Richardson Environmental Solutions & Design, LLC

May 13, 2015

Mr. Jim Griswold
Chief, Oil Conservation Division
New Mexico Energy, Minerals and Natural Resources
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Re: C.K. Disposal E & P Landfill and Processing Facility Permit Application Review

Dear Mr. Griswold:

As per your instructions, I have reviewed the plans and specifications and associated calculations of the C.K. Disposal E & P Landfill and Processing Facility Permit Application for its engineering content, completeness, and accuracy in accordance with NMAC 19.15.36 and/or applicable federal standards and guidelines, and generally acceptable engineering practice. The engineer of record for these specific portions was Parkhill Smith & Cooper (PSC). Contained herein are my observations and comments.

<u>General</u>:

It is my professional opinion that the engineering detailed in the permit application and calculations provided for the landfill component meets or exceeds the regulatory requirements established by the New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD), Oil Conservation Division (OCD), except as noted below.

Upon request by this reviewer, detailed engineering calculations were provided by PSC as a supplemental Attachment M: Engineering Design Calculations for the landfill component of the C.K. Disposal E & P Landfill and Processing Facility. The engineering calculations were well-organized and written in a logical and concise format that made the review of the engineering content and subsequent calculations straightforward. The procedures and methodologies used by PSC for specific calculations and analyzes are well-established for landfill design and accepted within the engineering community. Use of various engineering formulae and assumed engineering parameters or coefficients was referenced within respective calculations. The magnitude of each engineering parameter or coefficient used was deemed reasonable and in-line with generally accepted values. This review focused on the overall design for the landfill component and associated engineering calculations. Additional aspects of the permit application were reviewed with respect to the liquid processing and stabilization and solidification unit processes.

<u>Permit Plans</u>:

Attachments A and B: General Facility Maps and Site Drawings and Attachment and Engineered Design Plan, respectively, were reviewed. The elements of design presented were quite detailed, specifically with respect to landfill component. No design

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Applicant's Exhibit P
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issues were noted as per the site layout and existing conditions, base grade and final grading plans, cell cross-sections, liner and final cover details, leachate management and leak detection details, stormwater management elements, as well as in the specific details related to the processing area layout, tank receiving area liner system, evaporation pond layout, evaporation pond liner and leak detection system, and stabilization and solidification liner and leak detection system.

Two specifications were noted on drawing C-501 for the reinforced GCL used on the sideslope *versus* that used on the floor of the landfill as per specifications Section 02240 (not included). Section 1.10 NMAC 19.15.36.14C: Liner Design Specifications does not indicate the use of two different reinforced GCL for liner construction. Attachment C: Liner Construction Quality Assurance Plan, Section 2: Geosynthetic Clay Liner did not address this dual specification. Attachment F: Geosynthetic and Pipe Document provides product specifications for a GSE Bentoliner® EC GCL.

Attachment B: Engineered Design Plan, Drawing C-505 indicates a 6 in gravel overlay on the 60 mil HDPE liner for the receiving tank liner containment. A geotextile cushion should be considered to provide puncture resistance protection for the geomembrane should the receiving tank area be a high traffic area with dynamic loading.

Based on a review of the plans and specifications provided, it is my professional opinion that the design represents a state-of-the-art consensus practice for landfill engineering.

Volumetrics:

The capacity analysis and materials balance for the landfill cells were provided based on a cut and fill analysis. The evaluation appears reasonable based on the stated fill area; excavation of future cells; waste acceptance rate; daily cover requirement; depth of protective, intermediate, and final cover; and perimeter berm requirements. For soil daily cover, an assumption of 20 % reduction in airspace is typical for this size of landfill based on depth of daily cover and configuration of the daily cell. The material balance calculations indicate a net excess of soil remaining (27 %) after anticipated construction requirements. Based on these volumetric estimates and a range of waste receipts, adequate site life capacity has been incorporated into the facility (39 to 115 yrs).

