Clean Harbors Environmental Services, LLC
Lone Mountain Facility
Waynoka, Oklahoma

RCRA/HSWA Permit Renewal Application

Volume 10

October 1, 2020

Lone Mountain RCRA Permit Renewal

Volume 10

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6.1

Landfill Operation Procedures

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1.0 Waste Disposal

Currently, Cell 15 Subcells 9 through 13 are the only active Landfill Cells operating on site. Cell 15 Subcells 1 through 8 are closed, Subcell 14 is built, and Subcells 15 through 22 are proposed. The Drum Cell and Landfill Cells 1 through 8 were closed in prior to 1990. Landfill Cells 10 through 13 were constructed or closed prior to July 29, 1992.

Waste destined for landfill disposal at the Lone Mountain Facility must meet the requirements noted in the applicable sections of the Waste Analysis Plan. In addition to the Waste Analysis Plan requirements, wastes which are ignitable, reactive and/or incompatible with other wastes will be managed according to the section for Ignitable, Reactive, and Incompatible Wastes Procedures. Containers disposed in the landfill must either be at least 90% full or crushed, shredded, or similarly reduced in volume to the maximum practical extent when placed in the landfill.

1.1 Cell 15 Access

Access to Landfill Cell 15 will be via a haul road or haul roads, constructed for that purpose in accordance with the current approved design specifications for Cell 15. As filling of Landfill Cell 15 progresses, access ramps constructed of waste or soils will be built to allow access into and across the cell. These ramp(s) will be moved, or additional ramps installed as the filling of Cell 15 progresses. All access points into the cell will consist of constructing a roadway between the top of the embankment and the top of the waste material in the cell.

1.2 Cell 15 Progress

Although Cell 15 can be filled in a manner similar to that used in previous cells at the Lone Mountain Facility, a "moving cell" technique is planned. Using the moving cell procedures, filling will proceed from the south end of the cell (Phase I) towards the north into Phase II, and then in the west leg of the cell (Phase III). The areas within the temporary berms(s) in which wastes are placed will be considered the active portions(s) of the cell. Under normal operating conditions, waste will be placed in the active portion behind the temporary area berm, brought to final grade, and covered with a closure cap. However, the facility may begin filling subsequent Subcells before completing waste placement in the previous Subcell. At any given time, there may be Subcells under construction, active Subcells receiving waste, and inactive Subcells with or without a closure cap.

For any given Subcell or phase, the closure cap may be constructed immediately or may be delayed to occur simultaneous to cap construction for other Subcells or phases. Final closure shall be certified following completion of the cap and closure for the final Subcell.

2.0 Inspections

Landfill inspections will be conducted as noted in the Inspection Program.

3.0 Leachate Management

The Lone Mountain Facility employs a comprehensive leachate management program and will maintain and operate the leachate collection and removal system (if present) and the leak detection system(s) (if present) throughout the operating and post- closure period of the landfill cells. The location of landfill Cells on site is presented as Figure 1: *Site Landfill Map*.

3.1 Leachate System Design and Inspection

Design

Landfill Cells at the Lone Mountain facility vary in Cell age and type of construction. The Drum Cell is the oldest landfill cell at the facility. Construction began in 1978 and the unit commenced operation in 1979. The Drum Cell and Cells 1 through 8 began post-closure care monitoring within the time period between July 1987 and March 1992. The Drum Cell and landfill cells 1, 2, 4, 5, 6, and 7 were constructed with compacted clay bottom liners and do not have leachate collection systems. A leachate collection "well" was installed in both the Drum Cell and Cell 3. These "wells" serve to remove free liquids which may accumulate above the low point of the clay liners but do not cover the entire floor of the cells. Cells 1 through 7 do have leak detection systems that were constructed below the clay bottom liners. Landfill Cell 8 was the first cell to be constructed with a geosynthetic liner system and a leachate collection system. Landfill cells 10 through 15 were constructed with geosynthetic layers in the bottom liner systems, leachate collection systems, and one (1) or two (2) leak detection systems. Landfill Cells 10 through 14 began post-closure care monitoring between February 1994 and June 2002. This information is summarized in Table 1a: *Landfill Cell Status and Proposed 2020 Action Leakage Rates*.

Landfill Cell 15 consists of several Subcells in various states of operation. Subcells 1 through 8 are closed, Subcells 9 through 13 are active, Subcell 14 is constructed, and Subcells 15 through 22 are proposed. For these newer Subcells, the Lone Mountain Facility has installed two leak detection systems and a leachate collection and removal system, each with their own separate pumping system. Beginning with Cell 15 Subcell 6, and for the remaining Subcells of cell 15, there will be one leak detection system and one leachate collection system. These systems have been constructed and run within the landfill dikes or along the dikes/roads into a common leachate storage tank or can be individually pumped into containers or tank trucks.

Inspection

The Lone Mountain Facility will inspect the leachate lines as required by the Inspection Program. The leachate collection and removal system of landfills subject to the Operating Permit will be inspected for the presence of liquids weekly. If liquid is present in the leachate collection and removal system, the volume of liquid removed will be noted in the Operating Record, and the liquid will be removed from the leachate collection and removal system to the extent practicable in as timely a manner as possible. If the inspections detect a break or breach of the lines, the Lone Mountain Facility will repair the leachate lines as required. If a release occurs, a report will be completed and submitted to the DEQ as necessary.

3.2 Leachate Collection

For Cells subject to the Operating Permit, facility personnel will pump leachate from the riser pipes on the periphery of the cell. The liquids will be transferred to the wastewater treatment system, storage tanks, collection areas, or other vessels via a double walled above ground or underground pipe, truck or other means. Alternately, the liquids may be sent off-site for appropriate treatment and disposal. Much of the precipitation falling into the cell will pool on top of the waste and will slowly infiltrate to the uppermost leachate collection and removal system. Under some circumstances (e.g., when ponded water interferes with operations in the cell), ponded stormwater on top of the waste may be pumped manually before it percolates into the waste. This water will be handled in the same fashion as all other leachate.

Until waste is placed in a Subcell, precipitation falling in that Subcell will be considered to be uncontaminated. Once waste is placed in a Subcell, precipitation falling in the Subcell will be handled as leachate. Once waste is being placed within the area inside the Subcell that is reserved for containment of after 25-year, 24-hour storm, the active Subcell and the adjacent (not yet active) Subcell will be observed carefully after any precipitation event to ensure that overtopping of the temporary berm does not occur. If overtopping of that berm does occur, the next Subcell (into which the precipitation has flowed) will be considered to be active, and all precipitation collected in the area will be handled as leachate.

3.3 Maximum Leachate Head

<u>*Landfill Cell 15*</u>
Using the currently constructed sumps in Cell 15, with linear flow from the floor of the cell directed toward leachate collection ditches which subsequently drain into the sumps, the uppermost leachate collection system, together with a regular leachate pumping schedule is capable of controlling leachate such that the maximum head of water on top of the liner will be less than one foot, except for possibly short periods of time after severe storm events which may occur while the landfill is open. This system meets the requirements of 40 CFR 264.301 (a) (2), and calculations are provided in the Cell 15 Design and Engineering Report (DER). Pumps having a capacity of at least 60 gallons per minute (gpm) will be placed in the sumps to pump any accumulated leachate to the top of the embankment, where it can be collected.

Among their other functions, the middle detection system, where applicable and bottom leachate detection systems are backup systems used to check for leaks in the liner system located immediately above. The design of these systems, as discussed in the Cell 15 DER, meets the requirements of 40 CFR 264.301 (a) (3) (i) through (v). Drainage net specifications and configuration are the same as those in the uppermost system, with the exception that the lower two leachate detection systems include drainage net extending up the side slopes of the cell.

Regarding the minimization of head on the bottom-most and uppermost liners, the Lone Mountain Facility will utilize pumps which have the capacity to remove liquids in the sumps down to at least four (4 inches, which meets the requirements of 40 CFR 264.301 (c)(4). The maximum depth of fluid allowed by the DEQ at this time is twelve (12) inches above the residual level or sixteen (16) inches total depth.

3.4 Action Leakage Rate

As described in the Federal Register, Volume 57, number 19 Wednesday January 29, 1992 (Federal Register), Section C: *Response to Leaks*, 1. *Action Leakage Rate* page 3473, the action leakage rate is a leakage rate that requires implementation of a response action to prevent hazardous constituents from migrating out of the unit. The United States Environmental Protection Agency (USEPA) states that the ultimate goal of the liner and leak detection system (LDS) requirements is to prevent the release of hazardous constituents from the unit, thereby protecting the ground water and surface water. These systems should be in place to detect leaks at the earliest practical time should also be complemented by early follow-up actions to effectively minimize the chance for migration of hazardous constituents from the unit. Furthermore, the USEPA states that it is often more effective to address leaks within the liners than to later address ground-water contamination through corrective action. A copy of applicable sections of the Federal Register are provided in Appendix 1 of this document.

The initially permitted (May 1998) Action Leakage Rate (ALR) for the Lone Mountain Facility was established by the DEQ based on preliminary information available in 1987, when the rule was first proposed. However, the final EPA ALR rule in 1992 designated a specific formula and specific methodology (which includes a safety factor of at least 2) for calculating the ALR be implemented. The formula for calculating the ALR was published on page 3474 of the Federal Register, see Appendix 1. This formula provided a standardized procedure for determining the ALR and was developed to provide a more accurate estimate on a cell-by-cell basis.

Under the rule, the owner or operator must propose an ALR based on calculations of the maximum flow capacity of the LDS system design so as not to exceed one (1) foot head on the bottom liner. the model is based on Darcy's Law for non-turbulent flow through saturated media. The USEPA found that the following formula for flow originating through a hole in a geosynthetic liner is the most likely leak scenario for a geomembrane liner:

Equitation 1: Flow Through a Hole in a Geosynthetic Liner

$Q = k \times h \times \tan\alpha \times \beta$

where

Q=flow rate in the LDS (drainage layer),

h=head on the bottom liner,

k=hydraulic conductivity of the drainage medium,

α =slope of the LDS,

β=width of the flow in the LDS, perpendicular to the flow.

The final background document considered by the USEPA in promulgating the rule on ALRs (*Action Leakage Rates for Leak Detection Systems*, January 1992) provides further discussion and background on these recommended ALRs.

While the USEPA recommended an ALR for Landfills based on minimum design specifications, the USEPA recognized in 1992 that a number of site-specific factors affect the maximum flow capacity of a LDS, and owners or operators may want to propose alternative ALRs. For example, the LDS design may be different than the minimums specified in the rule. Hydraulic conductivity of the LDS is a factor that significantly affects the flow capacity of the system. The USEPA allows that LDS with greater hydraulic conductivities would have higher ALRs. In additional, owners or operators may have information to justify a different width (β) of flow. Operators also may justify a higher ALR by using a different formula or model than Equation 1. While the USEPA recommends the use of the above model for defining the maximum flow capacity of the LDS and ALR, EPA recognized that there may be alternative models available in the future that may more accurately predict system flow capacity to justify higher ALRs. Therefore, owners or operators may propose the use of an alternative model that they believe more accurately predicts the maximum flow capacity of the LDS. Further, owners or operators may want to do a flow (pump) test on the LDS to show actual flow capacity, which may justify a higher ALR. Finally, the owner or operator may have flow rate data on similarly designed units to use to justify a different level.

The considerations described in the Federal Register (paraphrased above) are reflected in the current US EPA regulations; specifically 40 CFR § 264.301 - *Design and operating requirements*.

