9.0 PROFESSIONAL ENGINEER CERTIFICATION

The undersigned registered Professional Engineer is familiar with the requirements of the CCR Rule and has visited and examined the Lawrence Energy Center or has supervised examination of the Lawrence Energy Center by appropriately qualified personnel. The undersigned registered Professional Engineer attests that the design and construction for the proposed Cells 4 through 8 bottom liner system and leachate collection system has been prepared in accordance with good engineering practice, the applicable industry standards, meets the requirements of 40 CFR §257.70 and §257.81 and K.A.R. 28-29-104, and that this expansion is adequate for Lawrence Energy Center. This certification was prepared as required by §257.70(c) and (e) and §257.81(c).

Name of Professional Engineer: Richard Southorn

Company: CB&I

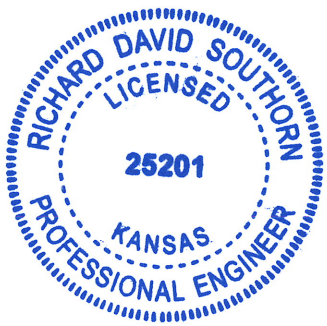
Signature:

Date: 6/16/2017

PE Registration State: Kansas

PE Registration Number: PE25201

Professional Engineer Seal:



Appendix A – Compliance Summary Table

Compliance Summary Table for Industrial Landfill No. 847 Cells 4 - 8 CCR Design Modification Report
Westar Energy, Lawrence Energy Center