Settlement:

The analysis examined foundation soil settlement via elastic settlement and waste settlement through primary and long-term settlement, as well as final cover settlement. Elastic settlement was included for foundation settlement based on the presence of silty sand (SM) type soils taken from on-site samples. Borehole data for BH-1 and BH-2 was included in Attachment G: Hydrogeology Report. These data were reviewed. Geologic cross-sections C-C' and D-D' were included in the attachment showing BH-1, BH-3, and BH-5 and BH- 2, BH-3, and BH-4, respectively, with respect to the landfill base grade. Data for BH-3, BH4, and BH-5 were not included in the attachment.

The overall settlement and subsequent angular distortion between various points within two cross-sections (A-A', and B-B' as shown on Attachment B, Sheet C-105) were determined based on an overburden loading using a conservative approach for selection of key parameters and coefficients. The resultant maximum change in design slope was calculated for the liner, leachate collection pipe, and final cover and contrasted against performance standards for each respective design element. These calculations were reviewed.

The calculated angular distortions are negligible throughout the landfill base; therefore, foundation settlement is not a design issue. The minimum design slope on the landfill floor perpendicular to the leachate collection pipe is 2.0 %. The minimum design slope along the leachate pipe is 2.0 %. Note that the angular distortion calculations provided list the design slope as 2.5 %. Attachment B, Sheet C-105 shows these as 2.0 %.

Primary and secondary settlement of the waste was based on a single waste layer of maximum thickness at point locations within the above two cross-sections. Compression indices used for settlement estimates reflected a rather incompressible waste matrix. Documentation of the composition of the landfill waste stream was requested to confirm this assumption. Information was provided by PSC. The primary compression index was based on a waste matrix similar to a SM type soil at 80 % relative density with a secondary compression index taken as one-third the primary compression index. This effectively makes the waste matrix incompressible. Given the types of accepted wastes (contaminated soil and drilling muds) and secondary generated bottom sediments processed through stabilization and solidification, the degree of incompressibility seems justified.

Total waste settlement over 30 yrs was estimated to be 1.2 ft, which would have a nominal impact on surface drainage and integrity of final cover. Final closure cap settlement and angular distortion will typically be negligible for the thicknesses of earthern materials used in final cover. The calculations presented confirm this rule-of-thumb presumption.

It is my professional opinion that these calculations accurately reflect maximum settlement conditions that will be experienced within the landfill infrastructure based on the assumptions used and that settlement should not adversely affect the performance of the landfill as per effective leachate collection and surface stormwater control.

Slope Stability Analysis:

Simulations were evaluated for critical slopes (east and west) within the east-west cross-section under static and seismic loading. The modeling software Slide® was used. This reviewer has this software and is familiar with its use to evaluate slope stability. Both Bishop and Janbu Simplified stability methods were employed using a circular failure analysis. Program print-outs were provided in Attachment M. These results were reviewed. The assumptions used for all materials and layers within the cross-sections (strength parameters, unit weight, cohesion, friction angle, etc.) were considered reasonable and in-line this type of stability analysis.

The peak ground acceleration (PGA) for the site was 0.116 g (Attachment M, Appendix C). The horizontal seismic coefficient was conservatively set at 0.8 PGA; the vertical seismic coefficient was set at 0.5 PGA. Typically a pseudo-static analysis only uses a horizontal seismic coefficient to mimic seismicity loading. Static FOSs for both east and west slopes of the east-west cross-section were approximately 2.5; whereas seismic FOSs were approximately 1.9. This is above the typically accepted FOS of 1.25 for outside slope stability.

It is my professional opinion that adequate stability analysis has been performed by PSC and that the respective cross-sections would be stable under the stated conditions.

Materials of Construction Compatibility:

No comment is needed as the geocomposite, HDPE geomembrane, geotextile, geosynthetic clay liner, and HDPE collection pipe specified are industry standard materials of construction for landfills. Attachment F: Geosynthetic and Pipe Document provides compatibility information.

Pipe Loading:

This section examined ring deflection and wall buckling for a 6 in Schedule 80 PVC and ring deflection, wall buckling, and wall crushing for a 6 in SDR 11.0 HDPE leachate pipe. Two loading scenarios were indicated: 1.) live load using landfill construction equipment, and 2.) dead load using a maximum static lift for the completed cell. Note that the dead load is generally the controlling design over equipment loading as subsequent calculations demonstrated.