- § 264.301 (a) of the regulations state that "Any landfill that is not covered by paragraph (c) of this section or § 265.301(a) of this chapter must have a liner system for all portions of the landfill (except for existing portions of such landfill)".

- § 264.301 (b)) of the regulations state that "The owner or operator will be exempted from the requirements of paragraph (a) of this section if the Regional Administrator finds, based on a demonstration by the owner or operator, that alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents (see § 264.93) into the ground water or surface water at any future time. In deciding whether to grant an exemption, the Regional Administrator will consider: (1) The nature and quantity of the wastes; (2) The proposed alternate design and operation; (3) The hydrogeologic setting of the facility, including the attenuative capacity and thickness of the liners and soils present between the landfill and ground water or surface water; and (4) All other factors which would influence the quality and mobility of the leachate produced and the potential for it to migrate to ground water or surface water."

- § 264.301 (c) of the regulations state that "The owner or operator of each new landfill unit on which construction commences after January 29, 1992, each lateral expansion of a landfill unit on which construction commences after July 29, 1992, and each replacement of an existing landfill unit that is to commence reuse after July 29, 1992 must install two or more liners and a leachate collection and removal system above and between such liners."

The applicability of these three Sections in regard to the Clean Harbors Lone Mountain Facility are expanded upon below.

The applicability of the 40 CFR § 264.301(a)-(c) to landfill cells at the Lone Mountain Facility is directly related to the age and materials used to construct the landfill cells. Landfill cells in which construction commenced prior to July 29, 1992 are exempt from the rule. Additionally, the regulation is specific to leaks in landfills constructed with geosynthetic liners and leakage into the LDS is calculated based on the number and size of holes in the liner. Many of the landfill cells on site at the Clean Harbors Lone Mountain Facility pre-date the regulation and were not constructed with geosynthetic liners as quoted below.

- The Drum Cell and Cells 1 through 8 began post-closure care monitoring within the time period between July 1987 and March 1992. These Cells are exempt from the rule due to age. Further, the Drum Cell and Cells 1 through 7 were constructed with compacted clay bottom liners and Equation 1 is not applicable. Although Landfill Cell 8 was the first cell to be constructed with a geosynthetic liner system and a leachate collection system, it is exempt due to age.
- Landfill Cells 10 through 13 were constructed with geosynthetic layers in the bottom liner systems and one (1) collection system to two (2) leak detection systems. Landfill Cells 10 through 14 began post-closure care monitoring between February 1994 and June 1999. The date that construction formally commenced is understood to be before July 29, 1992 for Cells 10 through 13; documentation to verify this fact is currently archived and pending.
- Landfill Cells 14 and existing Subcells of Cell 15 were constructed in keeping with 40 CFR § 264.301(a)-(c) and is subject to ALR monitoring.

An additional factor in considering the representative nature of the current ALR is the presence of groundwater above the LDS in many of the Landfill Cells on site. It is understood that the older Cells were excavated and constructed without the appearance of groundwater in the excavations due to the very slow groundwater migration rate and the rapid rate of evaporation at the site. A comparison of the potentiometric surface based on groundwater elevations measured in April 2020 to the elevation of the LDS in each Cell is presented as Figure 2: *Cell Bottom – Potentiometric Surface Difference Map*. In instances where the groundwater elevation is above the LDS, the landfill cell is colored blue; brown where the LDS is above groundwater. The results indicate that the LDS system of the Drum Cell and Cells 1 through 8 are entirely below groundwater; Cells 10, 11, and 13 are partially below groundwater; and the LDS systems of Cells 12 and 14 are above the groundwater table. Cell 15 was not modeled. The resulting daily infiltration rate calculated for each Cell is listed in Table 1. Infiltration rates range from 0 to 124 gallons per day.

The rate of infiltration was estimated for each Cell modeled. Groundwater volumes entering the leachate detection systems in the older Landfill Cells were approximated using Darcy's Law:

<u>Equation 2: *Darcy's Law*</u>

$Q = K \cdot A \cdot \frac{h_{wt} - h_{ld}}{l}$, where:

Q = Volumetric flow rate of groundwater into the leachate detection system

K = Effective hydraulic conductivity of liner material

A = Cross-sectional area of landfill cell wall

h_{wt} = Water table elevation at landfill cell edge from the approximate potentiometric surface interpolated using April 2020 groundwater elevation data

h_{ld} = Elevation of the leachate detection system

l = Lateral distance between h_{wt} and h_{ld}

In the task of calculating the groundwater infiltration rate for the clay lined Cells it was assumed that the head in the leachate detection systems (h_{ld}) is roughly equal to the elevation of the LDS. The lateral distance (l) between the water table head approximation (h_{wt}) and the head in the LDS (h_{ld}) is approximated using the slope of the Landfill Cell wall, where l is twice the difference between the two head measurements (h_{wt} - h_{ld}). The cross-sectional area (A) was calculated using the cross-sectional area of the Landfill Cell wall. For Cells constructed with a geosynthetic liner, the effective hydraulic conductivity was estimated based on Equation 1 and an assumed number of defects in the liner.

To demonstrate the volume of fluid collected from the LDS of each Landfill Cell, bar charts depicting the averaged weekly LDS fluid removed from each landfill in gallons per day is presented as Figures 3: *Weekly LDS Fluid Removed: Drum Cell* through Figure 17: *Weekly LDS Fluid Removed: Cell 15*. The time period summarized in the bar charts is January 1, 2016 to July 31, 2020. The contribution due to groundwater infiltration that has been calculated for each Cell is shown on each chart as a dashed black line. The plots illustrate consistent pumping from the LDS systems with variable volumes of fluid collected. Presumably, Cells that have been closed since at least 2002 are at equilibrium with their surroundings with regard to those Cells that are affected by groundwater infiltration. The range of pumping values should be representative of typical operation.

Per the Lone Mountain Facility Post-Closure Permit Renewal Application dated September 2015, TOX and TOC samples were to be collected if the Tier 2 ALR was exceeded. In 2019, the only period analyzed, samples were collected on a near weekly basis from most Landfill Cells on site. The 2019 results of sampling are presented in a table of summary statistics. The statistics chosen to describe the data set include the Number of Data (frequency of sampling), Percent Detects, and the Average, Median, Minimum, and Maximum concentrations for each Cell. The maximum concentration of TOX analyzed in fluid samples from a Cell was collected from Cell 5 at a concentration of 16.53 parts per million (ppm). Cell 5 is currently in the Corrective Action program due to the presence of chlorinated solvents in groundwater. The next highest maximum concentration sample was collected from Landfill Cell 15. This high value appears to be somewhat anomalous as the average and median concentrations for samples collected form the LDS for the Cell are less than 1.6 ppm. Aside from these two Cells, the maximum concentration of TOX for all other Cells was below 5.0 during 2019. The Median concentration for all Cells with the exception of Cell 5 and Cell 15 is generally less than 0.7 ppm. Similarly, the Median concentration with the exceptions noted is below 0.35 ppm. These results indicate that the fluid collected from the LDS is likely diluted leachate. It should also be noted that based on the data collected during the April 2020 semi-annual groundwater monitoring event and the results of the required data evaluation, it appears that with the exception of the previously documented release from Landfill Cell 5 and the Drum Cell, there has not been a new verified release from a regulated unit at the Facility.

Proposed ALR Calculations for the Drum Cell and Cells 1 through 14
Recognizing the age, Cell liner construction materials, and influence of groundwater on the rate of fluid production in the LDS, the Lone Mountain facility proposes changes to the current calculation method of the average daily volume for the Drum Cell and Landfill Cells 1 through 14. The average daily volume is to be calculated considering groundwater utilizing the following steps:

A.) sum the volume of fluid collected from all applicable leachate detection sump(s) in the Landfill Cell (gallons per acre per time unit) for the appropriate time period per § 264.303(c);

B.) convert the flow volume for the time period to an average daily volume (gallons per day) for the Cell;

C.) subtract the groundwater contribution (gallons per day) found in Table 1a: *Landfill Cell Status and Proposed 2020 Action Leakage Rates* from the average daily volume (gallons per day);

D-1.) divide the value computed is Step C by the total number of acres of the Cell, as appropriate. Compare this value to the ALR.

D-2.) alternatively, compare the value computed in Step C to the Tier 1 ALR (100 gallons per acre per day) x area (acres) or the Tier 2 ALR (345 gallons per acre per day) x area (acres), as applicable. Cell acreage and computed ALR values for each Cell are provided in Table 1a: *Landfill Cell Status and Proposed 2020 Action Leakage Rates*.

An exceedance of the Tier 1 or Tier 2 ALR has occurred if the value calculated in Step D exceeds 100 gallons per acre per day or 345 gallons per acre per day, respectively. The resulting Response Action to an exceedance is dependent upon whether or not 40 CFR § 264.301(a)-(c) applies to the Cell. The Response Action is described below.

Proposed ALR Calculations for Cell 15

The Lone Mountain Facility contracted with Geo Syntec Consultants to calculate the ALR for Cell 15 Using the USEPA guidance document *Action Leakage Rates for Leak Detection Systems*. Using the USEPA guidance document, the calculated ALR is 1,725 gpapd (see Appendix 2). This ALR is based on the enhanced geocomposite drainage layer specified for the project in the Construction Quality Assurance (CQA) document. Specifically, the ALR is based on using a geocomposite having a transmissivity value greater than or equal to $5X10^{-4}$ m^2/sec. The flow characteristic of this geocomposite is many orders of magnitude higher than that of sand used in the original EPA ALR calculations. The calculated ALR for Lone Mountain (i.e.; 1,725 gpapd) is consistent with EPA requirements. A Tier 2 ALR is not proposed, instead the Response Action is directly to Tier 3 above 1,725 gpapd.

Proposed Response Action to ALR Exceedance

Per the current Operating Permit Part VI.F: *Capacity and Leachate Collection and Leak Detection Rates*, The Lone Mountain Facility is utilizing a three tier assessment plan of the ALR. The tiered approach describes levels of action and response corresponding to an increase in leachate production in the LDS. The Tiers are as follows:

- **TIER 1** Normal leachate accumulation rate of 0 - 100 gpapd (Drum Cell and Cells 1 through 14). Normal leachate accumulation rate of 0 – 1,725 gpapd (Closed and Active Subcells of Cell 15): No notification required;
- **TIER 2** Leachate accumulation rate between 100 gpapd to 345 gpapd (Drum Cell and Cells 1 through 14). Leachate accumulation rate greater than 1,725 gpapd (Closed and Active Subcells of Cell 15);
- **TIER 3** Leachate accumulation rate greater than 345 gpapd (Drum Cell and Cells 1 through 14). Leachate accumulation rate greater than 1,725 (Closed and Active Subcells of Cell 15).

Under Tier 2 and only for Landfill Cells 14 and 15, the Response Action to an accumulation rate greater than the applicable Tier 2 limit is as follows. The Facility must notify the Oklahoma DEQ in writing within three (3) days that the Facility has exceeded the 100 gpapd leachate accumulation rate. In addition, a sample shall be collected within three (3) days and a metals and general chemistry analysis shall be performed. The general chemistry analysis shall include specific conductivity, pH, cations (Na, Ca, Mg, Mn,) and anions (Cr, S04, and N03). The written notice and the analysis described must be submitted to the DEQ within thirty (30) days of the first exceedance of the 100 gpapd leachate production rate.

