main body of the gypsum stack vary from 6,790 to 6,785 feet (NGVD), respectively, on the west side of Areas 1 and 2 and more on the order of 6,775 to 6,770 feet (NGVD) on the south and north sides of Areas 4 and 5. Elevations of the perimeter gypsum dikes in the lined expansion area are in the range of 6,715 to 6720 feet (NGVD), respectively, on the east and south sides of Area 6 and generally in the range of 6,725 to 6,720 feet (NGVD) on the east and north walls of Area 7.

The surface elevation in Cell 3 is similar to the elevation in Cell 5 but it is assumed that this area is in the process of being raised and will be joined with Cell 2 prior to the commencement of closure construction activities. Decanted process water from the stack currently flows by gravity through a perimeter ditch system to an existing lined process water surge pond and return water pump station located just south of the southwest corner of the gypsum stack. Return water is pumped from this pond back to the plant for reuse.

Based on seepage and stability analyses performed in prior years (see Ardaman report titled: "Engineering Evaluation and Recommendations for Proposed Gypsum Stack Expansion, SF

Phosphates Limited Company, Rock Springs, Wyoming", May 2001), seepage collection drains have been installed at vertical intervals around portions of the exterior walls of the gypsum stack. The primary purpose of these drains is to provide seepage control needed to improve the overall stability of the exterior slopes of the gypsum stack as the stack height increases with time. The seepage control provided by these drains has also allowed J.R. Simplot to cover and grass select portions of the gypsum stack side slopes in advance of final closure. In that regard, the closure plan presented herein assumes [redacted] have already been reclaimed and are not included in the final closure cost estimate.



WYOMING STATE MAP
NOT TO SCALE

TOWNSHIP: 18N
RANGE: 104W
OBTAINED FROM: USGS QUAD MAP:
ROCK SPRINGS, WYOMING
(PHOTO INSPECTED 1968, REVISED 1978)

SITE VICINITY MAP
SCALE: 1" = 2000'

SITE LOCATION MAP

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

J.R. SIMPLOT COMPANY
CLOSURE COST ESTIMATES
ROCK SPRINGS, WYOMING

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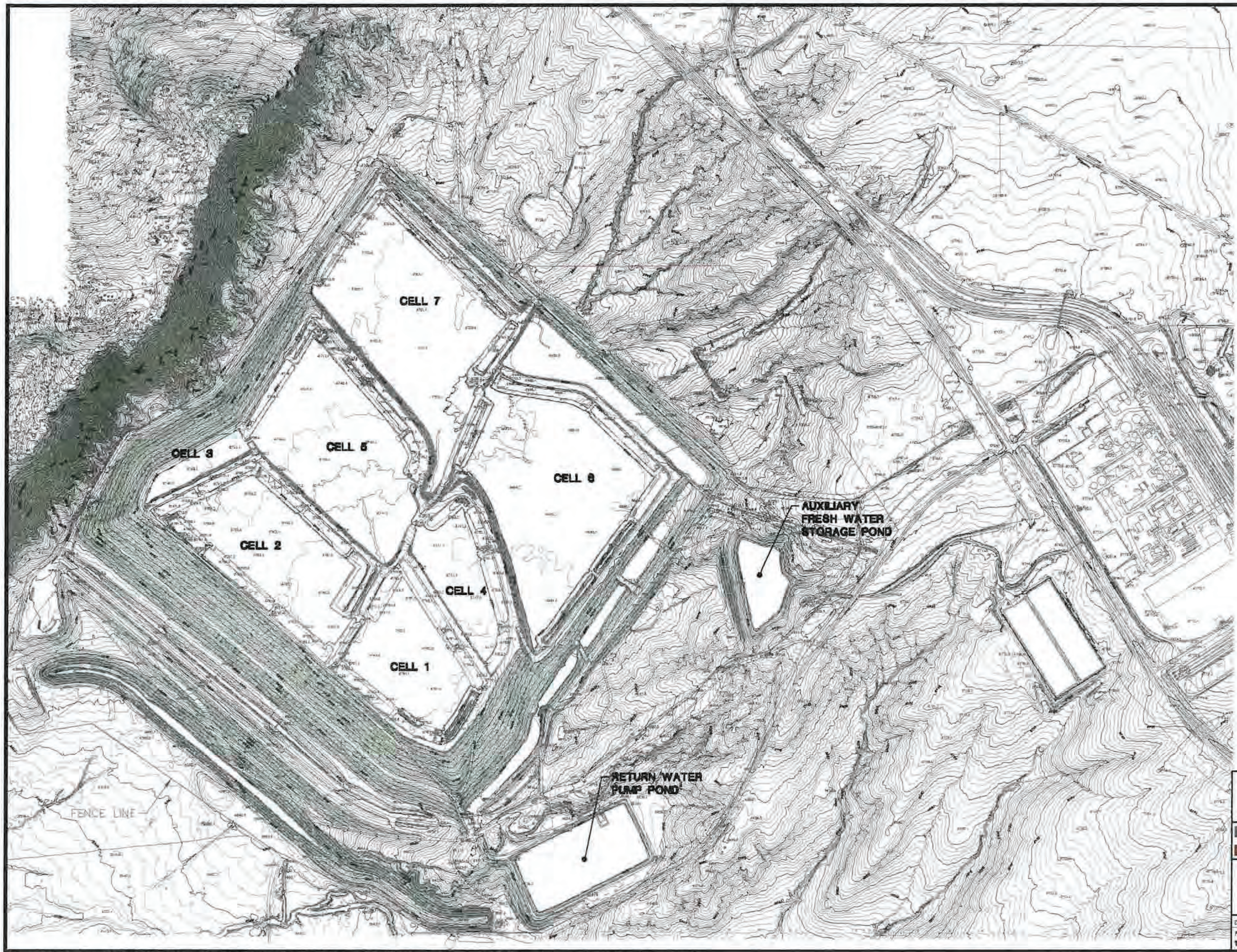
AERIAL PHOTOGRAPH OF PHOSPHOGYPSUM STACK SYSTEM

