SECTION 3

DESIGN REPORT

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3 DESIGN REPORT

Overview of Design

Clinton Landfill, Inc. (CLI) requests approval to modify the design of the permitted Clinton Landfill No. 3 to include a Chemical Waste Unit. The proposed Chemical Waste Unit would occupy approximately 22.50 acres of the permitted waste boundary.

Chemical Waste Unit Cell Design

In conjunction with a suitable site location and favorable geologic and hydrogeologic conditions, the engineered design features proposed for the Clinton Landfill No. 3 Chemical Waste Unit act together to safely contain the waste which is placed in the proposed cells. These design features have been shown to protect the public health, safety, and welfare, include the following:

1. *Multiple Layer-Composite Liner System.* The Clinton Landfill No. 3 Chemical Waste Unit has been designed with a multiple layer-composite liner system consisting of a minimum 3-foot thick compacted cohesive soil liner with a maximum permeability 1×10^{-7} cm/sec, a 60-mil high density polyethylene (HDPE) geomembrane, a geocomposite drainage layer, and a second 60-mil HDPE geomembrane throughout the unit. In addition, CLI has included a geosynthetic clay liner (GCL), and a third 60-mil HDPE geomembrane above the floor and lower portions of the sidewall. The multiple layer-composite liner system will effectively prevent the release of potential hazards from the Chemical Waste Unit.

2. *Geotechnical Analysis.* The proposed Chemical Waste Unit has been designed to provide sufficient factors of safety during static (F.S. $\geq$ 1.5) and seismic (F.S. $\geq$ 1.3) conditions for short and long term conditions for global mass stability. The geotechnical analyses demonstrate that landfill slopes will not fail and that liner and final cover integrity will be maintained over the life of the landfill and beyond.

3. *Leachate Drainage/Collection System.* Liquids that come in contact with waste are known as leachate. These liquids will be collected and managed so as not to impact the environment. The proposed Chemical Waste Unit has been designed with an extensive multiple layer leachate drainage/collection system to quickly remove leachate from the landfill for proper disposal.

4. *Construction Phasing.* The Clinton Landfill No. 3 Chemical Waste Unit consists of approximately 22.5 acres located within the existing permitted 157.45 acre waste footprint. The proposed Chemical Waste Unit cells will be constructed and filled in phases. The remainder of the landfill (the Municpal Solid Waste Unit) will be accepting waste simultaneously and will also be constructed in phases. Landfill operations in both units will be conducted so as to protect newly constructed liner and to minimize the active areas of the landfill.

5. *Final Cover System.* The final cover system that will cap the landfill consists of a low-permeability layer to prevent precipitation from entering the landfill,

and a protective soil layer to prevent erosion and maintain the long-term integrity of the cap. The low-permeability layer will include a double-sided, textured 40-mil HDPE geomembrane and a one-foot thick compacted cohesive soil layer with a maximum permeability of 1 x 10^{-7} cm/sec. A combination of a geonet and a geotextile will overlay the geomembrane to drain infiltrated water away from the low-permeability layer. The geotextile will serve to prevent clogging of the geonet from the overlying protective soils. The protective soil layer will be placed over the geotextile and will include a minimum of three (3) feet of protective soil, with the upper six (6) inches being a vegetative layer. To facilitate drainage and minimize erosion, the overall slope of the final cover will be a maximum of 4H:1V and a minimum of 5 percent. The final slopes of the landfill will be vegetated.

Design Capacity

The Chemical Waste Unit has a design capacity of 2.55 million cubic yards of airspace, inclusive of daily and intermediate cover. CLI estimates an airspace utilization of 1 ton of waste per cubic yard of airspace. Waste receipts are expected to average about 75,000 tons per year. At this rate, CLI expects to operate the Chemical Waste Unit for approximately 34 years. Volume calculations are provided in Appendix L.

Multiple Layer-Composite Liner System

An engineered multiple layer-composite liner system will be constructed across the base and sideslopes of the proposed Chemical Waste Unit in order to contain the waste materials and prevent contaminants from leaving the landfill and impacting groundwater.

Across the entire Chemical Waste Unit, the multiple layer-composite liner will include a primary composite liner consisting of a compacted cohesive earth liner overlain by a geomembrane, a geocomposite drainage layer, and a second geomembrane. At the base of the Chemical Waste Unit an additional GCL, and a third geomembrane will be installed above the primary composite liner system. The compacted cohesive earth liner will consist of a minimum 3-foot thick layer of compacted cohesive soil with a maximum permeability of 1 x 10^{-7} cm/sec. The geomembranes will consist of a double-sided textured 60-mil HDPE.

Hydrogeology Considerations

A succession of low-permeability cohesive soil units (Tiskilwa Formation, Roxana/Robein Silt, Berry Clay, Radnor Till, Vandalia Till, Smithboro Till, Yarmouth Soil, Tilton Till, and Hillary Till) are present beneath the site which will separate the footprint of the proposed Chemical Waste Unit from the regional aquifer. These low permeability cohesive soil units have an average thickness of approximately 200 feet at the site (approximately 170 feet of which will remain between the bottom of the proposed liner invert and the regional Mahomet Sand Aquifer). Field and laboratory test results and field observations indicate that these materials will effectively restrict vertical and horizontal movement of groundwater and will serve as an additional environmental safeguard beneath the proposed Chemical Waste Unit.