Under Tier 3 and only for Landfill Cells 14 and 15, the Response Action to an accumulation rate greater than the applicable Tier 3 limit is as follows. The Permittee shall then be subject to Permit Conditions VI.F.3 through VI.F.9. As 40 CFR § 264.301(a)-(c) does not apply to the Drum Cell and Landfill Cells 1 through 13, the Facility proposes that a Response Action to a Tier 3 exceedance is conducted at the request of the DEQ or as a voluntary action by the Facility if the leachate production rate spikes or damage to a Cell liner is suspected. For a Tier 3 exceedance in any Cell, the Facility will immediately increase the pumping rate of leachate from the primary leachate collection system in order to minimize the amount of accumulated leachate.

Permit Conditions VI.F.3 through VI.F.9 describe the Action Response to be conducted in response to a Tier 3 exceedance. These steps include:

- The Permittee shall notify the DEQ in writing within three (3) days;
- The Permittee shall submit a preliminary written assessment to the Oklahoma DEQ within seven (7) days of the determination, describing the amount and likely sources of the liquids; the possible location, size, and cause of any leakage; and the short term actions already taken and those planned within the next 14 days;
- The Permittee shall test a sample of the liquid removed from the Leak Detection, Collection and Removal System (LDCRS) for Permit Condition VI.F.2.b, and compare these results to the results of samples obtained from all other Leachate Systems (LCRS) from the same Cell or Subcell. The analytical results from the Leachate Systems may also be compared to the analytical results from the groundwater monitoring wells, for the purposes of determining if the leachate is actually groundwater infiltrating into the system.
- The data obtained by the implementation of Permit Condition VI.F.5 will be submitted to the DEQ along with a recommendation regarding further investigations, if any. This report shall be made, in writing, to the DEQ within fourteen (14) days of the receipt of analytical results, with documentation as part of the formal report required by Permit Condition VI.F.8.
- Any additional investigations will be performed in accordance with the recommendations approved by the DEQ. If it is determined that the fluid in the LDS is leachate, the Permittee shall prepare and submit a Leachate Escape Assessment Plan (LEAP) to the DEQ within thirty (30) days.
- The Permittee shall prepare and submit a report to the DEQ within thirty (30) days after the initial agency notification that the ALR has been exceeded, which gives the results of the actions and analyses specified above and lists other actions planned. Action required by Permit Conditions VIF.2a and VIF.7 may be ongoing at the time that this report is submitted.
- The Permittee shall submit monthly reports thereafter to the Oklahoma DEQ summarizing the results of any actions taken, and outlining actions planned, for as long as the flow rate in the Leachate System exceeds the Tier 1 gpapd. Once leachate production decreases to less than Tier 1 gpapd for six (6) consecutive months, the Permittee will revert to Tier 1 status.

Standard Post-Closure LDS Monitoring

Per 40 CFR § 264.303 - Monitoring and inspection Part (c)(2), "After the final cover is installed, the amount of liquids removed from each leak detection system sump must be recorded at least monthly. If the liquid level in the sump stays below the pump operating level for two consecutive months, the amount of liquids in the sumps must be recorded at least quarterly. If the liquid level in the sump stays below the pump operating level for two consecutive quarters, the amount of liquids in the sumps must be recorded at least semi-annually. If at any time during the post-closure care period the pump operating level is exceeded at units on quarterly or semi-annual recording schedules, the owner or operator must return to monthly recording of amounts of liquids removed from each sump until the liquid level again stays below the pump operating level for two consecutive months." Given the rate that fluid is produced in the LDS of most Landfill Cells on site, the fluid will likely need to be measured and removed at least weekly so as not to exceed one (1) foot head on the bottom liner.

3.5 Leachate Volume Measurement and Recordkeeping

The Lone Mountain Facility employs both standard operating and administrative methods to determine the depth and volume of leachate present in the top and bottom liner systems sumps. The Lone Mountain Facility will first calculate the residual volume of liquid which cannot be removed from the sumps when pump suction is broken. Then, each time the leachate is removed, the pump will be operated until suction is broken. The volume removed will then be added to the residual volume to determine the total volume which was present in the sump prior to pumping. This volume will also be recorded in logs and retained. The total volume also corresponds to a depth of fluid in the sump. As a backup, the Lone Mountain Facility may employ other level measuring methods (e.g., probe-type sensors, water level sounders, etc.).

3.6 Response Action Plan

See <u>*Proposed Response Action to ALR Exceedance*</u> discussion in Section 3.4: *Action Leakage Rate*, above.

4.0 Dust Suppression

The purpose of the Dust Suppression Program is to minimize fugitive dusts from the Lone Mountain Facility.

The use of recycled leachate as dust suppression water within the active landfills is currently permitted by Clean Harbors Environmental Services Inc. On April 16, 1999, the Lone Mountain Facility proposed numerical limits for constituent concentrations to the ODEQ above which recycling efforts would not be permitted. On May 20, 1999, the ODEQ approved the proposed limits, which have been incorporated into the SOP found within Volume 12, Section 6.7, Section 2.0 of the Leachate Recycling SOP. The SOP also outlines the operational requirements to be followed when using leachate for dust suppression water in the open landfill from which the leachate was originally generated.

4.1 Background

The Lone Mountain Facility disposes of hazardous and other solid waste at the facility. These materials are disposed in landfill units. There are several ways materials are disposed in the landfill(s), including directly from incoming trucks, both outside and CHESI transporters, and from internal trucks (e.g., haul trucks from the stabilization tanks to a landfill unit).

Most materials which are disposed in landfills have to meet stringent criteria including, but not limited to, the land disposal restrictions (LDRs). These restrictions generally require treatment at the point of generation or at the disposal facility. The most prevalent materials utilized in this treatment are pozzolans (cementing agents) such as Portland cement, fly ash, cement kiln dust, and other dusty reagents. These dusty materials are easily windborne and require suppression to eliminate excessive particulate emissions. These materials are stored in silos, which have baghouse collection devices that are 95-99% efficient.

During both the off-loading of vehicles and through the course of disposal, dusty materials require specialized management to minimize fugitive dust emissions.

4.2 Procedures

1. During the pre-acceptance review, the waste will be reviewed to determine if it has the potential to become airborne easily (i.e., dusty). If it does, the reviewer will determine if the waste can be packaged to minimize airborne emissions during the off-loading of the material[1]. If it can, then the reviewer will require appropriate packaging or an assurance from the generator[2] that the material will be sufficiently treated, wetted, or packaged to minimize wind dispersal of waste during off-loading.

2. For bulk (potentially) dusty materials going for direct disposal in the landfill, where packaging is not an appropriate option, the material will be off-loaded only when the wind speed is <20 mph and the material can be wetted during the off-loading process (e.g., water mist applied utilizing the on-site water truck), or the material is delivered in such a way that significant wind dispersal is not an issue. For example, the waste may be delivered in a container such that the material can be off-loaded with a minimum dropping distance (e.g., less than 5 feet), or the waste may be packaged into containment bags inside a roll-off box or dump trailer.

[1] This may be possible when the material does not require treatment (e.g., it is not subject to treatment at the Lone Mountain Facility to meet LDR treatment standards).

[2] 2Generator is used to denote the responsible party such as the project manager, or broker, etc.

During this process, the watering apparatus will be positioned such that the waste is wetted during off-loading. To the extent possible, the wetting of the waste surface should be continued after off-loading to ensure the surface has been sufficiently wetted to prevent wind dispersal.

3. For materials going to stabilization, dusty flowable materials should be delivered in pneumatic trailers, where possible, in containment bags, or will be off-loaded into the stabilization tanks with a constant water spray to minimize particulate emissions as the waste is placed into the tank. The pneumatic tankers can be off-loaded slowly and in a controlled fashion to minimize dispersion of particles.

During the addition of the bulk stabilization reagents, the stabilization tank lids are in the closed position.

4. Existing surface areas and particularly discrete loads of waste are to be wetted periodically to minimize wind dispersion[3].

5. Unnecessary disturbance of discrete dusty loads will be minimized. As soon as practical, dusty materials should be covered by other material not subject to significant wind dispersal.

6. Dust suppressants, such as foam, may be applied to minimize wind dispersal from discrete loads in the landfill.

5.0 Run-On and Run-Off Controls

5.1 Run-On Controls

In general, run-on diversion channels and embankments exist up-gradient of and within the active portions of the site and are used to divert stormwater away from hazardous waste management areas. Channels are designed to handle at least the 24-hour, 25-year rainfall event. In addition, the disposal cells are situated above ground. Therefore, the embankment heights will also prevent run-on into the active portion of the landfill cells.

More detailed information concerning the run-on controls for the Lone Mountain Facility may be found in the Run-On Control System and Cell 15 Design and Engineering Report Sections of the permit application.

[3] It is recognized that during freezing or wet conditions, this may be halted if the surface of the material is frozen or not subject to significant wind dispersal. However, during warm, dry conditions when evaporation causes the surface layer to become dry and subject to wind dispersal, this may have to be accomplished more frequently.

5.2 Run-Off Controls

The run-off control system will contain and divert the precipitation that falls directly on the active portion of the open landfill cells. The run-off control system will consist of conveyance channels, ditches, low areas, etc. along the perimeter and internal portions of the cells. The landfill cell conveyance channels, ditches, low areas, etc. will be constructed and operated to control and contain the water volume of a 24-hour, 25-year storm event, which is 6.1 inches, and one foot of freeboard. As noted in the Leachate Management section, the ponded stormwater collected on top of the waste will be managed as leachate.

Cell 15 will also be operated with the conveyance channels and one foot of freeboard to control run-off in the subcells and phases. As waste placement in Cell 15 is intended to follow a "moving cell" technique, two types of berms will be constructed on the cell floor to prevent run-off from active areas of the cell from entering areas that have not yet received waste materials. These include permanent (phase division) berms and temporary (area) berms (dividing subcells from one another within each phase). The detailed information concerning the run-off controls for Cell 15 may be found in the Cell 15 Design and Engineering Report.

6.0 Waste Management Plan for F020-F023, F026, and F027

6.1 Physical and Chemical Characteristics of Wastes

Prior to the land disposals of waste which has been classified as F020- F023, F026, and F027, the waste must be treated to meet the treatment standards found in 40 CFR Part 268, unless it is subject to an extension or exemption.

Currently, the treatment standard for these wastes is 1 microgram per liter or part per billion (ppb) for the residual dioxin and furan constituents(s) for non - wastewater forms. Since the treatment standards for these wastes are extremely low, it virtually eliminates the presence of dioxins/furans in the waste which are land disposed. In most circumstances, the generator or treatment facility will be required to provide a certification with each shipment of waste that the dioxin/furan concentrations are below the applicable treatment standard of one (I) part per billion (ppb).

6.2 Attenuative Properties of Underlying and Surrounding Soils

Prior to the issuance of the land disposal restrictions (LDR) for F020- F023, F026, and F027, the attenuative properties of the underlying and surrounding soils were a significant environmental factor in the event that the landfill liner(s) failed. However, the LDRs for F020-F023, F026 and F027 require that the waste disposed in a landfill unit meet the treatment standard of one (I) ppb for dioxin/furan constituents. The risk of dioxin/furan constituents escaping into the underlying or surrounding soils is very low, as the EPA recognized when they promulgated the treatment standard for dioxin containing waste. The risk in handling these wastes may only exist when they are being transported and handled prior to incineration.