The methods used for evaluating pipe performance followed standard practice. A modified Iowa formula was used for ring deflection with a design vertical static load. The resultant ring deflection is acceptable for the stated loading condition with a FOS of 3.7 and 1.14 for the PVC and HDPE pipe, respectively. Note that a hole perforation diameter of 0.5 in was used *versus* 0.375 in as specified in 1.15 NMAC 19.15.36.14.C(5): Leachate Collection and Removal System and 0.5 in diameter as in Attachment B, Sheet C-502, Detail A-4. The FOS for wall buckling was 13.6 for the PVC pipe. FOSs for the two remaining aspects of pipe loading (wall buckling FOS 1.88) and (wall crushing FOS 1.64) for SDR 11.0 HDPE were also acceptable.

It is my professional opinion that PVC and HDPE pipe of stated specification will meet the overall performance standards for pipe loading under the dead loads and live loads anticipated at the C.K. Disposal E & P Landfill and Processing Facility.

Rainfall and Wind Soil Erosion Loss:

The Revised Universal Soil Loss Equation (RUSLE) and the Wind Loss Equation (WEQ) were used respectively to estimate the soil erosion from rainfall and wind for the closure veneer. The reviewer is familiar with both of these procedures used by PSC.

A review of the erosion loss procedure and calculations for the WEQ equation did not indicate any unusual specification of input parameters for I, K, C, or V based on the stated conditions of the site and a loamy soil texture. Wind rose information was taken from the Hobbs Lea County Airport indicating south wind dominance. This was used to estimate the longest wind fetch across the site (L = 2,300 ft from southwest to northeast) for input into the WEQ. The wind erosion loss is estimated at 1.2 tons/ac/yr acre based on the longest unsheltered wind fetch for a C = 150, I = 134, and K = 1.0 (no wind break). Values for C and I were taken from the National Agronomy Manual for New Mexico and a SM type soil, respectively. An equivalent vegetative cover (V) was based on a native and drought resistant seed mix and mix rate yielding an estimated 1500 lbs per acre vegetative cover. This wind erosion rate is below the target soil loss of 2.5 tons/ac/yr.

Rainfall soil erosion was based on an assumption of a silty sand soil and a 50 % vegetative cover. A cover management factor of 0.06 was estimated for rangeland using the method of Haan, *et al.* (1994). This reviewer has used the same procedure to estimate this factor. The soil loss for the stated slope lengths (1266 ft top slope and 400 ft sideslope), rainfall erosivity (45), and soil erodibility (0.15) is 0.19 and 4.32 tons/ac/yr, respectively, for the 4% top slope and 4H:1V side slope. Rainfall erosivity was taken from the NRCS Agricultural Handbook #703 for the site area. Soil erodibility was based on the on-site soil texture. The estimated soil loss was verified using the reviewer's in-house RUSLE calculator. This rainfall erosion rate is below the target soil loss of 5.0 tons/ac/yr.

Note that with 50 % cover and 50 % plant residue in contact with the soil surface for an established grass, a C factor 0.06 may be reasonable to assume based on guidelines from the NRCS NEH Chapter 3. This is contingent upon establishing a stable vegetation cover over the sideslopes especially, which depends upon good germination and adequate moisture.

Attachment D: Final Cover Quality Control Plan discusses the soil erosion layer and establishment of vegetation. Table D.4 lists the seed mix and rate. The statement, "*Structural Best Management Practices (BMP) and an effective vegetation plan will aid in erosion protection*" is provided in the narrative. However, a formal erosion control plan should be included in the permit application Attachment L: Closure and Post-Closure Plan for review to consider adequacy of proposed BMP methods to remedy this issue should vegetation not be established in a timely and sustainable manner, especially with the site-specific soil on the 4:1 H:V sideslope final grade. Specifically, the plan should address with sufficient detail erosion control methods that will be employed and demonstrate how the applicant will inhibit erosion. Attachment L, Section 1.2 Post-closure Plan indicates, "*Activities may include regrading, placement of additional soil, seeding, and repair of erosion control features. (70 % of vegetative natural cover must be achieved)*". Attachment B, Sheet G-005 has several informational notes relating to BMP; however, these do not address soil erosion. Sheet G-005 does contain a drawing of a fabric silt fence. Landfill cover drainage plans (Sheet C-103) contained in Attachment B and in Attachment J: Drainage Study, Figure J.7 do not show any structural BMPs related to soil erosion control along the 4H:1V sideslope where erosion would be more pronounced.