Regulation	Compliance Text	Cell 4-8 Design Compliance	Location in Application
Compliance Summary Table			
TITLE 40 CFR SECTION 257			
257.70 - Design Requirements			
257.70(a)	New CCR landfills and any lateral expansion of a CCR landfill must be designed, constructed, operated, and maintained with either a composite liner that meets the requirements of §257.70(b) or an alternative composite liner that meets the requirements in §257.70(c), and a leachate collection and removal system that meets the requirements of §257.70(d). Prior to construction of an overfill the underlying surface impoundment must meet the requirements of §257.102(d).	An alternate composite liner will be installed at LEC Cells 4-8 due to the fact that insufficient volumes of low-permeability clay are available on-site for construction of a traditional compacted clay liner. The alternate composite liner is comprised of a geosynthetic clay liner (GCL) overlain by a 60-mil HDPE textured geomembrane. The leachate collection system includes a double-sided geocomposite layer that drains to leachate collection trenches. The trenches utilize 6-inch perforated HDPE SDR-11 pipe surrounded by a gravel envelope and overlain by a geotextile.	Section 5.0
257.70(b)	A composite liner must consist of two components; the upper component consisting of a minimum a 30-mil geomembrane liner (GM), and the lower component consisting of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1x 10-7 cm/sec. GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. The GM or upper liner component must be installed in direct and uniform contact with the compacted soil or lower liner component. The composite liner must be: (1) Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the CCR or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation; (2) Constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding of the upper component including on slopes; (3) Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift; and (4) Installed to cover all surrounding earth likely to be in contact with the CCR or leachate.	The alternate composite liner is comprised of a geosynthetic clay liner (GCL) overlain by a 60-mil HDPE textured geomembrane. These components have been shown to be chemically compatible with the LEC leachate (see**Appendix D.1**). Due to the fact that the landfill is located above the groundwater table, external pressure gradients are not exerted on the landfill. The leachate system components (geocomposite and pipe network) are able to remain free draining, therefore internal pressure gradients do not present concern for failure. The landfill will be constructed with the same underlying geologic units that have been demonstrated to provide appropriate protection from settlement, compression, or uplift. A generalized differential settlement calculation has been completed for the foundation soils. The alternate composite liner components will be installed in all areas likely to be in contact with the CCR or leachate.	Section 4.0, 5.0, 6.0 Appendix D
257.70(c)	If the owner or operator elects to install an alternative composite liner, all of the following requirements must be met: (1) An alternative composite liner must consist of two components; the upper component consisting of, at a minimum, a 30-mil GM, and a lower component, that is not a geomembrane, with a liquid flow rate no greater than the liquid flow rate of two feet of compacted soil with a hydraulic conductivity of no more than 1 x 10-7 cm/sec. GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. If the lower component of the alternative liner is compacted soil, the GM must be installed in direct and uniform contact with the compacted soil. (2) The owner or operator must obtain certification from a qualified professional engineer that the liquid flow rate through the lower component of the alternative composite liner is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of 1 x 10-7 cm/sec. The hydraulic conductivity for the two feet of compacted soil used in the comparison shall be no greater than 1 x 10-7 cm/sec. The hydraulic conductivity of any alternative to the two feet of compacted soil must be determined using recognized and generally accepted methods. The liquid flow rate comparison must be made using Equation 1 of this section, which is derived from Darcy's Law for gravity flow through porous media. (Eq. 1) $Q/A = q = k((h/t)+1)$ Where, Q = flow rate (cubic cm/sec); A = surface area of the liner (squared cm); q= flow rate per unit area (cubic cm/sec/squared cm); k = hydraulic head above the liner (cm); and t = thickness of the liner (cm). (3) The alternative composite liner must meet the requirements specified in paragraphs §257.70(b)(1) through (4).	