F020-F023, F026 and F027 waste which meets the applicable treatment standards does not demonstrate a potential to migrate through soil or to volatilize into the atmosphere due to the physical state of the waste being solid and the low vapor pressure of dioxin/furan compounds.

With both the extremely low treatment standards and low vapor pressure, the need to demonstrate that the surrounding and underlying soils will attenuate the movement of dioxin/furan is not required. The three liner/leachate system employed by the Lone Mountain Facility adequately minimizes the release of all hazardous constituents within the landfill unit.

6.3 Mobilizing Properties of Co-Disposed Materials

The treatment residues of F020-F023, F026 and F027 typically do not demonstrate mobilizing properties due to the treatment required to meet the land disposal restriction (i.e., incineration). Due to the physical state of the waste being a solid and the chemical state being relatively neutral and non-reactive, these wastes are not expected to demonstrate mobilizing properties.

In addition, other potentially mobilizing waste (e.g., solvents) are not permitted for direct land disposal unless they also meet the applicable treatment standards. Other mobilizing materials (i.e., free liquids) are also not permitted for direct landfill purposes.

In summary, there is an absence of other materials within the landfill unit which could potentially mobilize the very low levels of dioxin constituents and cause them to migrate out of the landfill unit.

6.4 Additional Treatment, Design, or Monitoring

Below are the guidelines which will be followed when F020-F023, F026, and F027 wastes are received for storage, treatment, and/or disposal.

Waste containers will be kept closed, except during general sampling activities or waste unloading into either the stabilization tanks or a landfill unit, to prevent potential wind dispersal of the materials. The container will be kept closed until immediately prior to sampling or unloading. Should the waste descended for landfill require further treatment to meet additional treatment standards (e.g., characteristic metals), it will be treated in the stabilization tanks or the container management areas. Dust control measures (e.g., water spray) may be implemented during the unloading process at the stabilization tanks to prevent potential waste dispersal outside of the tank system, depending on wind speed, wind direction, etc.

When these wastes are unloaded directly by highway trucks in the landfill unit, the truck will not be completely uncovered until it is located at the unloading site within the landfill unit. Wind dispersal measures will be implemented during the unloading process, should these measures be required. The unloading of these wastes which have a potential for wind dispersal (i.e., dusty) is not allowed when the wind speed exceeds approximately twenty miles per hour (20 mph). After placement of the waste or treated waste in the landfill, it will be covered with appropriate cover material (either other waste or materials formulated to prevent wind dispersion) within 24 hours. Waste which requires verification of treatment standards will be segregated from other waste, but not covered, until confirmation of meeting the treatment standards has been received.

TABLES

Table 1a: Landfill Cell Status and Proposed 2020 Action Leakage Rates
Summary of Landfill Cell Per the Post-Closure Permit September 2015
Clean Harbors Lone Mountain, LLC

Leppert Associates

Landfill Cells	Status	Post Closure Date	Landfill Bottom Liner System Materials	Landfill Area (Acres)	Groundwater Infiltration Contribution (gallons/day)	Tier 1 ALR(2) 100 gpapd (gallons/day)	Tier 2 ALR(2) 345 gpapd (gallons/day)	Leak Detection Systems	Leachate Collection System
Drum Cell	Closed	July 1987	Clay	1.42	124	*142*	*490*	1	"well"
Cell 1	Closed	July 1989	Clay	0.59	19	*59*	*204*	1	None
Cell 2	Closed	July 1989	Clay	0.60	25	*60*	*207*	1	None
Cell 3	Closed	July 1989	Clay	1.42	49	*142*	*490*	1	"well"
Cell 4	Closed	June 1990	Clay	2.16	99	*216*	*745*	1	None
Cell 5	Closed	July 1987	Clay	2.24	83	*224*	*773*	1	None
Cell 6	Closed	March 1992	Clay	0.94	32	*94*	*324*	1	None
Cell 7	Closed	June 1990	Clay	1.51	70	*151*	*521*	1	None
Cell 8	Closed	June 1990	Geosynthetic	1.70	51	*170*	*587*	1	yes
Cell 10	Closed	February 1994	Geosynthetic	4.0	6	*400*	*1380*	3	yes
Cell 11	Closed	February 1994	Geosynthetic	10.0	22	*1000*	*3450*	2	yes
Cell 12	Closed	March 1999	Geosynthetic	10.0	36	*1000*	*3450*	2	yes
Cell 13	Closed	January 1999	Geosynthetic	10.0	38	*1000*	*3450*	2	yes
Cell 14	Closed	June 2002	Geosynthetic	10.0	0	1000	3450	2	yes
Cell 15	Partially Closed	Portions Active	Geosynthetic	96.8	Not Considered	See Table 1b		Varies	yes

Notes:

1.) Landfill Area (Acres): Acreage source see Post-Closure Permit Renewal Application September 2015.

2.) Per 40 CFR § 264.301 - *Design and operating requirements* Item (c) the ALR only applies to landfill cells that commenced construction after January 29, 1992; therefore, the ALR does not apply to Drum Cell and Landfill Cells 1 through 8. Documentation to verify that construction commenced prior to January 29, 1992 for Landfill Cells 10 through 13 is pending.

3.) Per the CHLM Post-Closure Permit May 2018, The Permittee began post-closure care for the closed units listed in Table II.G.1. The date of approval is listed here as the "Post Closure Date".

4.) Proposed method to calculate the ALR for the Clean Harbors Lone Mountain, LLC facility: A.) sum the volume of fluid collected from all applicable leachate detection sump(s) in the Landfill Cell (gallons per acre per time unit) for the appropriate time period per § 264.303(c); B.) convert the flow volume for the time period to an average daily volume (gallons per day) for the Cell; C.) subtract the groundwater contribution (gallons per day) found in Table 1a: Landfill Cell Status and Proposed 2020 Action Leakage Rates from the average daily volume (gallons per day); D-1.) divide the value computed is Step C by the total number of acres of the Cell, as appropriate. Compare this value to the ALR. D-2.) alternatively, compare the value computed in Step C to the Tier 1 ALR (100 gallons per acre per day) x area (acres) or the Tier 2 ALR (345 gallons per acre per day) x area (acres), as applicable. Cell acreage and computed ALR values for each Cell are provided in Table 1a: Landfill Cell Status and Proposed 2020 Action Leakage Rates.

5.) gpapd = gallons per acre per day.

Table 1b: Landfill Cell Status and Proposed 2020 Action Leakage Rates; Cell 15
Summary of Landfill Cell Per the Post-Closure Permit September 2015
Clean Harbors Lone Mountain, LLC

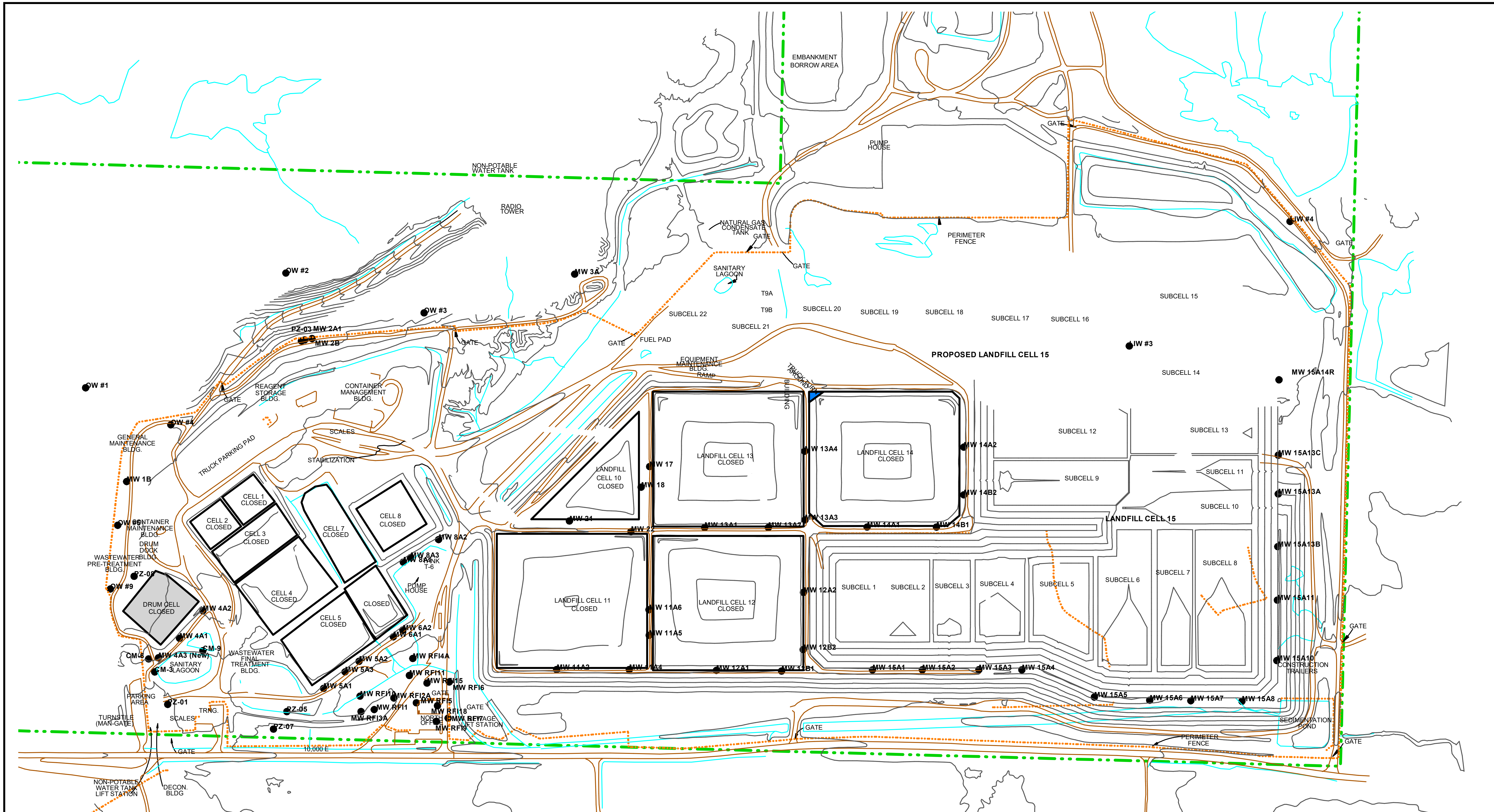
Subcells	Status	Sump Service Area /Landfill Area (Acres)	Proposed Tier 1 ALR 1725 gpapd (gallons)
Cell 15 Subcell 1	Closed	4.92	8,487
Cell 15 Subcell 2	Closed	3.16	5,451
Cell 15 Subcell 3	Closed	2.84	4,899
Cell 15 Subcell 4	Closed	3.51	6,055
Cell 15 Subcell 5	Closed	4.94	8,522
Cell 15 Subcell 6	Closed	5.22	9,005
Cell 15 Subcell 7	Closed	3.50	6,038
Cell 15 Subcell 8	Closed	7.00	12,075
Cell 15 Subcell 9	Active	4.90	8,453
Cell 15 Subcell 10	Active	3.00	5,175
Cell 15 Subcell 11	Active	2.60	4,485
Cell 15 Subcell 12	Active	4.50	7,763
Cell 15 Subcell 13	Active	3.60	6,210
Cell 15 Subcell 14	Built	6.10	10,523
Cell 15 Subcell 15	Proposed	6.00	10,350
Cell 15 Subcell 16	Proposed	4.90	8,453
Cell 15 Subcell 17	Proposed	5.00	8,625
Cell 15 Subcell 18	Proposed	4.30	7,418
Cell 15 Subcell 19	Proposed	4.30	7,418
Cell 15 Subcell 20	Proposed	4.30	7,418
Cell 15 Subcell 21	Proposed	4.30	7,418
Cell 15 Subcell 22	Proposed	3.90	6,728

Notes:

1.) Cell 15 Subcells 1-6: Proposed ALR 1725 gallons per acre per day; See Appendix 1: *Leak Detection System Design, Action Leakage Rate for Lone Mountain Cell 15* dated November 24, 2008. An ALR of 1725 gpapd is proposed for all existing Subcells of Cell 15. No Tier 2 ALR is proposed. If the Tier 1 ALR is exceeded the Facility would proceed to Tier 3.