The natural clay that is present beneath the site will act as a tertiary, natural barrier to water infiltration at the proposed Chemical Waste Unit in addition to the proposed engineered liner system.

The hydrogeologic conditions at the site and the landfill design allow a comprehensive groundwater monitoring system to be implemented which will be able to adequately verify if groundwater resources are being threatened by the landfill.

The Clinton Landfill No. 3 Chemical Waste Unit floor will be excavated to an approximate elevation ranging from 660 feet to 670 feet above MSL, thereby removing the native Tiskilwa Formation and Roxana/Robein Silt soils. The landfill floor will be founded on very dense unweathered glacial till of the Berry Clay and/or Randor Till units. To provide a foundation for the liner, low permeability soil will be compacted above the bottom of mass excavation, as required, to the bottom of the low permeability earth liner in accordance with the construction quality assurance (CQA) Program. The Proposed Mass Excavation Grades are shown in Drawing No. D4, and the Proposed Leachate Collection Layer (bottom of waste) are shown on Drawing No. D6.

Compacted Cohesive Earth Liner

The compacted cohesive earth liner for the proposed Clinton Landfill No. 3 Chemical Waste Unit will meet all regulatory requirements by providing a minimum 3-foot layer of compacted cohesive soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec. Based on its physical properties, low hydraulic conductivity and current landfill construction practices various on-site soils are proposed to be used for construction of the bottom liner (and interim and final covers) at the site. To assure that the soil liner meets design specifications, the Construction Quality Assurance Program outlined in Section 5 of this application will be implemented.

Geomembrane

The geomembrane liners will be installed by personnel experienced in liner installation. The geomembrane liners will consist of panels of 60-mil HDPE which will be field welded and tested as outlined in the Construction Quality Assurance Program located in Section 5 of this application.

The lowermost geomembrane liner subgrade (compacted earth liner) will be prepared to be smooth and free of rocks, stones, roots, sharp objects or other undesirable debris. In order to maintain stable side slopes, the geomembrane liners will be anchored beyond the limits of the waste into the anchor trenches as shown on Drawing No. D7 (or will be properly welded in the case of the geomembrane which will terminate near the base of the sideslope).

The geomembrane liner will also be protected from sharp items in the waste by the granular drainage blanket which will serve as part of the leachate collection system on the landfill floor. An 18-inch thick layer of clean earth fill or select waste will protect the geomembrane along the landfill sidewalls.

Geosynthetic Clay Liner (GCL)

A GCL will be placed between the two uppermost geomembranes throughout the landfill floor. GCLs are factory manufactured hydraulic barriers typically consisting of bentonite clay minerals supported by geotextiles and/or geomembranes, which are held together by needling, stitching, or chemical adhesives. Sodium bentonite, the clay used in the GCL, exhibits a high swelling property when hydrated. This swelling property provides the ability to seal around penetrations, giving the GCL self-healing characteristics. The GCL bentonite has a hydraulic conductivity no greater than 5.0×10^{-9} cm/sec.

CQA Documentation

Liner construction, documentation, and certification will be performed in accordance with the Construction Quality Assurance Program contained in Section 5 of this application. A construction quality assurance (CQA) officer will supervise and be responsible for all inspections and testing. The CQA Officer will be an independent licensed Professional Engineer. If materials used to construct the liner change significantly (unlikely to occur due to the uniformity of the site geologic conditions as confirmed by the extensive hydrogeologic investigation performed at the facility), an additional test liner will be constructed and tested to verify that an alternate material is suitable for full scale liner construction. Additionally, a construction acceptance report will be prepared under the direct supervision of the CQA Officer and submitted to the appropriate State or Federal Agency after completion of each major phase of construction. All construction documents and as-built drawings will be kept on file at the site and will be available for inspection.

Geotechnical Analyses for the Chemical Waste Unit

The following section describes the geotechnical analyses conducted on the proposed design in order to verify that the liner and final cover will be stable during construction and operation of the landfill and after closure of the facility. The analyses demonstrate that landfill slopes will not fail and that the structural integrity of the bottom liner and final cover will be maintained over the life of the landfill and beyond. Specifically, this section addresses:

1. *Slope Stability*. This subsection analyzes the slopes of the active face of the waste and the interim and final land forms in order to demonstrate that the necessary safety factors are achieved. In addition, stability of the bottom and sideslope liner, leachate collection system, final cover and terrace berms are analyzed to determine factors of safety against failure.

2. *Foundation and Mass Stability*. This subsection examines the foundation materials below the landfill, ensuring that the foundation will not be compromised by bearing capacity failure.