It is my professional opinion that the soil erosion estimates provided accurately reflect potential soil loss at the site based on the assumption of established vegetative surface coverage.

Tensile Stress Analysis:

This section examined tensile stress in the geosynthetics during initial placement of protective soil and waste lifts via a resolution of shear forces within the layered system; tensile stress in the geosynthetics during placement with equipment loading; anchor trench pullout of the geosynthetics under tension applied by the waste fill; and geosynthetics slippage and subsequent tension via a method of active and passive wedges at fill depth. The analysis and procedures used are standard engineering analysis for landfill application. Strength parameters assumed for each material of construction and the respective interface were reasonable and documented by literature citation. Each FOS was checked based on the design configuration specified and engineering parameters used.

The free body diagram for calculating the shear forces upon filling assumed a 10 ft lift and 2 ft PSL. The resolution shows that the 200 mil geocomposite is in tension. Based on a correlation between CBR puncture strength and wide-width tensile strength for the 8 ox/yd^2 geotextile fabric sandwich over the geonet core and geocomposite thickness, the FOS is 1.87. Wide-width tensile strength values are typically not specified in the manufacturer's specifications, only grab strength. This estimation method by Koerner (2012) is standard practice. The remaining layers below in sequence are not in tension.

Under equipment loading by a D6N bulldozer during placement of the protective soil layer upslope (4H:1V) for a maximum unsupported length of 70 ft and soil toe buttress, the generated tensile forces were less than the resisting forces (negative tensile stress in geocomposite). The analysis shows that equipment loading does not exceed the resisting forces; therefore, the liner system is not in tension under equipment loading.

The anchorage capacity of the L-shaped anchor trench was based on the interface friction between geocomposite and backfill soil and GCL and undrained subgrade soil. The anchorage provided is above the ultimate geomembrane tensile strength based on allowable stress and geomembrane thickness and, therefore, would represent a rupture mode should the stress be mobilized for a single geomembrane liner. Given the interface friction angles provided in the calculation, the mobilized interface would be along the geocomposite/textured primary HDPE liner (minimum friction angle) with the resultant stress realized in the geocomposite, not in the primary HDPE liner. Rupture failure of the geomembrane should not compromise the integrity of the primary HDPE liner.

A waste fill cross-section for a translational failure analysis considering active and passive waste wedges was provided with the requested calculations. The estimated passive wedge weight for the configuration exceeds the active wedge weight. Additionally, the interface friction angle for the floor (passive wedge) is higher that the sideslope (active wedge). With the stated conditions, the calculated FOS of 2.75 was determined.

The associated tensile stresses and FOSs were verified based on the given assumptions. It is my professional opinion that the geosynthetics specified for the liner design will meet or exceed regulatory performance standards for tensile strength.

<u>Minimum Liner Thickness:</u>

A minimum liner thickness was determined based on design overburden and a worst-case scenario of subgrade subsidence of a single geomembrane liner using the method of Korner (2005). Given an allowable liner stress at yield, a FOS of 1.1 was determined for the specified 60 mil HDPE. This analysis does not account for the multi-component tensioning in the sequenced liner system and waste arching that would occur under a catastrophic subgrade failure. Thus, the analysis represents a conservative approach. It is my professional opinion that a 60 mil primary HDPE liner is adequate thickness.

<u>Geonet Compression:</u>

The thickness of the geonet was estimated based on design overburden and a reference compressed thickness of 0.1 in at a loading of 20,000 lb_f/ft^2. The compressed thickness after design loading was determined to be 0.138 in. A commonly accepted

FOS of 1.5 was applied for geotextile intrusion, creep deformation, and chemical and biological fouling. The manufacturer's transmissivity, corrected for the FOS, yielded a saturated hydraulic conductivity (K_{sat}) of 10.99 cm/s at compressed thickness. The HELP modeling (discussed later) used a K_{sat} of 10.0 cm/s. It is my professional opinion that the geocomposite under design overburden will provide adequate conveyance of leachate to the leachate collection system.