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

J.R. SIMPLOT COMPANY
CLOSURE COST ESTIMATES
ROCK SPRINGS, WYOMING

DRAWN BY: RDC	CHECKED BY: WAS	DATE: 04/05/19			
FILE NO. 16-13-0070B	APPROVED BY:		FIGURE: 2		

T:\Corporate\16\16-13-0070B\SIMPLOT ROCK SPRINGS - CLOSURE COST ESTIMATE_CURRENT SHEET SET\2 AERIAL PHOTOGRAPH OF PHOSPHOGYPSUM STACK SYSTEM.dwg 4/05/2019 12:08:29 PM, richard.clemons



TOPOGRAPHIC MAP OF PLANT SITE AND GYPSUM STACK

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

J.R. SIMPLOT COMPANY
CLOSURE COST ESTIMATES
ROCK SPRINGS, WYOMING

DRAWN BY: RDC	CHECKED BY: WAS	DATE: 04/05/19
FILE NO. 16-13-0070B	APPROVED BY:	FIGURE: 3

T:\Composite\16\16-13-0070B\SIMPLOT ROCK SPRINGS – CLOSURE COST ESTIMATE__CURRENT SHEET SET\3 TOPOGRAPHIC MAP OF PLANT SITE AND GYPSUM STACK.dwg 4/05/2019 12:08:41 PM, richard.clemons

TOPOGRAPHIC MAP OF STACK EXISTING GEOMETRY

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

J.R. SIMPLOT COMPANY
CLOSURE COST ESTIMATES
ROCK SPRINGS, WYOMING

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FILE NO. 16-13-0070B		APPROVED BY:		FIGURE:	4

T:\Corporate\16\16-13-0070B\SIMPLOT ROCK SPRINGS - CLOSURE COST ESTIMATE__CURRENT SHEET SET\4 TOPOGRAPHIC MAP OF STACK EXISTING GEOMETRY.dwg 4/05/2019 12:08:50 PM, richard.clemons

Section 2

INITIAL CLOSURE PLAN AND SCHEDULE

2.1 Closure Schedule

Although J.R. Simplot intends to continue to operate the Rock Springs facility going forward, the closure plan and cost estimates presented herein are based on an assumed terminal gypsum stack geometry that is represented by the existing stack geometry, projected upward after five years of continued stack operation [redacted] Closure in 2024, after disposal of [redacted] phosphogypsum and prior to construction of the next lateral expansion, is considered to represent the condition when the cost for closure, water management/treatment, and long-term care for the current lined footprint of the Rock Springs phosphogypsum stack system would be the most expensive.