3. *Landfill Settlement*. This subsection details the anticipated settlement of the foundation and waste within the landfill, and estimates the potential differential settlement at the landfill. The landfill has been designed to withstand this settlement without any decrease in the performance of the engineered systems.

4. *Anchor Trench/Runout Design*. This subsection estimates the length of geomembrane liner runout required beyond the top of the side slope in order to maintain a stable side slope.

5. *Liquefaction.* This subsection outlines the types of materials prone to liquefaction, and demonstrates that such materials are not located within the site.

6. *Geosynthetic Protection.* This subsection examines whether the proposed geosynthetics to be utilized in the various landfill systems will function as required over the life of the landfill.

All supporting documentation and calculations are provided in Appendix H. All foundation and mass stability analyses have been performed under the direct supervision of a licensed professional engineer experienced in geotechnical engineering.

Slope Stability

The Clinton Landfill No. 3 Chemical Waste Unit is designed with typical final slopes of 4 Horizontal to 1 Vertical (4H:1V), and a peak height of approximately 110 feet above the surrounding natural grade. As indicated on the Design Drawings, once the Chemical Waste Unit is filled to final grade, the "wedge" between the Municipal Solid Waste Unit and the Chemical Waste Unit will be filled with Municipal Solid Waste. The temporary interior slopes of the Chemical Waste Unit will be at a grade of no steeper than 3 horizontal to 1 vertical (3H:1V). The outer slopes will be 4 horizontal to 1 vertical and will ultimately be covered to form part of the final landform.

Seismic Analysis

A seismic analysis was performed based on a horizontal acceleration of 0.0981g to demonstrate that the slopes will be stable during seismic events. The design horizontal acceleration corresponds to an earthquake event that has a 10% probability of occurring every 250 years.

Failure Scenarios

The following slopes and potential failure scenarios were modeled for both the Clinton Landfill No. 3 (including the proposed Chemical Waste Unit) and for the proposed Clinton Landfill No. 3 Chemical Waste Unit, itself:

1. Waste active face with circular failure (short term static and seismic conditions).

2. Excavation face with circular failure (long and short term static and seismic conditions).

3. Foundation circular failure (long and short term static and seismic conditions)

4. Final landform conditions with circular failure through the foundation soil (long and short term static and seismic conditions).

5. Final landform conditions with circular failure through the waste (long and short term static and seismic conditions).

6. Final landform conditions with a block failure through the liner system (long and short term static and seismic conditions).

The landfill geometry was studied to determine the critical stability scenarios. These sections are illustrated as Cross Section A-A' (critical section used to evaluate the Clinton Landfill No. 3 (including the Chemical Waste Unit)) and Cross Section B-B' (critical section used to evaluate the proposed Chemical Waste Unit (refer to Appendix H)).

Table 2.3-1 demonstrates that the Clinton Landfill No. 3 Chemical Waste Unit will achieve a static slope safety factor greater than 1.7 and a seismic safety factor greater than 1.3.

TABLE 3-1 FACTORS OF SAFETY				
Scenario	Short Term Conditions		Long Term Conditions	
	Static	Seismic	Static	Seismic
Section A-A'				
Liner Block Failure	1.77	1.32	2.45	1.77
Waste Circular Failure	1.76	1.31	3.41	2.56
Foundation Circular Failure	1.93	1.43	2.72	1.98
Active Face Circular Failure	2.00	1.47	-	-
Section B-B'				
Liner Block Failure	2.07	1.41	3.06	2.05
Waste Circular Failure	2.13	1.49	4.64	3.25
Foundation Circular Failure	2.28	1.57	3.66	2.49

A stability analysis of the leachate collection system for the Clinton Landfill No. 3 Chemical Waste Unit was also performed. The factor of safety against slope failure of the leachate collection system was determined assuming buttressing effects at the bottom of the sideslope. Assuming a 18-inch select fill material, a geocomposite and 3 horizontal to 1 vertical (3H:1V) sideslopes, the factors of safety were calculated to be greater than 1.7 for static conditions and greater than 1.3 for seismic conditions. Placement of the sideslope protective layer may also be performed in increments to further enhance stability.

Foundation Construction

The foundation materials below the landfill consist of competent bedrock, ancient topsoils (palosols), overconsolidated glacial tills and associated outwash layers. These materials have sufficient strength to support the weight of the proposed Chemical Waste Landfill during all phases of construction and operation.

A detailed description of the properties of the in-situ materials around and beneath the facility is provided in Section 2 of this application. These soils are capable of safely supporting the loads induced by the landfill. All fill materials used for foundations shall be compacted to achieve the necessary strength and density properties in accordance with the Construction Quality Assurance Program procedures identified in Section 5 of this application. The foundation shall be constructed and graded to provide a workable surface on which to construct the liner.