Geotextile Retention and Clogging:

A commonly applied relationship for apparent size opening (AOS_{95}) for the specified geotextile was evaluated against the d_{85} of the onsite soil. This metric is to evaluate soil fines intrusion into the geotextile that encases the leachate collection aggregate. The AOS_{95} was determined to be acceptable. Typically a minimum geotextile porosity of 30 % is also specified to prevent clogging. The porosity of the geotextile was estimated at 89 % using the design equation of Koerner (2005). It is my professional opinion that the 8 oz/yd^2 geotextile specified for the leachate collection system will provide adequate soil retention and allow for adequate conveyance of leachate into the piping system based on its AOS_{95}, permittivity, and porosity.

Drainage:

Attachment J: Drainage Study, examined stormwater management for the site, specifically existing and proposed hydrologic and hydraulic conditions with respect to runon and runoff.

The software HEC-HMS was used for hydrologic analysis. Peak discharge for drainage areas was evaluated using the NCRS Unit Hydrograph and Curve Number (CN) method; whereas the Rational Method was used for top-of-waste perimeter drains and letdown structures for the landfill. This reviewer is familiar with these standard procedures.

A Type II 25 yr, 24 hr rainfall event was specified. The 25 yr, 24 hr precipitation ($_{25}P_{24}$) depth based on site latitude and longitude coordinates as taken from the NOAA Precipitation Frequency Data Server (PFDS) (http://hdsc.nws.noaa.gov/hdsc/pfds/) is 4.93 in *versus* 4.8 in given in Attachment J, Pg. 1 and 5.

The NRCS method was employed for estimating time of concentration, consisting of sheet flow, shallow concentrated flow, and channel flow components. Culvert and channel hydraulics were computed using Manning's equation.

Existing conditions for the site were evaluated based on the site overlapping two sub-areas (Appendix A, Fig. J-1). Both areas drain off-site to an ephemeral draw. A weighted CN was estimated for each based on soil type and land use. Peak discharge and volume of runoff was computed with HEC-HMS. These calculations (Appendix A) were reviewed. No issues were noted, other than the minor discrepancy in design rainfall depth. The difference would be between 6 to 8 % increase in runoff for the respective CN indicated in Appendix A for the two sub-areas.

For the post-development site hydrology, the facility was divided into 10 drainage sub-areas (Appendix B, Fig. J-4). A weighted CN approach was implemented based on soil type and land soil. Appendix B, Fig. J-5 provides a schematic of the HEC-HMS drainage used to computed peak discharges and runoff volumes at key junctions. Table J-2 provides an overview of peak discharge and runoff volume for each sub-area. A minimum time of concentration of 10 minutes was used for sub-areas having a time of concentration less than 10 minutes. The table identified the sub-areas as being runon or runoff. These calculations were reviewed. No issues were noted; however, the same comment above applies relative to the minor discrepancy in design rainfall depth.

Two detention ponds were incorporated into the stormwater management plan and were identified on the HEC-HMS drainage schematic. Overflow crest elevation for the broad-crested weir design was established using Bentley FlowMaster to contain inflow and allow discharge to downstream drainage thence to the ephemeral draw at rates that do not exceed pre-development rates. This reviewer routinely uses this software for design. Appendix C, Fig. J-8 contains hydraulic details of each detention pond. These calculations were reviewed. No issues were noted.

Appendix C, Fig. J-6 and J-7 provides hydraulic details of developed drainage structures for the site and for the final landfill cover. Perimeter trapezoidal channels were designed using Bentley Flowmaster. A 6 in freeboard was provided. Although no FOSs were calculated for each channel, designing a 6 in freeboard with a 4H:1V sideslope for trapezoidal channels generally provides an adequate FOS at full flow. For completeness, a FOS should be provided based on channel design and peak discharge.