The alternate composite liner is comprised of a geosynthetic clay liner (GCL) overlain by a 60-mil HDPE textured geomembrane. The GCL has been show to provide an equal or ower liquid flow rate than a 2-foot compacted clay liner using Darcy's Law assuming the regulatory maximum allowable leachate head (30 cm), maximum leachate head determined through HELP modeling (11.6 inches), and anticipated typical leachate head (6 inches) (see**Appendix D.8**).	Section 5.0, 6.0 Appendix D
257.70(d)	The leachate collection and removal system must be designed, constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post- closure care period. The leachate collection and removal system must be: (1) Designed and operated to maintain less than a 30-centimeter depth of leachate over the composite liner or alternative composite liner; (2) Constructed of materials that are chemically resistant to the CCR and any non-CCR waste managed in the CCR unit and the leachate expected to be generated, and of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying waste, waste cover materials, and equipment used at the CCR unit; and (3) Designed and operated to minimize clogging during the active life and post-closure care period.	A HELP model has been completed to estimate the leachate head that may accumulate on the leachate collection system during active and post-closure conditions. A maximum leachate head of 11.6 inches was found to occur during active conditions (see**Appendix D.5**). The primary leachate collection system across the landfill floor is comprised of geocomposite. The leachate collection trenches include HDPE pipes enveloped in a granular drainage envelope and overlain with a geotextile. All selected materials are compatible with LEC leachate (see**Appendix D.1**). Evaluations have been completed to demonstrate that the leachate collection pipes will not crush or buckle due to the weight of the overlying landfill or construction equipment loading (see **Appendices D.2** and **D.3**). The pipes have been found provide acceptable factors of safety against these failure modes. The geonet component of the geocomposite has also been evaluated to ensure that it is capable of transmitting the maximum leachate generation rate per unit area that is anticipated to be generated during the design period (see**Appendix D.7**). The evaluation shows that the geonet is able to remain free-flowing, even when compressed due to the weight of the overlying landfill. The leachate pipes have also been shown capable of transmitting the peak anticipated leachate generation rate of the design period (see**Appendix D.6**).	Section 5.0, 6.0 Appendix D
257.70(e)	Prior to construction of the CCR landfill or any lateral expansion of a CCR landfill, the owner or operator must obtain a certification from a qualified professional engineer that the design of the composite liner (or alternative composite liner) and the leachate collection and removal system meets the requirements of this section.	Certification is provided in Section 9.0	Section 9.0
257.70(f)	Upon completion of construction of the CCR landfill or any lateral expansion of a CCR landfill, the owner or operator must obtain a certification from a qualified professional engineer that the composite liner (or alternative composite liner) and the leachate collection and removal system has been constructed in accordance with the requirements of this section.	Certification is provided in Section 9.0	Section 9.0
257.70(g)	The owner or operator of the CCR unit must comply with the recordkeeping requirements in §257.105(f), the notification requirements in §257.106(f), and the Internet requirements in §257.107(f).	Not applicable for this report.	N/A