Bearing Capacity Analysis

A bearing capacity analysis was performed to demonstrate that the earthen materials beneath the landfill exhibit sufficient strength to support anticipated loads. Since the existing landfill is keyed into the Berry Clay and Radnor Till, a bearing capacity analysis was performed for these soils. Terzaghi's bearing capacity equation was used to calculate the ultimate bearing capacity using engineering properties of these materials. The factor of safety is the ratio of the ultimate bearing capacity to the overburden pressures expected to act on the foundation. Using conservative assumptions, factors of safety greater than 2.0 under static conditions and 1.5 under seismic conditions were achieved for the proposed Clinton Landfill No. 3 Chemical Waste Unit. The supporting calculations are provided in Appendix H. The calculations contained in Appendix H also demonstrate that the bedding materials of the leachate collection system possess the structural strength to support the maximum loads imposed by the overlying materials and landfill equipment.

Landfill Settlement

Settlement at a landfill is generally caused by the weight of the landfill compressing the foundation soils and by decomposition of the waste. Settlement analyses were conducted for the landfill foundation of the proposed Clinton Landfill No. 3 Chemical Waste Unit based on the proposed design and using conservative assumptions. The maximum differential settlement of the foundation soils was calculated between the locations of maximum and minimum load on the base of landfill over the shortest distance. The maximum waste settlement was estimated between the point of maximum waste height and the edge of the landfill, over the shortest distance.

Foundation Settlement. As the landfill is constructed, the weight of the landfill will cause the geological units and low permeability soil liner to consolidate slightly. Consolidation is the settlement due to the reduction of void space. The reduction in void space will have the additional benefit of reducing the hydraulic conductivity of both the liner and underlying soils.

Differential settlement calculations were performed to verify that the leachate collection system will still drain adequately even after the landfill foundation settles (refer to Appendix H). Although the slope of the proposed leachate collection system may change over time due to settlement, it will not affect the performance and efficiency of the system.

The site hydrogeologic conditions and history were also reviewed relative to the potential for sinkholes or subsidence to occur in the landfill foundation. Based on this review, there is no potential for sinkhole formation or subsidence at the site.

Waste Settlement. For the Proposed Clinton Landfill No. 3 Chemical Waste Unit, the maximum differential settlement was calculated to be 4.17% (refer to Appendix H). The final cover system is designed to accommodate the remaining settlement after cover materials are constructed. As a result, differential settlement will have little effect on the stability of the final cover system as demonstrated in calculations provided in Appendix H.

Leachate Management for the Chemical Waste Unit

Any liquid that comes in contact with waste is known as leachate and will be removed from the Chemical Waste Unit and properly managed. The design and plan of operations for the Clinton Landfill No. 3 Chemical Waste Unit are intended to minimize leachate production throughout the operating life of the landfill and the post-closure care period.

The Clinton Landfill No. 3 Chemical Waste Unit is designed with a comprehensive leachate collection system to collect and remove leachate. Because of the low solubility of PCB's, leachate is expected to exhibit significantly less than 50 ppm PCB's. Based on this, CLI anticipates hauling the extracted leachate to a commercial or publicly owned wastewater treatment facility for treatment and discharge under proper permits. Alternatively, CLI may solidify the leachate and dispose of the solidified waste in the Chemical Waste Unit as described in the facility's Operating Plan (section 6 of this application).

The leachate drainage/collection system will safely convey the maximum estimated leachate flow volumes expected for the landfill. The proposed design exceeds the state and federal performance requirements by maintaining less than the maximum allowable one foot of leachate head.

Leachate Drainage/Collection System

The leachate drainage/collection system is designed to efficiently drain and collect leachate throughout the operating life and post-closure care period and beyond for the proposed Clinton Landfill No. 3 Chemical Waste Landfill. Design calculations, with supporting assumptions and information, are provided in Appendix I.

The leachate drainage/collection system includes a highly permeable leachate drainage layers overlaying the entire base of the landfill. These layers drain to leachate collection sumps from which the leachate will be extracted. The location and details of the components of the leachate collection system are shown on Drawing Nos. D6 through D10. Calculations demonstrating that the leachate drainage/collection system will perform in accordance with the applicable regulations are contained in Appendix I. The calculations were performed using conservative assumptions, resulting in a system that is more than capable of handling projected leachate quantities. All material and construction specifications for the components of the leachate management system are provided in the CQA Program in Section 5 of this application.

The upper portion of the leachate drainage system above the Chemical Waste Unit floor will consist of a minimum one-foot thick layer of rounded to sub-rounded sand. This drainage material will have a minimum hydraulic conductivity of 3.0×10^{-2} cm/sec to facilitate the flow of leachate across the base of the landfill and into gravel filled trenches containing perforated collection pipes. Along the 3H:1V sideslopes a high flow capacity geocomposite will be used in place of the 1 foot granular drainage layer. A minimum nonwoven 6 oz/yd^2 geotextile will be placed above the entire drainage layer to minimize clogging. The geotextile seams shall be overlapped and field sewn or thermally bonded as required. The drainage material will also act as protection for the geomembrane against sharp objects which may be contained within the waste material.