The proposed water management plan for this facility relies on evaporation of a significant portion of excess process water during the initial 13-year period following deactivation, after which all drainage water seeping from the phosphogypsum stack will be treated with limestone and lime, with the treated water and associated lime sludge stored and evaporated in lined ponds that will be constructed on top of the closed phosphogypsum stack. The phosphogypsum stack system will be closed in phases as expeditiously as practicable. A discussion of the proposed closure phases and approximate schedule for implementation of each phase is provided below.

2.2 Closure Design Concepts

2.2.1 Overview

The phosphogypsum stack system will be closed in general accordance with the criteria contained in Appendix 1.C. of the proposed consent decree between the United States and J.R. Simplot (Appendix 1.C.). In general, evaporation will be used in the first phase of closure to evaporate process water, while side slopes and other parts of the stack will begin final grading and placement of a cover. The top surface area of the stack that is used for evaporation of process water and not used for lined sludge/evaporation ponds, will be flushed with treated water before closure. The proposed closure will consist of providing a final cover over the entire surface of the gypsum stack and associated process water ponds that will meet the performance standards of Appendix 1.C.. In particular, the top gradient of the gypsum stack and pond surfaces will be provided with a relatively impervious HDPE liner and protective vegetated soil cover that will be graded to promote drainage and minimize ponding of rain water or snow melt runoff on top of the lined surface. The side slopes of the stack will be provided with a final vegetated soil cover as needed to promote rainfall runoff and evapotranspiration, while reducing infiltration and controlling erosion of the side slope cover.

Considering continued gypsum stacking operations for a 5-year operation period, [redacted] the predicted average top elevation of the sedimentation ponds on the west side of the phosphogypsum stack (Cells 1 and 2 on Figure 2) will be just over 6,790 feet, NGVD. The top elevations will drop down from west to east in 10-foot increment to an average top elevation of just over 6,770 feet in Cells 6 and 7 on the east side of the stack. The predicted geometry in 2024 is shown in Figure 5.

Closure design concepts for the existing phosphogypsum stack system are illustrated on Figures 6 through 10, with their associated details presented in Figures 11 through 24. The assumed dimensions of the phosphogypsum stack system at the time of closure (i.e., prior to regrading), and used as the basis of the closure cost estimate presented herein, is tabulated below:

Closure Component	Estimated Area at Time of Closure (acres)
Total Lined Footprint*	420
Gypsum Stack Footprint	320
Final Top Area	205
Gypsum Side Slope Area	145
Return Water Surge Pond	15
*Includes 15 Acre Return Water Surge Pond	

2.2.2 Long-Term Care Plan

The long-term care plan includes the following elements:

- Surface water management: surface water runoff from the top of the closed phosphogypsum stack will be directed inboard by perimeter dikes to low points for controlled release through decant spillways and piping systems to the base of the stack. Section 2.4.3 describes the details of the management of surface water. Figure 10 presents the anticipated final geometry and conceptual surface water management plan of the gypsum stack after closure. Conceptual details of the proposed slope and toe ditch swales are illustrated on Figures 11 through 21. Costs associated with surface water management are shown in Table 3.1. This includes the costs for grading, and cover for the gypsum stack surfaces including swales.

- Seepage/leachate control: after final closure of the gypsum stack top ponds, seepage rates will diminish with time (see Figure 25). The reduced seepage flow will be collected in the existing surge pond and return water pump station and will be periodically treated/neutralized with limestone and lime. The treated water and lime sludge solids will be evaporated and stored in designated lined storage ponds on top of the closed gypsum stack. The seepage rate treated/neutralized after Year 12 is plotted as a function of time after closure in Figure 26. Costs associated with treatment of the leachate are described in section 3.3 and costs are shown in Table 3.3.

- Other activities associated with long-term care include groundwater monitoring, wildlife control, security, and land surface care. The facility already has a fence around the perimeter of the gypsum stack to act as a deterrent for both human and wildlife access. Also, the facility already uses propane cannons as a way of discouraging birds from using the return pond. Costs associated with these activities are found in Table 3.4.