Compliane Summary Table for Industrial Landfill No. 847 Cells 4 - 8
CCR Design Modification Report
Westar Energy, Lawrence Energy Center

Regulation	Compliance Text	Cell 4-8 Design Compliance	Location in Application
K.A.R. 28-29-104 DESIGN STANDARDS			
28-29-104(a) General Design Standards			
28-29-104(a)(1)	Existing units. Any portion of a trench or area of an existing unit not filled to its permitted design capacity by October 9, 1996, shall be considered a vertical expansion subject to the standards in K.A.R. 28-29-104(a)(2), or a new unit subject to the standards in K.A.R. 28-29-104(a)(3).	Not applicable for this report.	N/A
28-29-104(a)(2)	Vertical Expansions	Not applicable for this report.	N/A
28-29-104(a)(2)(A)	(A) Any proposed vertical expansion shall be considered a significant modification to the facility and subject to permit modification procedural requirements.	Not applicable for this report.	N/A
28-29-104(a)(2)(B)	Any proposed vertical expansion shall meet the following requirements, in addition to any other applicable MSWLF regulations. (i) A hydrogeologic site assessment shall be conducted in compliance with K.A.R. 28-29-104(b). (ii) A groundwater monitoring well system shall be in place, pursuant to K.A.R. 28-29-111. (iii) The owner or operator shall operate the landfill in a manner that minimizes leachate generation. (iv) If groundwater contamination is detected, the owner or operator of the proposed vertical expansion shall initiate an assessment of corrective measures, pursuant to K.A.R. 28-29-114(a)(1). (v) The final cover design shall meet the requirements of K.A.R. 28-29-121(e)(1). (vi) Local planning and zoning approval shall be obtained from the appropriate jurisdictional body. (vii) The owner or operator shall secure certification from the board of county commissioners that the vertical expansion is in conformance with the official county or regional solid waste management plan.	Although not a vertical expansion, a Phase I and Phase II investigation was completed in 2005. The landfill has an established groundwater monitoring program that is not intended to be modified as part of the CCR design modifications. As part of the groundwater monitoring program, the owner or operator has procedures in place to initiate an assessment of corrective measures in the event that groundwater contamination is detected. Although not a vertical expansion, the final cover design will be modified to incorporate a 40-mil LLDPE geomembrane liner, which will be overlain by a geocomposite and 36-inches of cover soils. The upper 6-inches of these soils will be capable of supporting vegetation. The 36-inches are provided to ensure frost protection of the geocomposite. The final cover design meets K.A.R. 28-29-121(e)(1 requirements.	N/A
28-29-104(a)(2)(C)	A vertical expansion over a closed unit which has received final cover shall be classified as a new unit, and therefore subject to the design standards for new units.	Not applicable for this report.	N/A
28-29-104(a)(2)(D)	In evaluating a proposed vertical expansion, the department shall consider the following factors: (i) The impact of the proposed vertical expansion on human health and the environment rather than other alternatives, including a new unit; (ii) the capacity needs of the community or communities and the region using the landfill; (iii) the proposed operating life of the vertical expansion; and (iv) the inclusion or exclusion of the landfill in a regional solid waste management plan.	These items were considered as part of the 2006 application that has been reviewed and permitted by KDHE-BWM.	N/A
28-29-104(a)(2)(E)	The expiration date for a permit modified to allow for a vertical expansion shall not exceed five years from the date the modified permit is issued. At the end of the initial five year period, and any subsequent five year period, the owner may submit a request for an additional five-year permit. The request shall include an assessment of the environmental impact of the vertical expansion. Based on an evaluation of the environmental impact, the permit shall either be denied, or renewed for a period not to exceed five additional years by the director.	Not applicable for this report.	N/A
28-29-104(a)(3)	New Units		
28-29-104(a)(3)(A)	All new units shall be equipped with a leachate drainage and collection system and liner designed as an integrated system in compliance with the requirements of this section.	The leachate collection system will include a double-sided geocomposite (ex: GSE CoalDrain 300-Mil Geocomposite). In the trench areas, an HDPE leachate collection pipe will be placed within gravel and overlain with a geotextile. The purpose of the top geotextile is to filter CCR material, which is much finer than material that is typically filtered using sand layers. The top geotextile layer of the geocomposite will filter the leachate as it enters the drainage layer. The geotextile has been specifically selected due to its ability to screen particles as small as fly ash (the finest ash material) without clogging (see **Appendix D.4**). This geotextile therefore minimizes the potential for clogging within the drainage layer. The geotextile seams will be overlapped, heat bonded and/or field sewn as required by the CQA Plan to ensure that ash does not migrate into the geonet.	Section 5.0, 6.0 Appendix D, E
28-29-104(a)(3)(B)	The design period for new municipal landfills shall be the estimated operating life plus 30 years of post-closure care.	A HELP model has been completed to estimate the leachate head that may accumulate on the leachate collection system during active/operating conditions (estimated to be 50 years) and post-closure conditions (30 years) (see **Appendix D.5**).	Section 6.0, Appendix D
28-29-104(b) Hydrogeologic Site Investigations		A Phase I and Phase II investigation was completed in 2005. The landfill has an established groundwater monitoring program that is not intended to be modified. The owner or operator has procedures in place to initiate an assessment of corrective measures in the event that groundwater contamination is detected.	N/A
28-29-104(c) Foundation and Mass Stability Analysis			