In addition to the leachate drainage system described above, a redundant leachate drainage layer will be installed directly above the bottom geomembrane. This layer will be comprised a geocomposite drainage layer. The primary leachate collection system will include perforated HDPE pipe situated within a gravel envelope and surrounded by washed gravel. Mulitple layers of geonet will be placed as part of the redundant collection system. Details of the leachate collection system are shown on Drawing Nos. D7 through D10.

The Clinton Landfill No. 3 Chemical Waste Unit leachate drainage system is designed to slope at a minimum of 2.66 percent toward the leachate collection trenches. The maximum horizontal spacing between leachate collection pipes is 340 feet, resulting in a maximum horizontal distance from the leachate divide to the collection point of 170 feet. The leachate collection pipes will be sloped at a minimum of 0.6 percent to promote drainage within the pipes to the leachate header pipes and leachate collection sumps.

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The leachate collection piping within the trenches of the Chemical Waste Unit is proposed to be a 6-inch diameter SDR 11 HDPE pipe. The trenches will be filled with processed gravel to promote the gravity flow of leachate into the pipe.

The HDPE collection pipe has the necessary flexibility to conform to localized variations in the bottom slope. The pipe also has the necessary strength to withstand the weight of the overlaying waste, operating equipment, and daily and final soil covers. Calculations demonstrating the structural capacity of the perforated pipe are presented in Appendix I.

The primary and redundant collection systems drain toward leachate collection sumps as shown on Drawing No. D6. Leachate will be extracted from the landfill using riser pipes. The riser pipes will extend from the collection sumps to the edge of the waste footprint, where the point of extraction is easily accessible. Pumps will be placed within the risers to safely remove leachate from the landfill, and will be equipped with a leachate level detection system for monitoring leachate levels.

Leachate Collection System Efficiency (Ability to Remove Leachate from the Landfill)

The leachate collection system was determined to be highly efficient even under conservative assumptions that overestimate the amount of leachate likely to be generated. The maximum leachate head on the liner system was calculated based on the estimated leachate generation rates, the hydraulic conductivity of the drainage layer and the leachate collection system design. The analysis is based on the worst case scenario during the life of the Chemical Waste Unit (operations), a minimum hydraulic conductivity of 3.0×10^{-2} cm/sec for the drainage layer, and average cell width of approximately 340 feet. Given these parameters, the analysis indicates that the maximum leachate head on the upper liner will not exceed 12 inches at any time. The head on the bottom geomembrane will be significantly less than 12 inches.

The efficiency of the leachate collection pipes to collect and transport the maximum estimated leachate volume was assessed using Manning's equation for open channel flow. The analysis indicates that the proposed 6-inch diameter pipes are more than capable of collecting and transporting the peak percolation rate calculated by the HELP model (provides more than 10 times the capacity than required volume). The pipes will not restrict leachate flow from the sand drainage layer, and have more than enough capacity to collect and transport the predicted leachate volume. The 6-inch diameter pipe size will also accommodate conventional sewer cleaning equipment for pipe cleaning and inspection purposes. Calculations which demonstrate the capacity of the leachate collection system are contained in Appendix I.

Leachate Collection

All leachate will be pumped from the landfill to an underground storage tank. The underground storage tank and underground leachate piping will be double walled and incorporate a leak detection system. The type of pump used will depend on the actual quantity and quality of leachate generated for each cell and is anticipated to vary over the life of the landfill. Typical pumps are described in Appendix I may be used. The actual type and size of the pump will be selected to maintain no more than one-foot of leachate head above the liner system. All pumps will be installed with an automated leachate-level activated switch to ensure that no more than 12 inches of leachate head builds up within the collection systems.

Leachate Treatment and Discharge

Leachate will be loaded in appropriately licensed tanker trucks at the concrete-lined leachate load-out facility shown on Drawing D10. The concrete-lined leachate load-out facility provides sufficient containment to prevent leachate from being released in the event overfilling, piping system leaks, etc. occur during the transfer process.

Since PCB's exhibit very low solubility in water, leachate is expected to contain significantly less than 50 ppm. As a result, leachate will be transported to a commercial or publicly-owned wastewater treatment plant for treatment prior to discharge. Proper permitting procedures, such as analyzing the physicochemical characteristics of the leachate, will be followed to ensure that the leachate is treated and discharged in accordance with state and federal regulations. Alternatively, leachate with less than 500 ppm PCB's may be solidified as described in the facility's Chemical Waste Unit Operating Plan (Section 6 of this application), and disposed in the Chemical Waste Unit.

Construction Phasing for the Chemical Waste Unit

The Clinton Landfill No. 3 Chemical Waste Unit consists of two cells, CWU1 (10.83 acres) and CWU2 (11.67 acres), which will be constructed in approximately three phases each. Depending on the volume of incoming waste, larger or smaller sections of a cell may be developed as needed.

Typically, only one active disposal area will be open at a given time. Landfill development is phased such that as one area is filled, a new lined area is being constructed. Occasionally, more than one active area may be open for a brief period of time. Such cases may occur during the final topping off of an area. The active face will be covered at the end of each day and intermediate cover will be applied to any areas not active for 60 or more days as described in the facility's Chemical Waste Unit Operating Plan (Section 6 of this applciation). Closure of each cell will be accomplished as soon as practical.