2.2.3 Management of Treatment Solids

Lined ponds will be built on top of the gypsum stack and will be used for treated water evaporation and lime sludge storage. These ponds will eventually be closed by dewatering, drying and stabilization of the sedimented solids to the degree necessary to facilitate placement of a 1-foot thick, vegetated soil cover. Further discussion on the management of treatment solids is found on pages 2-8, 2-10, 2-13 and Table 3.1 (cost information).

2.3 **Process Water Management During Closure**

The closure schedule for the Rock Springs phosphogypsum stack system will be dictated to a certain extent by the need to store and manage/treat existing process water inventories during the closure period. Primary factors include the process water inventory at the time of plant shutdown, available storage capacity within the process water containment system, post-shutdown water balance, process water seepage rates from the closed phosphogypsum stack and the ability to transfer and manage/treat water volumes throughout the closure period.

Unlike the humid subtropical climate in the southeastern U.S., where annual rainfall normally exceeds lake evaporation, the climate in the Rock Springs area is cold, semiarid, with evaporation rates far exceeding precipitation. The average rainfall near the Rock Spring plant is on the order of 8.4 inches per year, with lake or pond evaporation rates of 46.2 inches per year, equating to a net ponded area evaporation loss of about 37.8 inches per year. Given the high evaporation rates for this area, the proposed water management plan for the Rock Springs facility differs from those used in the humid subtropical climate of the Southeast U.S. During the first 13 years after the phosphoric acid plant ceases operations and the slopes of the phosphogypsum stack are being closed, any remaining ponded water as well as consolidation and drainage water seeping from the stack will be allowed to partially evaporate using pond or spray irrigation on top of the phosphogypsum stack and seep back into the stack, where it will be retained by surface water tension and adsorption in the phosphogypsum above the phreatic surface (water table) in the stack.

Construction of a treatment plant will begin on or before year 12. Drainage water seeping from the phosphogypsum stack will be neutralized with limestone and lime and then evaporated in lined sludge/evaporation ponds constructed on top of the closed phosphogypsum stack. This treatment (neutralization) will begin in year 13 of the closure along with continued partial evaporation of the drainage water. All gypsum stack drainage water (process water/leachate) will be treated in year 14. The sludge/evaporation ponds will ultimately be closed by dewatering, drying and stabilization of the sedimented solids, and placement of a 1-foot thick, vegetated soil cover.

The areas on top of the phosphogypsum stacks that are used for spray irrigation and evaporation and not used for lined sludge/evaporation ponds will be lined with 40-mil HDPE, covered with 2 feet of soil and planted in native vegetation. Prior to lining these areas, the upper one to two feet of phosphogypsum will be flushed with treated water. The depth of treated water applied will not be less than 4 inches over the entire surface to be covered.

2.3.1 Existing Process Water Inventories

The Rock Springs gypsum storage area has historically been operated with only limited process water inventories (see Figure 2). Clarified return water from the sedimentation ponds on top of the gypsum stack is decanted through various water level control structures into perimeter process water flow channels provided on the east and south sides of the gypsum stack, which, in turn, route the decanted process water back to a lined return water surge pond and pump station, located on the south side of Area 1 within the original gypsum stack footprint. Utilizing the October 2009 aerial photograph and topographic map, in conjunction with the other historical maps and information provided by J.R. Simplot personnel, [redacted] This estimated volume is for ponded water only and does not include consolidation and drainage water that will seep out of the phosphogypsum stack over time. An estimate of the drainable pore volume within the gypsum stack is provided below.

2.3.2 Drainage Characteristics of Existing Gypsum Stack

The sedimented gypsum contained in the Rock Springs gypsum stack is for the most part fully saturated with process water entrained within the pores of the individual gypsum crystals or particles. After the plant and gypsum stack are shut down (i.e., no gypsum slurry or process water pumped to the top of the stack), the entrained water in the pore spaces of the sedimented gypsum will drain from the stack by gravity over a period of time. Since the gypsum storage area is provided with a 60-mil HDPE bottom liner, any water that drains from the stack with time will be collected in the existing or proposed seepage collection drains and/or in the existing perimeter flow channels at the toe of the stack. As the closed stack drains with time, the rate of seepage entering the seepage collection drains or perimeter flow channel will likewise diminish. The rate at which pore water drains from the stack is a key factor needed for development of a detailed water management plan at the time of final closure.