2.) Sump Service Area /Landfill Area (Acres): Sump Service Area Cell 15 Subcells 1-6 acreage source see Appendix 1; Cell 15 Subcells 7-22 acreage source see *Post-Closure Permit Renewal Application* September 2015.

FIGURES



Legend

Scale:

0 250 500 750

(feet)

N

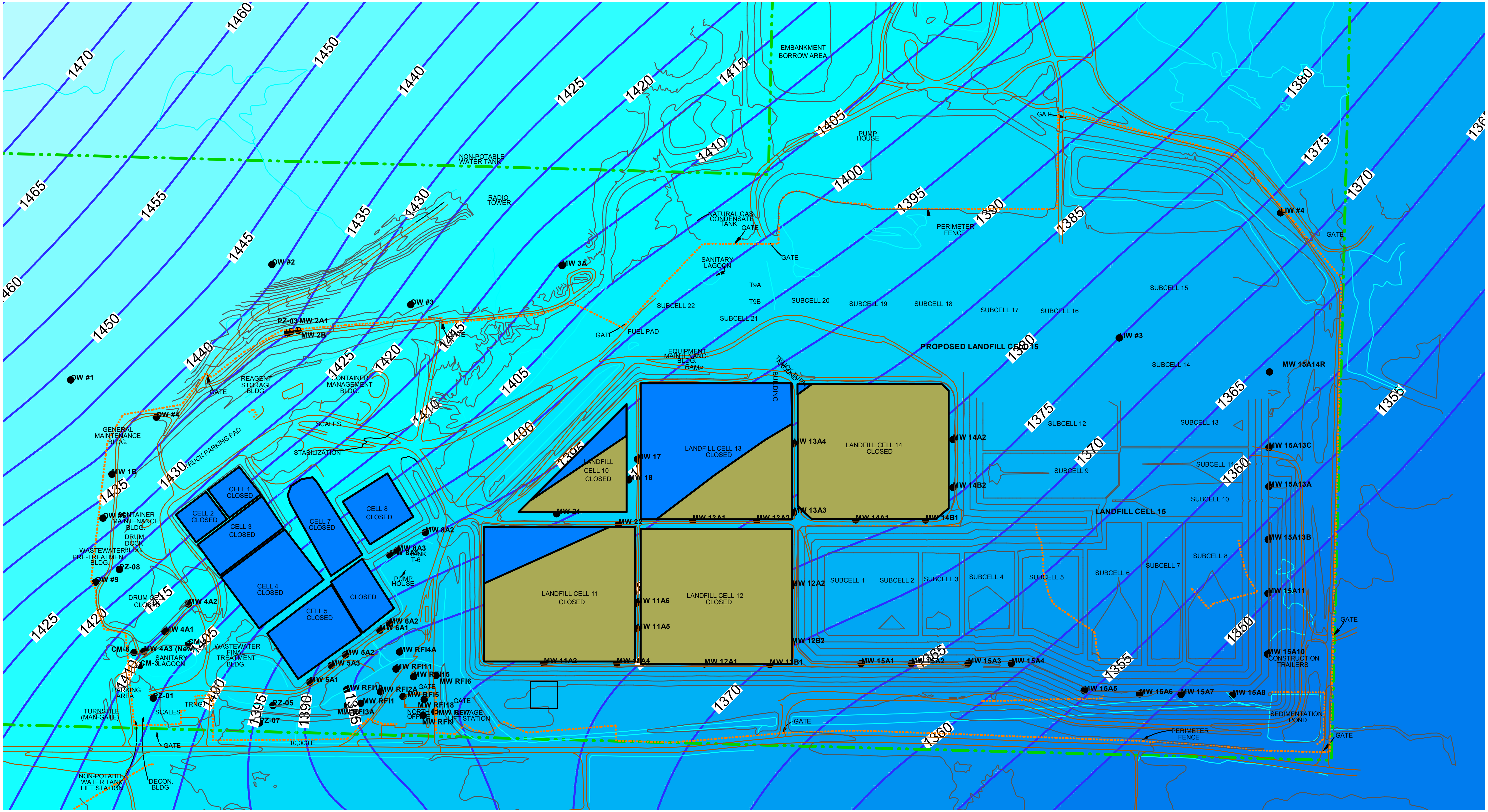
- Site Surface Feature
  - i.e. - Building, Road, Concrete Pad, etc.
- Fenceline
- Lease Boundary
- Surface Water Feature
- Landfill Cell Boundary
- Site Topographic Features of Interest

Figure 1:
Site Landfill Map

Clean Harbors
Lone Mountain Facility

Drawn By:
AJE
09/28/2020
SiteLandfillMap.lpk

Leppert Associates



Legend

Scale: 0 250 500 750 (feet)

N

- Site Surface Feature
  i.e. - Building, Road, Concrete Pad, etc.
- Fenceline
- Lease Boundary
- Surface Water Feature
- Landfill Cell Boundary
- Site Topographic Features of Interest

- Leachate Detection System below the April 2020 Groundwater Elevation
- Leachate Detection System below the April 2020 Groundwater Elevation

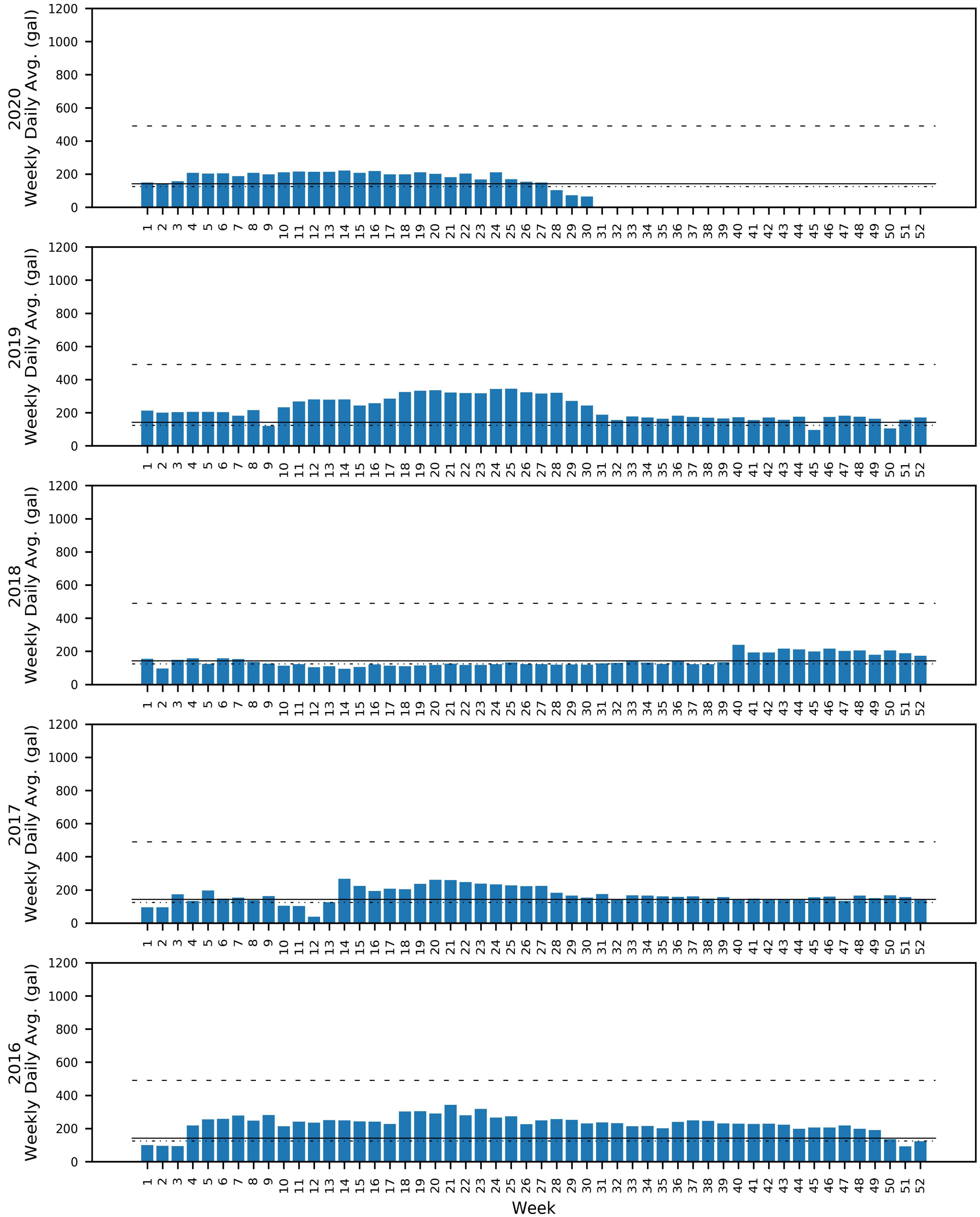
Notes:
1) Elevations reported in feet above MSL.
2) April 2020 groundwater potentiometric surface shown