It is anticipated that the first phase of cell development will consist of the western 500 feet (+/-) of the Chemical Waste Unit Cell CWU1. CLI anticipates that the eastern portion of Cell CWU1 will be completed in two additional phases prior to developing Chemical Waste Unit Cell CWU2. Cell CWU2 development is expected to progress in a method similar to CWU1. Considering all of the various influences on construction schedules, including weather and fill volumes, the estimated development progression represents the phasing envisioned at the time of design. Adjustments and modifications are anticipated considering the size, complexity and life of this project, and the design of the Clinton Landfill No. 3 Chemical Waste Unit provides the flexibility to make adjustments as necessary.

The north and east toes of the Chemical Waste Unit will terminate at an approximately 20-foot high berm that will initially separate the Chemical Waste Unit from the Municipal Solid Waste Unit as shown on Design Drawing No. D9. Waste placed into the Chemical Waste Unit will be placed at an intermediate slope of 3H to 1V. Once the Chemical Waste Units are filled to capacity an earthen separation layer will be placed above the Chemical Waste Unit crown and its northern and eastern slopes. The separation layer will separate waste placed in the Chemical Waste Unit from Municipal Solid Waste which will be placed on top of the Chemical Waste Unit crown and northern and eastern sideslopes. Separation layer details and cross sections illustrating the landfill geometry are provided on Drawings Nos. D14, D19 and D20, respectively.

The following is a summary of the main points regarding the sequence of construction and filling for the Clinton Landfill No. 3 Chemical Waste Unit.

1. A separation berm will be constructed to confine the northern and eastern perimeter of the Chemical Waste Unit.

2. A drainage ditch will be constructed on top of the separation berm. The drainage ditch will collect stormwater runoff from the intermediate grades which will be conveyed to collection sumps beyond the of the Chemical Waste Unit perimeter. At that point, the collected stormwater will be pumped to the perimeter ditch and then be conveyed to Sediment Basin B.

3. Landfill construction will be scheduled to the greatest extent possible so that the initial filling of each area will occur prior to winter.

4. Only one active face will be utilized during operation unless conditions arise that require more than one active face to be operated at a time. An example of such a condition is when a cell is "topped out" to reach its final permitted grades.

5. Cell development will generally proceed from west to east in each of the Chemical Waste Unit cells, beginning with the southernmost cell.

6. Stormwater management controls and monitoring systems for groundwater that are required for each area will be developed in advance of waste filling.

7. After the Chemical Waste Unit is filled to capacity, the wedge between the Chemical Waste Unit and the Municipal Solid Waste Unit will be filled with Municipal Solid Waste. An earthen separation layer at least 12 inches thick will physically separate the municipal solid waste from the wastes placed in the underlying Chemical Waste Unit.

Final Cover System

The Clinton Landfill No. 3 Chemical Waste Unit will be covered with an engineered final cover system which will meet or exceed all federal, state, and local requirements. The final cover will be used to: 1) minimize the infiltration of precipitation, 2) support vegetation, and, 3) prevent future harm or animal exposure to the waste. The proposed final cover system is a multi-layer system consisting of:

1. A 12-inch thick low permeability final cover barrier soil (maximum hydraulic conductivity of 1×10^{-7} cm/sec).

2. A 40-mil HDPE (double-sided textured on slopes steeper than 5H:1V).

3. A geocomposite drainage net with filter geotextile.

4. A minimum three-foot thick protective soil layer overlaying the low permeability layer, with the uppermost six inches consisting of soil suitable for vegetation.

5. A vegetation layer.

The final cover system will cover the entire landfill unit and connect with the bottom liner system. A typical cross section of the proposed final cover is shown in Drawing No. D14, and the contours of the final landform are shown on Drawing No. D13. As shown on Drawing No. D7, the low permeability layer of the final cover will connect with the bottom liner system. The slope of the final cover will be a minimum of 5 percent, with typical sideslopes of 4H:1V. The following text provides a more detailed description of each layer within the final cover system.

Final Cover Barrier Soil

The final cover barrier soil layer will have a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. The barrier soil will be placed in lifts and then compacted with a sheepsfoot roller. Each soil layer will be uniformly placed with all roots, cobbles, debris, organic, and other deleterious material removed prior to compaction. Additionally, the final surface will be inspected prior to geomembrane installation to ensure that no rocks, roots, or other objectionable items are exposed on the cover surface. The final cover barrier will be compacted to at least 95 percent Standard Proctor density (ASTM D 698). All construction will be conducted and documented in accordance with the procedures outlined in the Construction Quality Assurance Program located in Section 5 of this application.