Two reinforced concrete box culverts were designed for upstream peak discharge using Bentley Flowmaster. These convey stormwater from the liquid processing area and stabilization and solidification area into the perimeter trapezoidal channel thence to detention pond #1. A FOS for carrying capacity was not provided. Pg. 7 indicates "*All culverts will be constructed of reinforced concrete pipe, reinforced concrete box, or corrugated metal pipe*". Fig. J-6 specifies a 3 ft x 3 ft concrete box culvert.

Perimeter channels of articulated concrete block mattress are used to intercept sheet flow atop the landfill final cover. These perimeter drains convey the runoff to one of four letdown chutes, also constructed of articulated block mattress (Fig. J-7). The letdown chutes empty into the perimeter channels. Velocity calculations for the 3.6 % top slope and 4H:1V perimeter slope were provided in Appendix C. The velocity was estimated using the Rational Method and Manning's equation. An intensity of 5.9 in/hr was used for a time of concentration of 10 minutes. The intensity for the site from the NOAA Precipitation Frequency Data Server (PFDS) (http://hdsc.nws.noaa.gov/hdsc/pfds/) is 7.46 in/hr for a 10 minutes time of concentration. Thus, the calculated velocities are in error for the stated time of concentration. The flowrate will be 26 % higher; however, the impact is negligible for increased sheet flow velocities across the landfill veneer.

Stormwater management issues related to the have been addressed for the C.K. Disposal E & P Landfill and Processing Facility using standard hydrologic and hydraulic engineering methodologies. It is my professional opinion that the peak flows and runon/runoff volumes so determined are reasonable given the stated assumptions and site conditions. The design of hydraulic structures followed standard engineering practice using commercially available hydrologic and hydraulic software.

<u>HELP Model</u>:

PSC performed four HELP Model simulations: Prescriptive Liner (Appendix B); Alternative Liner (Appendix C); Prescriptive Final Cover (Appendix D); and Alternative Final Cover (Appendix E). The methodology and assumptions used by PSC in each simulation were reasonable as per site specifics, laboratory soils data, and manufacturer's data provided, except as noted. These simulations were reviewed. For the Prescriptive Final Cover, a geocomposite replaced the gravel layer in the HELP simulation. This cover design is used for the top landfill slope. The Alternative Final Cover is an earthern evapotranspiration layer of 48 in of on-site soil with a K_{sat} equal to 5.2×10^{-4} cm/s.

Simulations were performed using a HELP synthetically generated precipitation and solar radiation record based on Roswell, New Mexico coefficients. Evapotranspiration data was obtained Eunice, New Mexico.

Table E.2 lists the layer sequence for the Alternative Liner system as per the plans Attachment B, Sheet C-501. The GCL tabular entry specifies a K_{sat} equal to 1.0×10^{-7} cm/s. Attachment C, Section 2.4, Pg. 7 also lists a material specification for the GCL as a K_{sat} equal to 1.0×10^{-7} cm/s or less. The simulation contained in Appendix C indicates the typical value of 3.0×10^{-9} cm/s used in most HELP simulations for a GCL layer.

Table E.3 summarized the average annual percolation rate through the bottom layer and average annual head on the primary HDPE liner. The analysis shows that the performance of the alternative liner exceeds the performance of the prescriptive liner on both metrics. The specifications for the primary and secondary HDPE liners were more restrictive for the Prescriptive Liner simulation than the Alternative Liner simulation as per pinhole density and geomembrane placement quality, adding a level of conservatism to the analysis. Note also that each simulation used a lateral drainage length for layers 2 and 4 of 1160 ft. The base grading plan shown on Attachment B, Sheet C-101 would indicate a much lower lateral drainage length based on the trough to crest configuration and drawing scale. Since both simulations used the same input, the results and conclusion therein would not change using a lower lateral drainage length.

For both the Prescriptive Final Cover with geocomposite (topslope) and Alternative Final Cover (sdieslope), the evaporative zone depth was set at 18 in with a maximum leaf area index of 1.2. The CN was user input based on a poor stand of grass, average landslope, and a Type II storm. These were 80 and 92, respectively, for the top slope and sideslope cover designs. The HELP simulations of these cover systems indicated a zero percolation through the cover. The combination of high evapotranspiration and runoff effectively negated any vertical migration of moisture below the cover system. Note that the evaporative zone depth used in the simulations is considered conservative given the geographic location of the site in southern New Mexico.