Figure 2: Cell Bottom - Potentiometric Surface Difference Map

Clean Harbors Lone Mountain Facility

Drawn By:
AJE
09/28/2020
PotSurf2020andCellBot.lpk

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

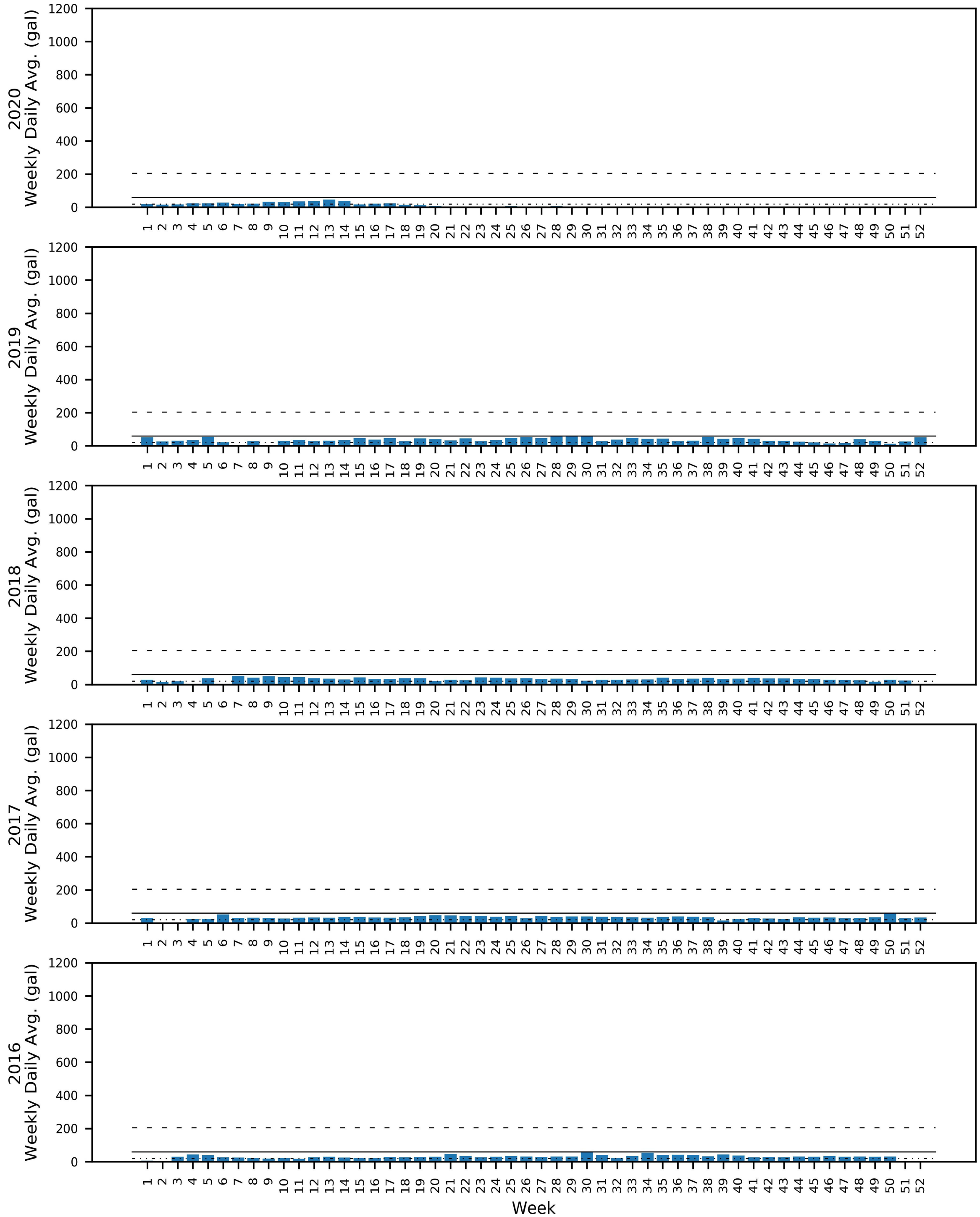
Groundwater Contribution

Clean Harbors Lone Mountain

Figure 3
Weekly LDS Fluid Removed: Drum Cell

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



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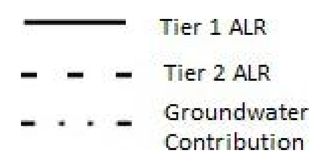
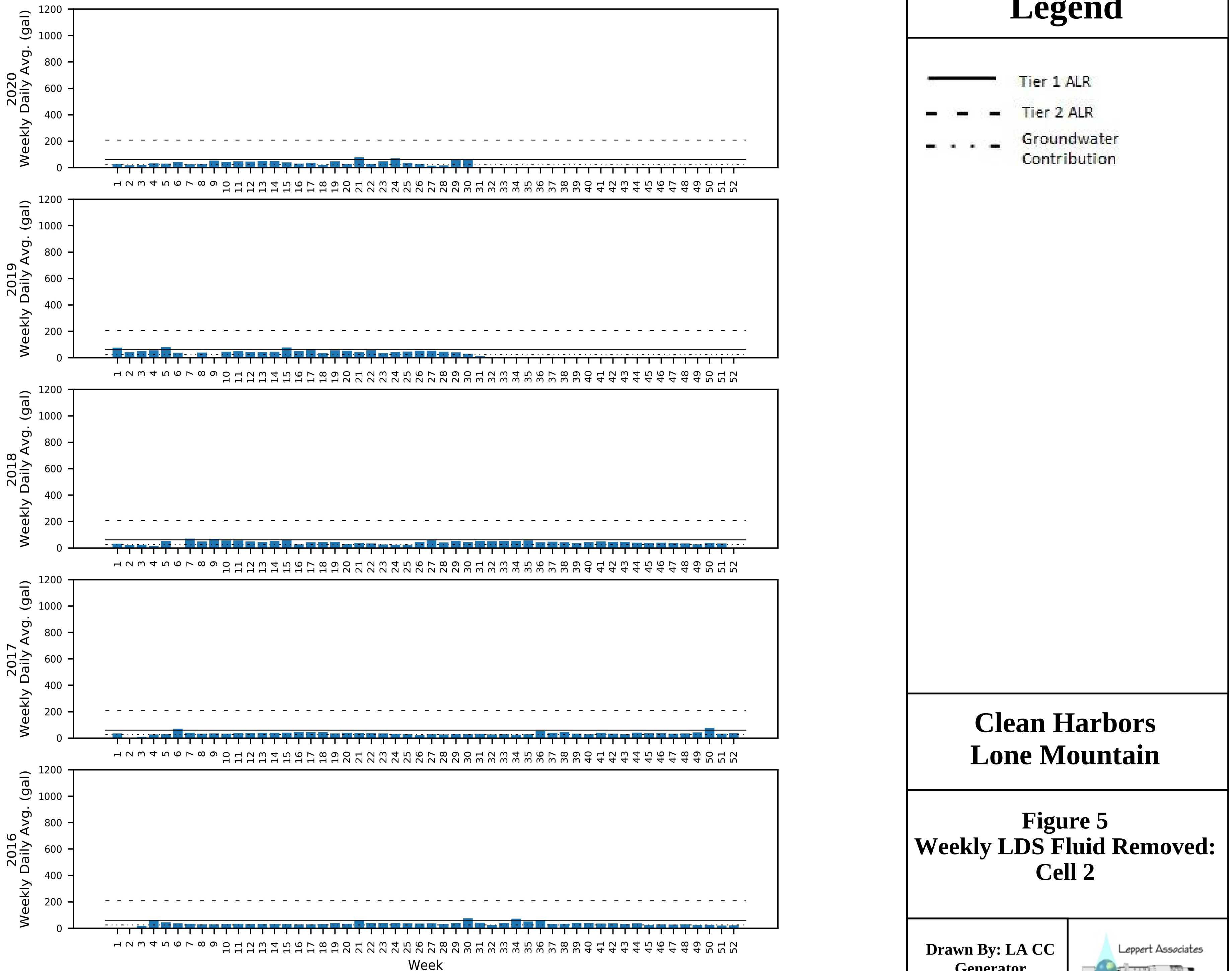