28-29-104(c)(1)	The material beneath the unit shall have sufficient strength to support the weight of the unit during all phases of construction and operation. The loads and loading rate shall not cause or contribute to the failure of the liner or leachate collection system.	The material below the liner has been previously demonstrated to support the weight of the unit during all phases of construction (see **Appendix D.2**). The proposed design modifications will not increase loading on the material below the liner. Therefore, this condition is met.	Section 6.0, Appendix D
28-29-104(c)(2)	The total settlement or swell of the foundation shall not cause or contribute to the failure of the liner or leachate collection system.	A generalized differential settlement calculation has been completed for the foundation soils. The calculation considers the compression of in-place Kappa Formation silts and gravels due to the overlying landfill. To determine the maximum variation in loading, a waste surface was modeled from 0 to 120-feet thick at a 3.25H:1V slope. Based on this change in loading across the foundation soils, a maximum differential settlement within the foundation soils is anticipated to be approximately 0.2 percent. This calculation will be refined and provided as part of the Comprehensive Design Modification Report after laboratory testing and final grades are completed. However, the current evaluation indicates that the leachate collection pipes (installed at a 0.5 percent grade) will continue to drain even after differential settlement.	Section 6.0
28-29-104(c)(3)	The solid waste disposal unit shall be designed to achieve a safety factor during the design period against bearing capacity failure of at least 2.0 under static conditions and 1.5 under seismic loadings.	The material below the liner has been previously demonstrated to meet bearing capacity requirements specified. The proposed design modifications will not increase loading on the material below the liner. Therefore, this condition is met.	N/A
28-29-104(c)(4)	The waste disposal unit shall be designed to achieve a factor of safety against slope failure during the design period of at least 1.5 for static conditions and 1.3 under seismic conditions.	A generalized slope stability model has been developed to determine minimum acceptable shear strength values for the base liner (See **Appendix D.10**). The model utilizes the Cell 4 base grades and an assumed waste mass that is 120-feet thick, with 3.25H:1V sideslopes, and a 3-foot final cover. The geologic units underlying the landfill were assigned the shear strength values determined in the 2005 hydrogeologic investigation and described in the 2006 permit application. The waste and final cover soils were assigned the unit weights and shear strengths in the 2006 application. The model was iteratively run to determine the minimum interface friction angle required along the base to achieve a safety factor of 1.3 during static and 1.5 during seismic conditions. An interface shear strength value of 19 degrees was identified during this modeling, assuming no cohesion. This value falls below typical published values for these interfaces, indicating that the materials are appropriate for use. Once site-specific interface values are provided by the laboratory, the model will be updated. In the unlikely event that safety factors are not achieved in the updated model, final landform surface will be lowered or otherwise modified to ensure that the landfill achieves acceptable safety factors. This information will be provided in the Comprehensive Design Modification Report.	Section 6.0, Appendix D
28-29-104(c)(5)	The liner and leachate collection system shall be stable during all phases of construction and operation. The side slopes shall achieve a minimum static safety factor of 1.5 and a minimum seismic safety factor of 1.3 at all times.		
28-29-104(c)(6)	In calculating factors of safety, both long term, in tens or hundreds of years, and short term, over the design period of the facility, conditions expected at the facility shall be considered.		
28-29-104(c)(7)	The potential for earthquake or blast-induced liquefaction, and its effect on the stability, and integrity of the unit shall be considered and taken into account in the design. The potential for landslides or earthquake induced liquefaction outside the unit shall be considered if such events could affect the unit.		
28-29-104(d) Foundation Construction			
28-29-104(d)(1)	If the in situ material provides insufficient strength to meet the requirements of subsection (c), then the insufficient material shall be removed and replaced with clean materials sufficient to meet the requirements of subsection (c).	In-situ material has been previously demonstrated to meet requirements. Any structural fill that may be required will be selected and placed following the CQA Plan (see **Appendix E**) to ensure that it meets the requirements of subsection (c).	Section 4.0, Appendix E
28-29-104(d)(2)	All trees, stumps, roots, boulders and debris shall be removed.	The CQA Plan requires that these items will be removed prior to GCL installation (see **Appendix E**).	Appendix E
28-29-104(d)(3)	All material shall be compacted to achieve the strength and density properties necessary to demonstrate compliance with this part.	The CQA Plan provides structural fill strength and density properties to demonstrate compliance (see **Appendix E**). In-situ soils were evaluated and meet this requirement.	Appendix E
28-29-104(d)(4)	Placement of frozen soil or soil onto frozen ground shall be prohibited.	Foundation fill will not be placed in a frozen condition, as described in the CQA Plan (see **Appendix E**). All construction will take place during non-deleterious weather following the procedures specified in the CQA Plan. These methods are based on industry standards, manufacturer recommendations, and best engineering practice.	Appendix E
28-29-104(d)(5)	The foundation shall be constructed and graded to provide a smooth, workable surface on which to construct the liner.	The GCL subgrade will be prepared to be smooth and free of rocks, stones, roots, sharp objects or other undesirable debris.	Section 5.0, Appendix E