Geomembrane Layer

A 40-mil high density polyethylene (HDPE) geomembrane material or equivalent will be included in the composite final cover system for the facility. The material specifications for the 40-mil geomembrane liner material are included in Section 5 of this application. The geomembrane layer will serve as an impermeable barrier against infiltration of moisture through the final cover into the landfill as well as a barrier to prevent future human or animal exposure to landfill wastes. Double-sided textured HDPE will be used on all slopes 5H:1V or steeper.

Drainage Layer

A drainage layer will overlay the geomembrane layer. The drainage layer will consist of a geonet (drainage net) overlain by a non-woven needle-punched geotextile. The material specifications for the drainage layer materials are included in Section 5 of this application. The drainage layer will serve two purposes. The first is to lower the hydraulic head acting on the final cover and therefore enhance the slope stability of the final cover and minimize the ability of water to seep through the 40-mil HDPE geomembrane. The second purpose is to provide a cushion layer between the 40-mil HDPE geomembrane and the protective layer. The drainage layer will be installed and tested in accordance with the requirements of the Construction Quality Assurance Program detailed in Section 5 of this application.

Vegetative Layer

A vegetative layer consisting of a minimum of 36 inches will be placed over the drainage layer to protect the underlying layers of soil from frost, desiccation, erosion, and penetration by roots or vectors. On-site material will be supplied for use in constructing the protective layer. The uppermost six inches of the vegetative layer will consist of soil capable of supporting vegetation. The vegetative layer will be tested and placed in accordance with the requirements detailed in the Construction Quality Assurance Program, Section 5 of this application.

Vegetative Cover

The vegetative cover planned for the Clinton Landfill No. 3 Chemical Waste Unit is intended to protect the final cover from wind and water erosion, as well as to minimize run-off and maximize evapotranspiration. The vegetative cover will be placed after completion of the vegetative layer at the appropriate time for successful germination and growth.

The vegetative cover will consist of a wide variety of grasses that will: 1) protect the soil surface against erosion; 2) not interfere with the integrity of the drainage layer, geomembrane, and final cover barrier soil low permeable layer; 3) increase evapotranspiration thereby minimizing infiltration into the landfill; 4) provide for sufficient stormwater management and flood control; 5) establish a diverse grassland habitat; and 6) improve the appearance of the final land surface.

Time of planting is a critical factor in successful establishment of plants from seeds. Seed will be planted at the appropriate time for successful germination and growth based on soil temperature and precipitation, to be determined each year at the time of planting. Generally, seed will be planted before June 10 or after September 1. Mulch and/or erosion control blankets will be applied as needed to control erosion and enhance vegetation establishment.

Final Cover Construction and Maintenance

The final cover will be constructed in accordance with the construction quality control guidelines outlined in the comprehensive Construction Quality Assurance Program (Section 5 of this application). The final cover barrier soil and geomembrane will be constructed no later than 60 days after placement of the final lift of solid waste. The vegetative layer will be placed as soon as possible after placement of the geomembrane to prevent desiccation, cracking, freezing or other damage to the geomembrane. The vegetative layer will be 36-inches thick. The maximum depth of frost penetration at the site is approximately 32 inches[1]. However, experience with liner and cap construction in Illinois indicates the frost depth is substantially less. The vegetative layer is therefore sufficiently thick to prevent frost penetration into the underlying layers. Cover maintenance will be performed as necessary to maintain the final cover to meet the design objectives. Any areas identified by the operator or by inspections as particularly susceptible to erosion will be re-contoured. The post-closure Care Plan contained in Section 8 of this application provides additional details regarding final cover maintenance activities.

Cover Percolation

After placement of final cover, virtually all of the precipitation which falls on the landfill will be diverted into the stormwater management system. Controlled runoff, evaporation, evapotranspiration, subsurface drainage through the drainage layer, and barrier layers will minimize percolation through the final cover system.

Final Landform

The proposed landscaping at the Clinton Landfill No. 3 Chemical Waste Unit will include the extension of berms and planting of grasses. Suitable grasses will be used for the vegetative

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1 See, for instance, the maximum frost penetration map compiled from U.S. Department of Commerce Weather Bureau data and contained in Koerner, R.M. and Daniel, D.E., Final Covers For Solid Waste Landfills and Abandoned Dumps, ASCE Press, 1997, p. 56.

cover, which will provide erosion protection. The grass seed mixture that is selected will be amenable to the soil quality/thickness, slopes and moisture/climatological conditions that exist and will not require significant maintenance. The seed mixture will be selected to protect the low permeability liner system from root penetration. Generally a vegetative layer that is 450 mm (17.7 in.) to 600 mm (23.6 in.) is adequate[2]. Since the vegetative layer will be 36-inches thick and the grass seed mixture will be carefully selected, the vegetative layer thickness is deemed more than adequate to prevent root penetration from occurring in the underlying layers.

Terrace ditches and riprap-lined terrace downslope ditches and/or letdown culverts will be incorporated into the final slopes to further minimize erosion, as described in the Stormwater Management Plan in Section 4 of this application.