Gypsum stack consolidation and drainage rates used for the closure plan and schedule presented herein were estimated using a phosphogypsum stack seepage model developed on an Excel spreadsheet. The seepage model takes into consideration the varying height, geometry, initial and final density, hydraulic conductivity, and drainable porosity of the sedimented gypsum. Material properties used to develop the relationships needed for the drainage model were obtained from a previous engineering evaluation of the Rock Springs gypsum stack (see Ardaman report titled: “Engineering Evaluation and Recommendations for Proposed Gypsum Stack Expansion, SF Phosphates Limited Company, Rock Springs, Wyoming”, May 2001). The Excel spreadsheet was developed by Ardaman & Associates and reviewed by EPA and its consulting expert.

[redacted]

[redacted]

2.3.3 Process Water Evaporation

Considering an initial ponded area [redacted] for ponds on top of the gypsum stack and a net evaporation rate of 37.8 inches per year, it is theoretically possible to evaporate [redacted] provided that the ponds are kept fully ponded or fully surface wetted. Using water management techniques (recycling water collected in perimeter flow channels and the seepage collection drains back to the top of the stack to keep the uppermost compartments ponded and/or surface wet), all of the water that seeps from the stack and any remaining ponded water can be evaporated from the top gradient of the phosphogypsum stack. During the first 13 years after closure, the process water will be partially evaporated and allowed to seep back into the top of the stack where it will be retained by surface water tension in the phosphogypsum above the phreatic surface. After 13 years, water seeping from the stack will be neutralized using limestone to a pH of approximately 4 and then lime to a pH of approximately 7. The treated water and sludge will be pumped back to lined ponds constructed on top of the stack where the treated water will be evaporated.

The conceptual water management plan during closure is to maximize evaporation rates from the gypsum stack top ponds by initially recycling collected seepage and free water back to the top of the stack in such a manner as to keep the surface area fully ponded or surface wet. Irrigation piping will be used as needed to distribute the water over the top gradient of the stack when the volume of water collected from stack seepage is no longer enough to pond the entire top surface. During years 12 and 13, three of the existing top ponds will be lined to provide sufficient area (75 acres) to evaporate treated water and store lime residue from the treatment process. After year 13, process water evaporation from the remaining ponds will cease and the remaining top ponds will be graded as needed for proper drainage, lined with the rule-specified 40-mil liner, and capped with a 2-foot thick protective soil cover. The final geometry of the top gradient is shown on Figure 10.

The water balance and drainage model used to develop this closure plan indicates that the irrigation area required to evaporate all the stack seepage will reduce over time [redacted] To distribute the partially evaporated water as evenly as possible over the top surface of the stack, the irrigation area will [redacted] until year 11 by reducing the time the irrigation system is operated each day. Seepage rates should be reduced sufficiently by year 13 to allow all collected water to be adequately managed in the return water pond, without pumping any untreated water back to the top of the gypsum stack. The return water pump pond will need to remain in place for another 50 years or until all of the seepage water can be contained prior to treatment in a surge tank.

2.3.4 Environmental Considerations

The closure plan for the gypsum stack incorporates several features for additional protection of the environment.

Fluoride Emissions

During the closure process, one objective is that the phosphogypsum water will be managed so that fluoride atmospheric emissions will be no more than the emissions during plant operation. In general, fluoride emissions from a closed gypsum stack are expected to be lower than those in an operating stack for two reasons: the vapor pressure of fluoride gases will be reduced because the process water will be at a much lower temperature (and thus less likely to result in fugitive air emissions) and fluoride will be removed from the process water due to adsorption onto compounds in the gypsum stack or from the formation of solid calcium fluoride compounds in the gypsum stack.

Estimating fluoride emissions from phosphogypsum stacks has a number of technical challenges. Thus, measurement methodologies have limitations. Potential methods include spectroscopy techniques or a mass balance approach.