Compliane Summary Table for Industrial Landfill No. 847 Cells 4 - 8
CCR Design Modification Report
Westar Energy, Lawrence Energy Center

Regulation	Compliance Text	Cell 4-8 Design Compliance	Location in Application
K.A.R. 28-29-104 DESIGN STANDARDS			
28-29-104(e) Liner Standards			
28-29-104(e)(1)	New MSWLF units shall be constructed:		
28-29-104(e)(1)(A)	with a composite liner and a leachate collection system that is designed and constructed in accordance with subsections (g), (h), and (i). For purposes of this regulation, "composite liner" means a system consisting of two components. The upper component shall consist of a minimum 30-mil geomembrane; the lower component shall consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1 X 10^{-7} cm/sec. Geomembrane components consisting of high density polyethylene (HDPE) shall be at least 60-mil thick. The geomembrane component shall be installed in direct and uniform contact with the compacted soil component in order to minimize the migration of leachate through the geomembrane should a break occur; or	The alternate composite liner is comprised of a geosynthetic clay liner (GCL) overlain by a 60-mil HDPE textured geomembrane. The alternate composite liner components will be installed in all areas likely to be in contact with the CCR or leachate. These components have been shown to be chemically compatible with the LEC leachate (see **Appendix D.1**). The GCL has been show to provide an equal or ower liquid flow rate than a 2-foot compacted clay liner using Darcy's Law assuming the regulatory maximum allowable leachate head (30 cm), maximum leachate head determined through HELP modeling (11.6 inches), and anticipated typical leachate head (6 inches) (see **Appendix D.8**).	Section 5.0, 6.0 Appendix D
28-29-104(e)(1)(B)	in accordance with an alternative design approved by the department. The design shall demonstrate that the concentration values listed in Table 1 (not shown in the Compliance Summary Table) will not be exceeded in the uppermost aquifer at the point of compliance. The point of compliance shall be within 150 meters (492) feet of the edge of the planned unit boundary. In addition, the point of compliance shall be on the owner's or operator's property and shall be at least 15.24 meters (50 feet) from the property boundary.	The proposed design modifications associated with the CCR Rule will reduce the potential for leachate leakage through the liner. Therefore, the previously completed and approved evaluations regarding 28-29-104(e)(1)(B) do not need to be revisited.	N/A
28-29-104(e)(2)	When approving a design that complies with paragraph (1)(B), the department shall consider at least the following factors:		
28-29-104(e)(2)(A)	the hydrogeologic characteristics of the facility and surrounding land;	Hydrogeologic factors have been considered. The proposed design revisions have maintained the invert landfill elevation and have maintained separation from the uppermost aquifer.	Section 4.0
28-29-104(e)(2)(B)	the climatic factors of the area; and	The HELP model has used climatic factors from Lawrence (see **Appendix D.5**). The protective layer to be placed over the geosynthetics on the bottom liner and the protective soils for the final cover will be required to be a minimum of 3-feet thickness, in order to provide frost protection anticipated for the Lawrence area.	Section 5.0, 6.0 Appendix D
28-29-104(e)(2)(C)	the volume and physical and chemical characteristics of the leachate. The design's performance shall be evaluated at maximum annual leachate flow conditions.	The leachate has been evaluated for chemical constituents to ensure that the liner and leachate collection layers are appropriately selected. Chemical compatibility information is provided in **Appendix D.1**. The maximum leachate flow rates were calculated in the HELP model. The geonet and pipe components of the leachate collection system were analyzed and found to be free flowing during peak leachate flow rates.	Section 6.0, Appendix D
28-29-104(e)(3)	Approval of alternate designs shall be considered by the department only when:		
28-29-104(e)(3)(A)	the technology or material has been successfully utilized in at least one application similar to the proposed application; and	All alternate design components have been used at numerous facilities across the United States with demonstrated performance (see **Appendix D.1**).	Section 6.0, Appendix D
28-29-104(e)(3)(B)	methods for ensuring quality control during the manufacture and construction of the liner can be implemented.	Quality control requirements are specified in the CQA Plan (see **Appendix E**). These methods are based on industry standards, manufacturer recommendations, and best engineering practice.	Appendix E
28-29-104(e)(4)	The owner or operator shall document in the operating record that the liner meets the liner standards in K.A.R. 28-29-104(e)(1)(A) or (B).	These installation methods will be followed to ensure that the materials are not damaged during installation. The liner construction will be documented to ensure that liner standards are achieved. These methods are based on industry standards, manufacturer recommendations, and best engineering practice.	Section 5.0, Appendix E
28-29-104(f) Liner Construction			