Landfill Gas Management

Based on the waste streams anticipated of to be deposited at the Chemical Waste Unit, it is not anticipated that landfill gas will be generated. However, the permitted Clinton Landfill No. 3 MSW Unit has been designed with a permitted landfill gas management system. The system includes perimeter gas probes around the Chemical Waste Unit to monitor for the presence subsurface landfill gas. Additionally, ambient air monitoring will be performed at the Chemical Waste Unit as discussed in Section 7.

Groundwater Impact Assessment

The purpose of this section is to summarize the Groundwater Impact Assessment (GIA) which was approved by the IEPA for the permitted Clinton Landfill No. 3 municipal solid waste landfill. The GIA included extensive fate and transport modeling to assess whether the landfill would have any impact on groundwater quality. Conservative one- and two-dimensional commercially available and IEPA approved models were used. The results of the GIA indicate that the permitted design for the Clinton Landfill No. 3, in conjunction with the hydrogeologic setting (refer to Section 2), is protective of the public health, safety, and welfare. A copy of the GIA report from the permitted Clinton Landfill No. 3, along with supporting information, is provided in Appendix N. The following sections summarize the model input parameters and key findings of the GIA investigation:

Groundwater Impact Assessment Model Input

- ❑ The permitted municipal solid waste landfill incorporates numerous environmental safeguards, including a composite liner system consisting of a 3 foot-thick compacted soil liner (1 x 10^{-7} cm/sec), a 60-mil High Density Polyethylene (HDPE) geomembrane, a leachate collection and removal system, and a composite final cover over the entire landfill. The liner and final cover geomembranes were conservatively assumed to be flawed and exhibit holes.

- ❑ Hydrogeologic model input parameters collected during a site-specific hydrogeologic investigation were used where possible. Conservative published data was used where site-specific data was not available. In addition, extensive sensitivity testing was conducted to evaluate the effects of varying key input data.

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2 Koerner, R.M., and D.E. Daniel. Final Covers For Solid Waste Landfills and Abandoned Dumps. ASCE Press, 1997.

- For modeling purposes, the concentration of each constituent in leachate can be assumed to exhibit a specific mass. However, this assumption would result in a decreasing source concentration over time and would not be conservative (although would most accurately represent expected conditions). As such, a constant concentration was conservatively assumed throughout a 145 year modeling period.

- The model conservatively assumed no contaminant biodegradation decay, sorption, or other decay processes of any of the leachate constituents.

- Leachate impingement through the liner system was based upon a hydraulic head of 10.7 feet acting on the liner system throughout the 145 year modeling period. The landfill was modeled assuming all leachate would be recirculated back in to the municipal solid waste. Although HELP modeling demonstrated less than 12 inches of leachate head would exist through the end of the 30-year RCRA post closure care period, the modeling predicted that the leachate head would eventually build to and stabilize at 10.7 feet once recirculation ceased following the end of the 30-year RCRA post-closure care period.

- Applicable Groundwater Quality Standards were used to compare and evaluate the model predicted groundwater concentrations within the Upper Radnor Till Sand, Lower Radnor Till Sand, and Organic Soil. Illinois Class I Potable Resource Groundwater Quality Standards were used to evaluate the model predicted groundwater concentrations within the Mahomet Sand.

- The Upper Radnor Till Sand, Lower Radnor Till Sand, Organic Soil, and the Mahomet Sand were modeled separately. Modeling the four geologic layers separately (creating four separate conceptual models) is a conservative approach.

Groundwater Impact Assessment Findings

- The GIA models were constructed using conservative assumptions.

- The baseline models for each of the four geologic layers predict that the concentration of all leachate constituents in the Upper Radnor Till Sand, Lower Radnor Till Sand, and the Organic Soil will be less than their respective AGQS values or Illinois Class I Potable Resource Groundwater Quality Standards.

- The proposed design for the Chemical Waste Unit includes a double composite liner system along the sidewalls and a quadruple composite liner system along the floor and the lower portions of the sidewalls. This liner system greatly exceeds the requirements of the USEPA and has been accepted by the IEPA and other experts in the landfill field as providing a high level of environmental safety. The native clays that are present below the liner system serve as an effective barrier to liquid migration.

- Leachate will not be recirculated into the Chemical Waste Unit, and will be removed in perpetuity. Therefore, no more than 12 inches of leachate head will ever build up on the primary liner system. This will reduce the impingement through the primary liner system to levels significantly less than that which was assumed in the GIA model.

- The very low impingement through the primary liner system, coupled with the highly efficient redundant leachate collection system, will essentially prevent any leachate head from acting on the bottom liner. Therefore, there will be virtually zero impingement through the liner system.

- The results of the permitted GIA and the design of the proposed Chemical Waste Unit demonstrate that the site is favorable for development of the proposed Chemical Waste Unit and that the proposed design will be effective in protecting groundwater quality beneath the site.

- It should be noted that a GIA is not required by the USEPA, and that this GIA was developed assuming the strict requirements set by the IEPA which far exceeds the federal requirements.

- The results of the computer models demonstrate that development of the Clinton Landfill No. 3 landfill is protective of the public health, safety, and welfare.