A mass balance model was reviewed by Simplot, EPA, and EPA's consulting expert. The recommended method of demonstration uses a monthly measurement (weather permitting) of the fluoride concentrations in the applied water and the water that accumulates during a 24-hour period in a shallow pan placed within the irrigation area. The measured concentrations can be used to compute [see Equation-1] the ratio of the mass of fluoride emitted during spray irrigation/evaporation to the mass of fluoride emitted from both solar and heat load evaporation during normal plant operations.

$$\text{[Eqn-1]}\quad \text{Mass Ratio} = F_eA_eT_e/F_oA_o/24,$$

where F_e is the dissolved fluoride concentration (mg/L) in the liquid accumulated in the pan located in the Sprayfield, A_e is the area (acres) of the Sprayfield, T_e is the duration (hours) of spray irrigation, F_o is the average concentration (mg/L) of dissolved fluoride in the process water during normal plant operations, and A_o is the ponded area (acres) on top of the operating stack system at the time of plant shut down.

Fluoride concentration would be measured (as permitted by the weather) in the liquid accumulating during a 24-hour period in a shallow pan placed at several locations within the Sprayfield at least once per month during Sprayfield operation and reported, along with the area of the Sprayfield and the duration of spraying quarterly. The average concentration of fluoride in the process water measured during the last year of normal operations and the size of the ponded area on top of the operating stack would be included in the quarterly report. The output of Equation-1 can be used to adjust either the size of the application area, the application period, or both to achieve this objective.

Based on an analysis performed by EPA's consultant, the fluoride emission objective will be met if the mass ratio is less than or equal to 2.5[1]. Other analytical methods or measurement techniques could also be used. These alternate methods, upon review and approval by EPA and Simplot, could be used to demonstrate achievement of this objective.

Wildlife

Currently, the facility utilizes a fence and propane cannons to reduce the potential for wildlife entering the phosphogypsum system. [The cannons are used at the return pond to discourage birds from landing.] During closure, the fence will remain in place and hazing methods (such as the propane cannons) will continue to be used to discourage birds from landing.

"Flush" of Gypsum Stack Surface

The areas on top of the phosphogypsum stacks that are used for spray irrigation and evaporation and not used for lined sludge/evaporation ponds will be lined with 40-mil HDPE, covered with 2 feet of soil and planted in native vegetation. Prior to lining these areas, the upper one to two feet of phosphogypsum will be flushed with treated water. The depth of treated water applied will not be less than 4 inches over the entire surface to be covered. This flush will reduce the acidity of the upper zone of the gypsum stack.

2.4 Key Elements of Closure Design, Long-Term Care and Treatment Solids

The Rock Springs phosphogypsum stack system will be closed in general accordance with the requirements of Appendix 1.C. In general, the proposed closure will consist of providing a final cover over the entire surface of the gypsum stack and associated water flow channels and storage ponds that will meet the specified performance standards. In particular, the top gradient of the stack and associated ponds will be provided with a relatively impervious liner and protective cover that will be graded to promote drainage and minimize ponding of water on top of the lined surface. The side slopes of the stack will be provided with a final vegetated soil cover as needed to promote

[1] The ratio of 2.5 was derived from the mass of water that evaporates from a ponded area on top of the Simplot Stack at Rock Springs from both solar and heat load evaporation and the mass of water that would evaporate from the same ponded area due solely to solar evaporation.

rainfall runoff and evapotranspiration, while reducing infiltration and controlling erosion of the side slope cover. Conceptual details of the proposed closure are discussed below.

2.4.1 Gypsum Stack Top Gradient and Capping

Appendix 1.C. requires, upon closure, that all phosphogypsum stacks be provided with a continuous, low permeability soil barrier or a relatively impervious geomembrane liner over the top gradient of the stack. If clay borrow materials are not locally available for a soil liner that meets the specified permeability criteria, an impervious geomembrane is typically used as the top liner.

For cost estimating purposes, the conceptual design of the final cover for the top of the Rock Springs phosphogypsum stack utilizes the alternate cover design consisting of a synthetic geomembrane with a vegetated, 24-inch thick protective layer of clean soil obtained from locally available borrow sources. A typical cross section of the closed gypsum field and a design detail for the proposed synthetic liner and top cover is provided on Figures 22 and 23. 60-mil HDPE liner will be used for the lined lime sludge/evaporation pond, while 40-mil liner will be used for the remaining top ponds not utilized for treated water evaporation.