28-29-104(f)(1)	The construction and compaction of the liner shall be carried out in accordance with the approved design to reduce void spaces and allow the liner to support the loadings imposed by the waste disposal operation without settling that causes, or contributes to the failure of the leachate collection system.	Not applicable, as a CCL is not intended to be installed.	N/A
28-29-104(f)(2)	The liner shall be constructed from materials whose properties are not affected by contact with the constituents expected to be in leachate generated by the landfill.	These components have been shown to be chemically compatible with the LEC leachate (see **Appendix D.1**).	Section 6.0, Appendix D
28-29-104(f)(3)	Geomembrane liners shall be constructed in compliance with the following requirements.		
28-29-104(f)(3)(A)	The geomembrane shall be supported by a compacted base free from sharp objects. The geomembrane shall be chemically compatible with the supporting soil materials.	The geomembrane will be installed on top of the GCL. The CQA Plan provides requirements to ensure that the GCL subgrade will be prepared to be smooth and free of rocks, stones, roots, sharp objects or other undesirable debris (see **Appendix E**).	Section 5.0, Appendix E
28-29-104(f)(3)(B)	The geomembrane shall have sufficient strength and durability to function at the site for the design period under the maximum expected loadings imposed by the waste and equipment and stresses imposed by settlement, temperature, construction and operation.	The geomembrane will be meet these requirements, as documented by testing required in the CQA Plan (see **Appendix E**). Once geosynthetics are installed, they will be covered with a minimum of 12-inches of ash or other appropriate material. Prior to winter, a minimum of 3-feet of ash will be installed to prevent the potential for frost damage.	Section 5.0, Appendix E
28-29-104(f)(3)(C)	Seams shall be made in the field according to the manufacturer's specifications. All sections shall be arranged so that the use of field seams is minimized and seams are oriented in the direction subject to the least amount of stress where practical.	This requirement is addressed in the CQA Plan (see **Appendix E**).	Appendix E
28-29-104(f)(3)(D)	The leachate collection system shall be designed to avoid loss of leachate through openings through the geomembrane.	Proper installation methods will be followed to ensure that the materials are not damaged during installation. The CQA Plan has requirements for the inspection of the installed geomembrane to identify defects in the liner and repair procedures and evaluations to ensure that the liner functions as intended (see **Appendix E**). Any penetrations will requie boots that are designed to minimize the potential for leachate migration.	Appendix E
28-29-104(g) Leachate Drainage System			
28-29-104(g)(1)	A groundwater monitoring network shall be designed, constructed and operated to detect all potential discharges to groundwater. The monitoring wells shall be constructed and cased to prevent direct contamination and clogging of the screen.	The currently permitted monitoring system is not intended to be modified based on the CCR design revisions.	N/A
28-29-104(g)(2)	The system shall be designed in conjunction with the leachate collection system required by subsection (h):	The HELP model has been used to demonstrate that the maximum anticipated leachate head is 11.6-inches, which occurs during the active operating period. However, flux calculations used to evaluate the GCL equivalency to a CCL have conservatively assumed a maxium 30 cm (approximately 12-inch) leachate head (see **Appendix D.8**).	Section 6.0, Appendix D
28-29-104(g)(2)(A)	to maintain a maximum head of leachate 0.30 meter (one foot) above the liner; and		
28-29-104(g)(2)(B)	to operate during the month when the highest average monthly precipitation occurs, and if the liner bottom is located within the saturated zone, under the condition that the groundwater table is at its seasonal high level.	The HELP model has been developed to incorporate this requirement (see **Appendix D.5**).	Section 6.0, Appendix D
28-29-104(g)(3)	A drainage layer shall overlay the entire liner system. This drainage layer shall be no less than 0.30 meter (one foot) thick.	The alternate composite liner components will be installed in all areas likely to be in contact with the CCR or leachate. It is noted that the geocomposite system is less than 1-foot thick, but provides superior drainage (see **Appendix D.8**). 1-foot of protective ash will be placed over the geocomposite.	Section 6.0, Appendix D
28-29-104(g)(4)	The drainage layer shall be designed to maintain flow throughout the drainage layer under the conditions described in paragraph (g)(2) above.	The geonet component of the geocomposite has also been evaluated to ensure that it is capable of transmitting the maximum leachate generation rate per unit area that is anticipated to be generated during the design period (see **Appendix D.7**). The evaluation shows that the geonet is able to remain free-flowing, even when compressed due to the weight of the overlying landfill.	Section 5.0, 6.0 Appendix D
28-29-104(g)(5)	Materials used in the leachate drainage system shall be chemically resistant to the wastes and the leachate expected to be produced.	Demonstration of chemical compatibility is provided in **Appendix D.1**.	Section 6.0, Appendix D