It is my professional opinion that the simulations contained therein have been conducted in accordance with accepted practice and may be used by PSC as supporting documentation to demonstrate equivalent performance for the proposed liner and cover systems to that of the prescriptive requirements.

<u>Other Considerations:</u>

Attachment K: Site Operations Plan provides a narrative description of the water treatment and reuse unit processes for treating a peak flow of 12,000 bbls of water per day. The three-stage treatment system consists of a stripping tower, greensand filters, and a reverse osmosis system. Detailed calculations and design information has not been provided as part of the permit application. As this facility will be phased-in over time, it is imperative that design documentation of all liquid processing unit operations be provided to the NMEMRD OCD for review and approval prior to these systems coming on-line. Emissions from the stripping tower may also require review and approval from the NMED, Air Quality Bureau.

A saltwater disposal well area is shown on the site development plan (Attachment B, Sheet G-004) and is discussed in Attachment K as being brought on line as needed. Implementing this injection well may fall under the Underground Injection Control (UIC) Program of the Safe Drinking Water Act (or other applicable state and federal statutes) for review and approval.

It is noted in the permit application that sediments from liquid processing, other B,S&W waste solids, and drilling muds will be deposited into the stabilization and solidification (S&S) area before ultimately being landfilled upon passing the paint filter test. Attachment K, Section 6, Pg. 13 indicates that dry soil may be used to accelerate the solidification process. Typically the S&S process involves incorporation of a recipe of admixtures with the waste matrix to promote the desire result. Since no recipe is provided, it would appear that the S&S area is simply a dewatering with no actual stabilization or solidification being provided. This should be addressed in the permit application to provide clarification of this aspect of the facility.

Three mechanical evaporators will be provided for each of the 12 evaporation ponds. Attachment K, Appendix D provided evaporation calculations based on Hobbs, New Mexico precipitation data and regional pan evaporation data. A monthly water balance was provided and a net evaporation determined to be 306 bbls/pond/day based on annual removal. These calculations were reviewed. No issues were noted. Additional confirmation of this evaporative potential was gleaned from commercial literature and design specifications for various industrial pond evaporators. Note also that the ponds were sized to maintain a minimum of 3 ft freeboard at all times. NMAC 19.15.36.17.C(4) indicates that *"the proposed mechanical evaporation system is designed to maintain spray-borne suspended and dissolved within the liner boundary of the ponds"*. An estimate of the area of influence of the spray pattern should be provided based on evaporator size and evaporation pond dimensions at freeboard elevation.

Attachment L: Closure Plan and Post-Closure Plan briefly discussed final closure activities for the liquid processing area and landfill disposal area. Final site closure was tied to a fixed site sampling grid to ascertain present of residual contamination relative to BTEX, TPH, and metals and organics as per the Water Quality Control Commission standards. Although brief, the activities delineated within Attachment L appear reasonable for the waste treatment activities and components specified. However, note that special closure activities are mandated for injection wells under the UIC program. Closure of the saltwater disposal well was not addressed in this attachment. Post-closure care maintenance for the 30 yr prescriptive period involved standard activities of site inspections, erosion control, leachate collection system maintenance, vadose monitoring (Attachment H: Vadose Monitoring Plan), surface runon and runoff control, and maintenance of vegetative cover. Groundwater monitoring and landfill gas control requirements were not included under post-closure activities. The applicant requests alternatives to these requirements under NMAC 19.15.36.19.A: Alternatives to Requirements. These exceptions, if granted, would apply to the active, closure, and post-closure periods.

Based on a review of the hydrogeology of the site and groundwater data provided in Attachment G: Hydrogeology, it is my professional opinion that a request for wavier of groundwater monitoring requirements, or limited provisions for monitoring, is justified.

Leachate monitoring is discussed in Attachment K: Site Operations Plan. PSC expects the landfill leachate generation to be low given the evaporation rate for the site and the field capacity of the waste. No value for field capacity was provided; however, based on the HELP simulations vertical migration through the final cover would be negligible. Any amount of field capacity within the waste matrix would attenuate leachate production until the field capacity is exceeded.