Clean Harbors Lone Mountain

Figure 4
Weekly LDS Fluid Removed: Cell 1

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates

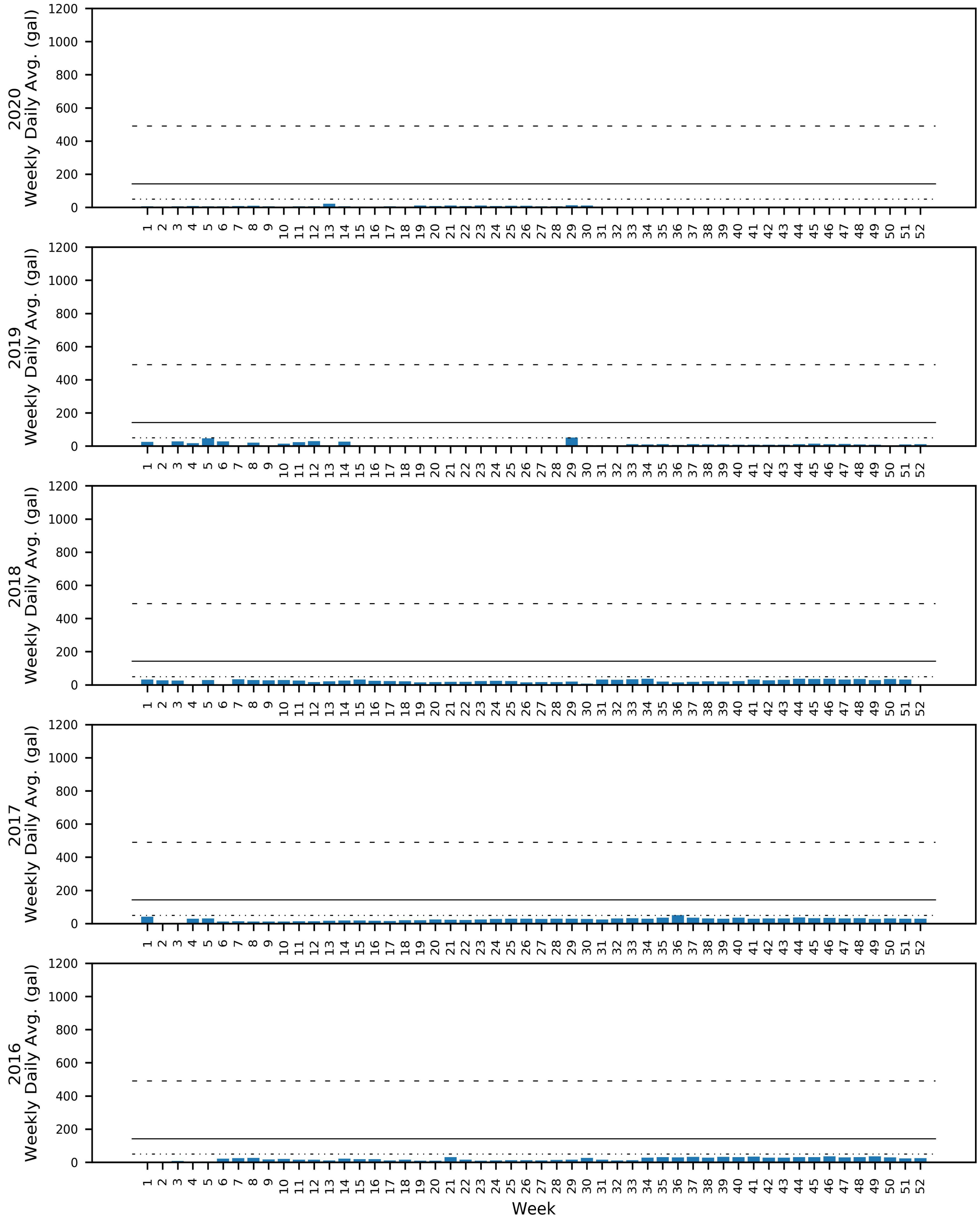


Clean Harbors Lone Mountain

Figure 5
Weekly LDS Fluid Removed: Cell 2

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

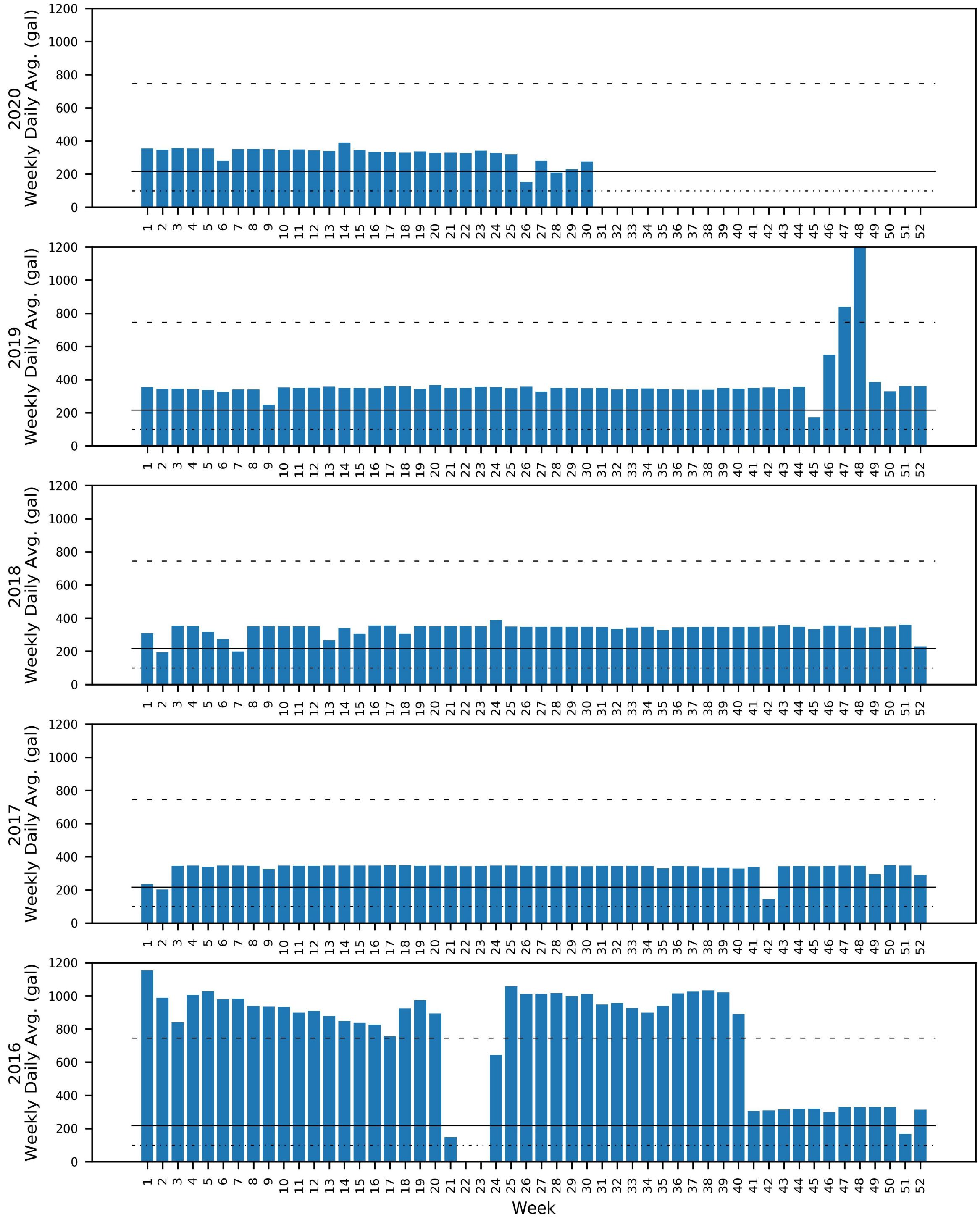
Groundwater Contribution

Clean Harbors Lone Mountain

Figure 6 Weekly LDS Fluid Removed: Cell 3

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

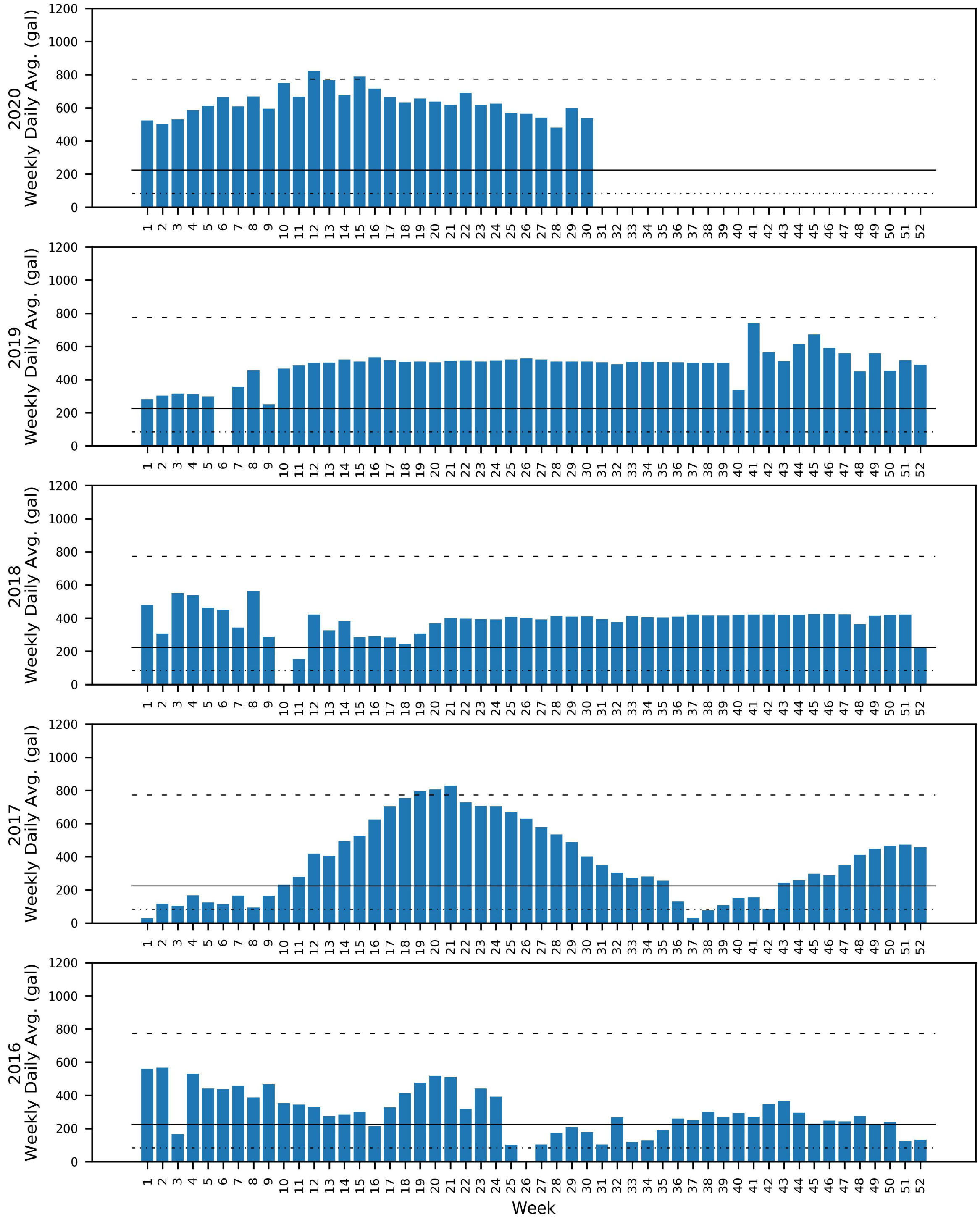
Groundwater Contribution

Clean Harbors Lone Mountain

Figure 7
Weekly LDS Fluid Removed: Cell 4

Drawn By: LA CC Generator
2020-09-28

Leppert Associates



Legend

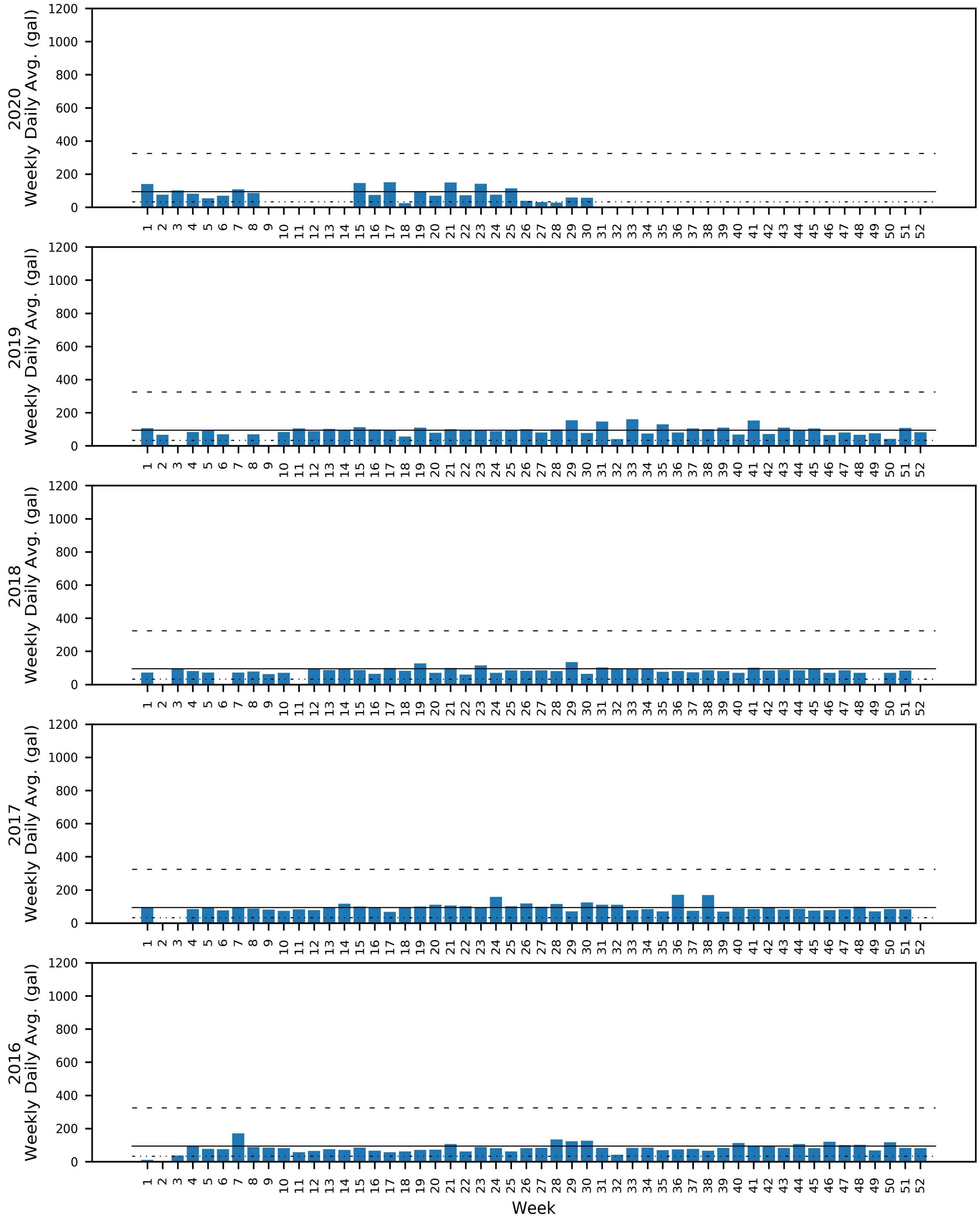
- Tier 1 ALR
- Tier 2 ALR
- Groundwater Contribution