Figure 10 conceptually presents the anticipated final geometry and layout of the closed gypsum stack and the probable location of surface water control structures. In general, the top grading plan for the gypsum stack will provide positive gradients that will promote rainfall runoff and minimize water ponding on top of the lined surface. A perimeter dike will be provided around the top edge of the gypsum stack to prevent rainfall runoff from discharging down the side slopes of the stack in an uncontrolled manner. Rainfall runoff on top of the stack will, instead, be directed inboard to low points in each compartment, where decant spillways and piping systems will provide controlled release to, or beyond, the base of the stack. The locations of the decant spillways may differ from those shown, based on the actual stack geometry and location of the low points at the time the stack is deactivated.

2.4.2 Gypsum Stack Side Slope Grading and Cover

Although the lower side slopes of the existing gypsum stack are typically flatter than 3.0 horizontal to 1.0 vertical, the slopes around the upper perimeter of the active storage compartments are steeper and will need to be flattened to no steeper than 3.0 horizontal to 1.0 vertical. The existing side slopes are presently stable and should become more stable as the gypsum stack begins to drain, dewater and settle after closure.

For cost estimating purposes, it is assumed that the final cover on the side slopes of the stack will consist of a 12-inch layer of soil that will support a drought-resistant vegetation cover to provide erosion control, increase evapotranspiration, reduce side slope infiltration and make the closed facility more aesthetically pleasing. Approximately 43 acres of the existing side slope area have already been reclaimed (covered with soil and grassed) and are not included in the final closure cost estimate presented herein.

2.4.3 Surface Water Management

Surface water runoff from the top of the closed phosphogypsum stack will be directed inboard by perimeter dikes to low points for controlled release through decant spillways and piping systems to the base of the stack. Runoff from the lower portion of the side slope will flow directly downgradient to a lined toe swale at the base of the stack. The slope of the swale (i.e., along the swale alignment) will generally be less than 0.2 percent. This is a relatively flat slope, which, for small rainfall events will result in relatively low flow velocities and correspondingly long retention periods. To minimize the infiltration of runoff collected on and routed along the benches, each swale will be provided with an impervious liner. For cost estimating purposes, it is anticipated that the runoff swales will be lined with a textured 60-mil HDPE liner, covered with a 24-inch thick protective soil cover, similar in design to that used for the gypsum stack top cover. Conceptual details of the proposed slope and toe ditch swales are illustrated on Figures 11 through 21.

Figure 10 presents the anticipated final geometry and conceptual surface water management plan of the gypsum stack after closure. As noted by the directional arrows shown on this figure, runoff from the top and side slopes of the gypsum stack will be discharged into the toe ditch swale and routed to the south side of the stack for discharge into a lined detention pond that will be constructed along the alignment of the original earthen starter dike for the gypsum stack. This pond, in turn, will provide controlled release of runoff from the closed facility to the freshwater retention pond. It should be noted that since all surfaces of the closed facility will be covered by not less than 12 inches of vegetated soil cover, runoff quality should be suitable for offsite discharge with no additional treatment.

2.4.4 <u>Seepage/Leachate Control</u>

Closure of the gypsum stack side slopes will require that portions of the existing side slopes be flattened and that additional seepage collection drains be provided at intervals on the slope and at the downstream toe of the gypsum to intercept process water seepage and route it back to the return water pump station for recycling to evaporation ponds located on top of the gypsum stack and eventually to the process water treatment plant. Based on the anticipated final stack geometry presented on Figure 10, it is estimated that seepage rates from the stack will initially be high, [redacted] but will further diminish significantly with time as the stack drains (See Figure 25). After final closure of the gypsum stack top ponds, seepage rates will diminish with time. The reduced seepage flow will be collected in the existing surge pond and return water pump station and will be periodically treated/neutralized with limestone and lime. The treated water and lime sludge solids will be evaporated and stored in designated lined storage ponds on top of the closed gypsum stack. The seepage rate treated/neutralized after Year 12 is plotted as a function of time after closure in Figure 26. It may be possible that the seepage rate is reduced sufficiently in the latter years of closure that an alternate method for managing the leachate can used rather than lime treatment.

The return water pump station pond will not be closed immediately but will remain open after final closure of the gypsum stack is complete to collect and evaporate residual process water seepage collected after the gypsum stack is closed.

[redacted]

2.4.5 Closure Techniques for Treatment Solids and Other Ponds

Three of the previously lined gypsum sedimentation ponds on top of the gypsum stack will ultimately be used for treated water evaporation and lime sludge storage. These ponds will eventually be closed by dewatering, drying and stabilization of the sedimented solids to the degree necessary to facilitate placement of a 1-foot thick, vegetated soil cover.