Compliane Summary Table for Industrial Landfill No. 847 Cells 4 - 8
CCR Design Modification Report
Westar Energy, Lawrence Energy Center

Regulation	Compliance Text	Cell 4-8 Design Compliance	Location in Application
K.A.R. 28-29-104 DESIGN STANDARDS			
28-29-104(h) Leachate Collection System			
28-29-104(h)(1)	The leachate collection system shall be designed and constructed to function for the entire design period. The leachate collection system shall consist of conduits including pipes, trenches, or a combination of pipes and trenches.	The system will function for the entire design period (during operations and post-closure) (see **Appendix D.5**). The leachate collection system uses pipes enveloped in a gravel envelope and overlain by a geotextile.	Section 5.0, 6.0 Appendix D
28-29-104(h)(2)	Materials used in the leachate collection system shall be chemically resistant to the leachate expected to be produced.	Demonstration of chemical compatibility is provided in **Appendix D.1**.	Section 6.0, Appendix D
28-29-104(h)(3)	The leachate collection system shall be designed so that leachate drains freely from the collection conduits. If sumps are used, leachate shall be removed via gravity flow, whenever possible, before the level of leachate in the sumps rises above the invert of the collection conduits under the conditions established in paragraph (g)(2) above. If gravity flow is not possible, pumping may be utilized to remove leachate, but the use of pumps shall be minimized.	Leachate collection trenches (pipes within a gravel envelope) will be installed within each cell and drain by gravity to the leachate collection pond.	Section 5.0
28-29-104(h)(4)	Collection conduits shall be designed to capture leachate for open channel flow to convey leachate under the conditions established in paragraph (g)(2) above.	The leachate pipes have also been shown capable of transmitting the peak anticipated leachate generation rate of the design period (see **Appendix D.6**).	Section 6.0, Appendix D
28-29-104(h)(5)	Collection pipe conduits.	The pipes are a minimum 6-inches in diameter (see **Appendix D.3**).	Section 6.0, Appendix D
28-29-104(h)(5)(A)	Collection pipe shall be of a cross-sectional area that allows cleaning and at least 0.10 meter (four inches) nominal inside diameter.		
28-29-104(h)(5)(B)	The collection pipe material and bedding materials as placed shall possess structural strength to support the maximum loads imposed by the overlaying materials and equipment used at the facility, as well as the effects of differential settling.	The pipes have been evaluated for buckling and ring deflection and have been found to have the structural strength to support the maximum loads imposted by the overlaying materials and equipment used at the facility (see **Appendices D.2**, **D.3** and **D.4**). A generalized differential settlement calculation has been completed for the foundation soils. The calculation considers the compression of in-place Kappa Formation silts and gravels due to the overlying landfill. To determine the maximum variation in loading, a waste surface was modeled from 0 to 120-feet in thickness at a 3.25H:1V slope. Based on this change in loading across the foundation soils, a maximum differential settlement within the foundation soils is anticipated to be approximately 0.2 percent. This calculation will be refined and provided as part of the Comprehensive Design Modification Report after laboratory testing is completed and the final grades are completed. However, the current evaluation indicates that the leachate collection pipes (installed at a 0.5 percent grade) will continue to drain even after differential settlement is considered.	Section 6.0, Appendix D
28-29-104(h)(5)©	Collection pipes shall be constructed within a coarse gravel envelope using a graded filter or geotextile as necessary to minimize clogging.	The leachate collection system uses pipes enveloped in a gravel envelope and overlain by a geotextile.	Section 5.0
28-29-104(h)(5)(D)	The collection pipe system shall be equipped with a sufficient number of manholes and cleanout risers to allow cleaning and maintenance of all pipes throughout the design period.	All leachate pipes will be designed to support periodic cleaning and maintenance (see **Appendix D.4**).	Section 6.0, Appendix D
28-29-104(h)(6)	Trench conduits.	The trenches will be covered with a geotextile to minimize clogging (see **Appendix D.4**). The placement of material within a V-notch trench will minimize the potential for movement.	Section 6.0, Appendix D
28-29-104(h)(6)(A)	Trench conduits shall be designed to minimize particulate and biological clogging.		
28-29-104(h)(6)(B)	Trench conduits shall be constructed to minimize movement of drainage media when a load is placed on the media.		
28-29-104(i) Leachate Treatment and Disposal System			
28-29-104(i)(1)	The owner or operator shall be responsible for the operation of a leachate management system designed to handle all leachate as it is removed from the collection system. The leachate management system shall consist of any combination of storage, treatment, pretreatment, and disposal options.	The permitted leachate treatment and disposal system is not intended to be modified as part of the CCR design revisions.	N/A