Given the largely inorganic characteristics of the waste matrix as stated in the permit application and lack of internal moisture (leachate) available for biological activity, landfill gas production should be negligible. It is my professional opinion that a request for wavier of landfill gas monitoring requirements, or limited provisions for monitoring, is justified. Note that a gas safety management plan is discussed under NMAC 19.15.36.13.O and a landfill gas control system and response plan mandating emergency action is discussed under NMAC 19.15.36.14.G and NMAC 19.15.36.H(1)-(4), respectively; however, the focus is primarily on H_2S.

The permit application indicates that portable and continuous monitoring for methane is mandated within habitable structures on a quarterly basis. Monitors for H_2S will be also placed throughout the site. If concentrations exceed 10 ppm H_2S for incoming waste loads or at the evaporation ponds, $Ca(OCl)_2$ will be applied to reduce the concentrations to below 1 ppm. A 1000 gal onsite stockpile of $Ca(OCl)_2$ solution is specified. Additionally, NaOH is specified in Attachment K: Site Operations Plan as an additive to adjust the evaporation pond pH to control H_2S emissions. No stockpile amount is provided for this chemical. The safety plan should discuss the proper use of these chemicals. Attachment K: Site Operations Plan, Appendices A and B address H_2S Management Plan and Contingency Plan, respectively. These appendices were reviewed. Other than the concern for use of $Ca(OCl)_2$ and NaOH by facility personnel, no issues were noted.

Attachment H: Vadose Zone Monitoring Plan was reviewed along with Attachment I: Sampling and Analysis Plan (SAP). A monitoring network of nine wells along the point of compliance around the site is provided as Attachment H, Fig. H.6. A typical monitoring well is also shown in Fig. H.7. No issues were noted as per the design and construction of the vadose zone monitoring well (Table H.2) or with the sampling and analysis procedures detailed in the SAP.

For fire control during landfilling operations (NMAC 19.15.36.14.A(3)), a stockpile of soil will be provided nearby the working face. Calculations were provided to estimate the stockpile quantity needed to cover the working face with a 6 in layer plus 20 % contingency. No further comment is needed.

The applicant requests an exemption to the migratory bird requirements for netting over the evaporation ponds (NMAC 19.15.36.17.C(3)) under NMAC 19.15.36.19.A: Alternatives to Requirements. As per NMAC 19.15.36.17.C(3) "*The C.K. Facility will inspect the evaporation ponds daily for birds and if a recurring problem, the C.K. Facility with either submit a migratory bird plan or place screening over the ponds*". Granting this exemption might be facilitated by an applicant survey of the region as a migratory habitat and flyway via the Migratory Bird Data Center (https://migbirdapps.fws.gov/). NMAC 19.15.36.13.I Migratory Bird Protection (protection not *projection*), Pg. 18 of the permit application suggests a Migratory Bird Plan exists. The text indicates "*This Plan describes visual inspections and migratory bird retrieval and clean-up procedures should bird(s) require decontamination*". Note also that this section states "*In addition, the Engineering Design provides a process design for produced waters and other liquids that will remove oils present in these materials prior to discharge through the evaporation ponds. Plan can be found in Section NMAC 19.15.36.17, Section 1.3C of this permit application.*" No plan is given in the referenced section, only a request for exemption. Further, the *Engineering Design* for liquid processing has not been fully provided for in Attachment K: Site Operations Plan as indicated above. This aspect was discussed with the engineer of record at PSC. It was the contention of PSC through previous conversation with OCD for similar permit applications that this level of engineering design for liquid processing was not a requirement for the permit application. As previously mentioned design documentation of all liquid processing unit operations should be provided to the NMEMRD OCD, and any applicable or appropriate regulatory agency, for review and approval prior to these systems coming on-line.

If you require additional information or clarification on this review, please contact me directly at 505-835-5467 (w) or 505-838-6227 (c), or email me at h2odoc@nmt.edu.

Sincerely,

Clinton P. Richardson, Ph.D., P.E., BCEE