The return water surge/pump pond will be used on a long-term basis to collect and manage small quantities of process water seepage collected after final closure of the gypsum stack is complete. Closure of this pond will need to be delayed until seepage quantities are reduced to insignificant levels that can be managed by a smaller sump and pump station. Closure of the return water pond will be accomplished by pushing down the side slopes and re-grading the surface of the pond in such a manner as to shed rainfall runoff/runon away from the original pond footprint. The regraded pond surface will be capped with a 40-mil HDPE liner and covered with a 2-foot protective cover of locally available soil borrow.

2.5 Phased Closure Construction Schedule

As discussed above, the proposed water management plan for this facility will rely on evaporation of excess process water instead of treatment and discharge. The closure schedule, therefore, will be determined by the need to store and manage process water inventories during the closure period. The following is an approximate plan and schedule for how the phosphogypsum stack system will be closed in phases as expeditiously as practicable.

Closure Years 1 through 5

- Continue to pump process water collected in the surge pond and return water pump station back to the top of existing gypsum stack for water management and evaporation. Portions of these ponds may need to be reconfigured and regraded to some degree to increase wetted surface water areas to maximize evaporation rates and accommodate the irrigation system.

- It is assumed that a two-year idle period will be required for permitting and the preparation of detailed plans and specifications and contract documents before any closure construction activities can commence. Initial closure activities will be limited to side slope areas that are not being used to store or evaporate excess process water or in active portions of the lined return water flow channel to the surge pond and return water pump station. Initial closure construction activities may include some of the following:

- Bench and install seepage collection drains on the side slopes of the gypsum stack at locations where they do not already exist.

- Install perimeter seepage collection toe drains on the north and west sides of the gypsum stack and at any other locations that are not being used as return water flow channels.

- Construct lined surface water swales and toe ditches on the north and west sides of the stack.

- Once seepage has subsided, finish grade, amend and cover side slopes of gypsum stack with 12-inches of locally available soil and grass/vegetate slopes.

- Grade and construct lined surface water detention pond on west side of gypsum stack. The detention pond will be provided with a 60-mil HDPE bottom liner and a vegetated, two-foot thick vegetated soil cover. All surface water runoff from the closed stack side slopes will be routed through this pond.

Phase 2 – (Years 6 through 15)

- All top ponds will be used on an as needed basis for process water irrigation and evaporation through year 11.

- On or before year 12, J.R. Simplot will begin construction of a double lime treatment plant that will be capable of treating all gypsum stack drainage water by year 14. It is also anticipated that by the end of year 13, three of the existing top ponds that will ultimately be used for lime sludge storage and evaporation of treated water will be regraded and provided with a 60-mil HDPE bottom liner.

- Lining of the remaining top ponds will commence after year 13 and should be complete by the end of year 15. Final cover will include a 40-mill HDPE liner covered with a protective, two-foot thick vegetated soil cover. Surface water control structures will be installed as needed to direct runoff from the closed top ponds to perimeter surface water swales or ditches and then to the lined detention pond on the west side of the gypsum stack.

- Process water treatment will commence during year 13, which will require that the proposed process water treatment plant be installed and fully operational by that time. Partial evaporation of drainage (process water) will continue in year 13 while the treatment plant is being brought into service. All gypsum stack drainage water (process water/leachate) will be treated in year 14.

<u>Phase 3 – (Years 16 through 50)</u>

- After closure of the top ponds, bench and install seepage collection drains on the remaining side slopes of the gypsum stack at locations where they do not already exist.

- Install perimeter seepage collection toe drains on the east and south sides of the gypsum stack once the return water flow channel has been taken out of service.

- Lined lime sludge storage and evaporation ponds on top of the closed stack will be closed incrementally once seepage rates from the closed phosphogypsum stack have reduced sufficiently to warrant closure. Closure of the sludge ponds will include dewatering and drying of the lime sludge materials to a stable consistency that will allow placement of a one-foot thick, vegetated soil cover. Any exposed HDPE liner materials on the side slopes of the pond, above the top surface of the lime deposits will be covered with a protective, two-foot thick vegetated soil cover.

- There is a fifty-year long-term care and maintenance program for the closed facility will commence once final closure activities are complete and certified.