Clean Harbors
Lone Mountain

Figure 8
Weekly LDS Fluid Removed: Cell 5

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

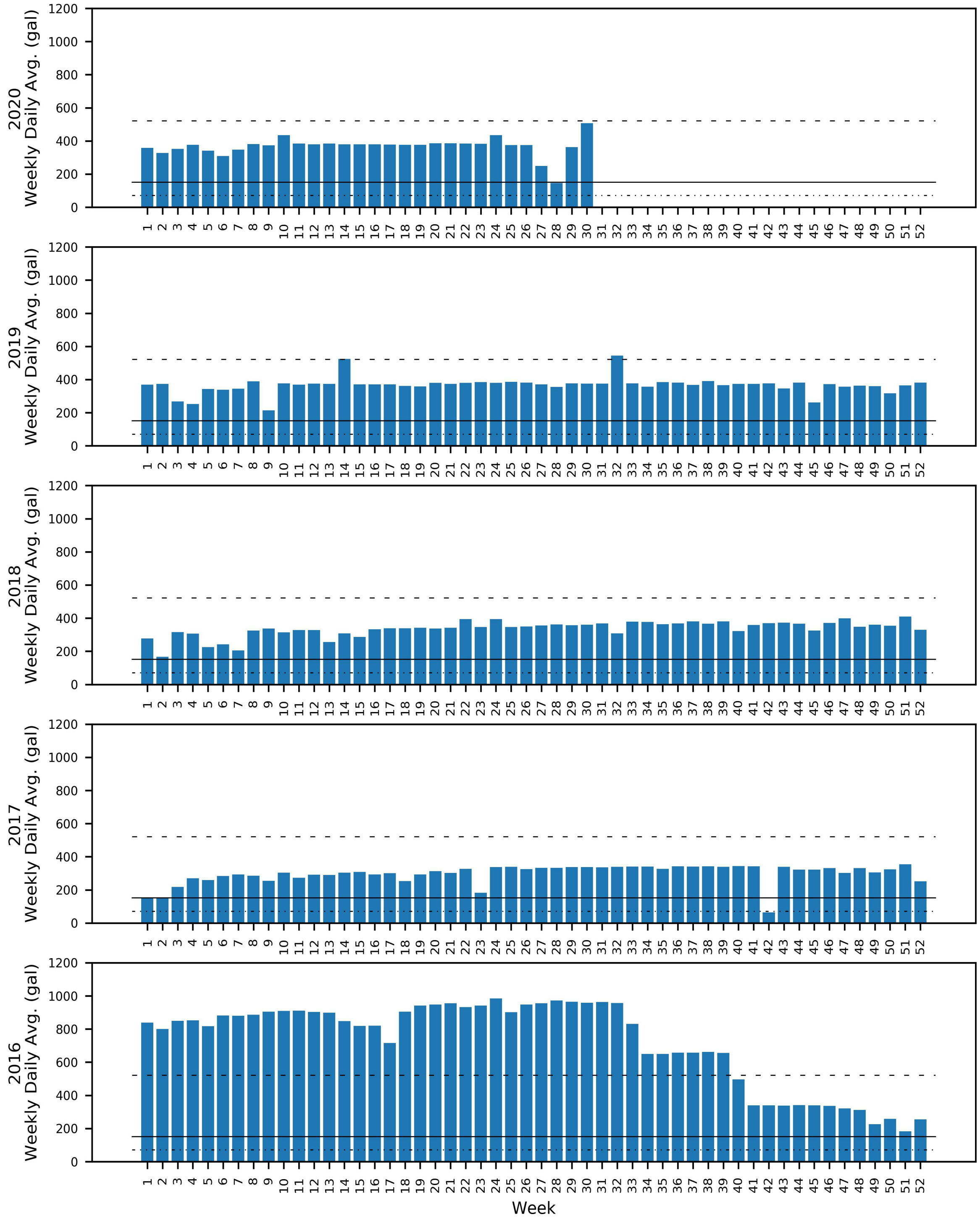
Groundwater Contribution

Clean Harbors Lone Mountain

Figure 9
Weekly LDS Fluid Removed: Cell 6

Drawn By: LA CC Generator
2020-09-28

Leppert Associates



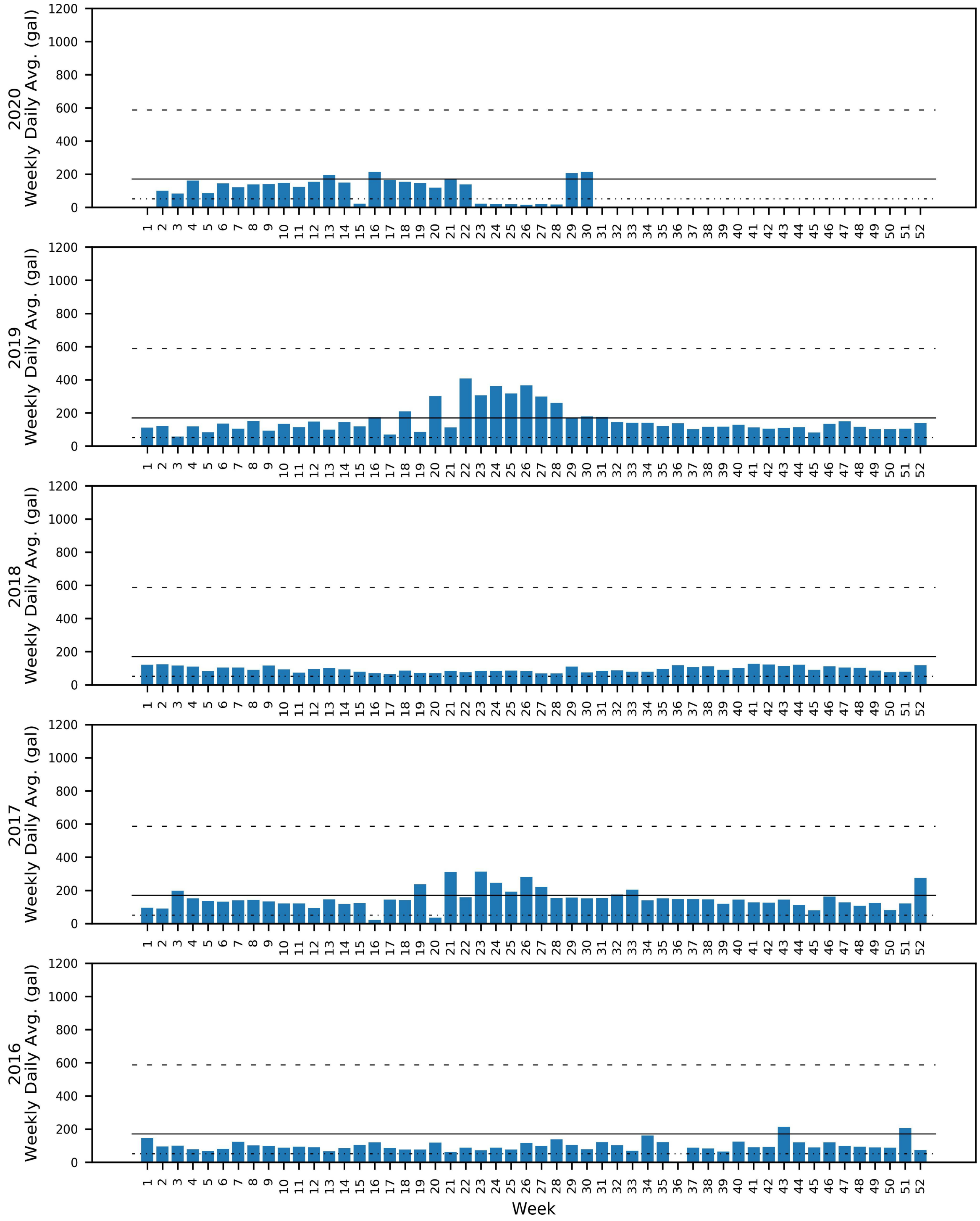
Legend

Clean Harbors Lone Mountain

Figure 10
Weekly LDS Fluid Removed: Cell 7

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

Groundwater Contribution

Clean Harbors
Lone Mountain

Figure 11
Weekly LDS Fluid Removed: Cell 8

Drawn By: LA CC
Generator
2020-09-28

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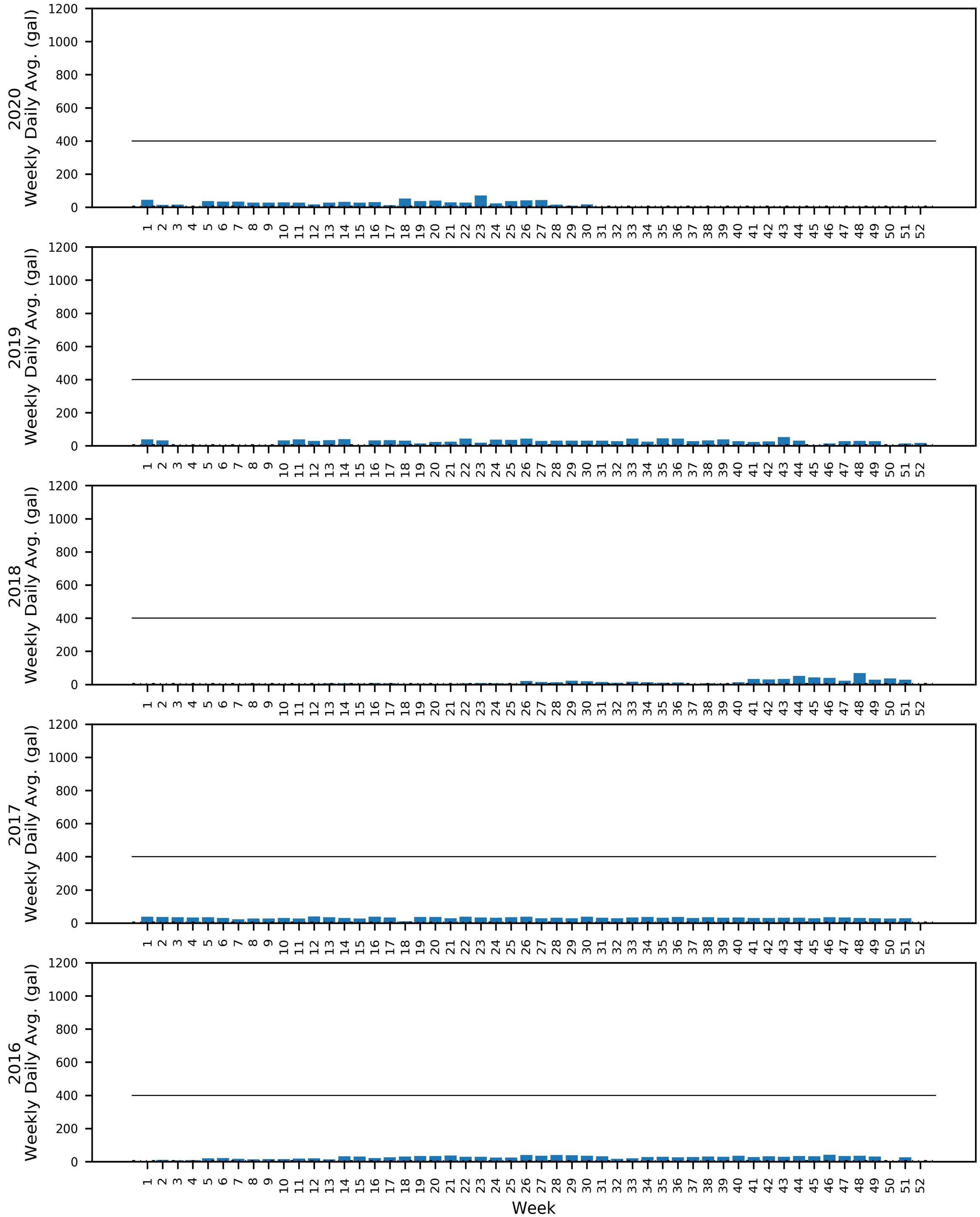


Legend

Tier 1 ALR

Tier 2 ALR

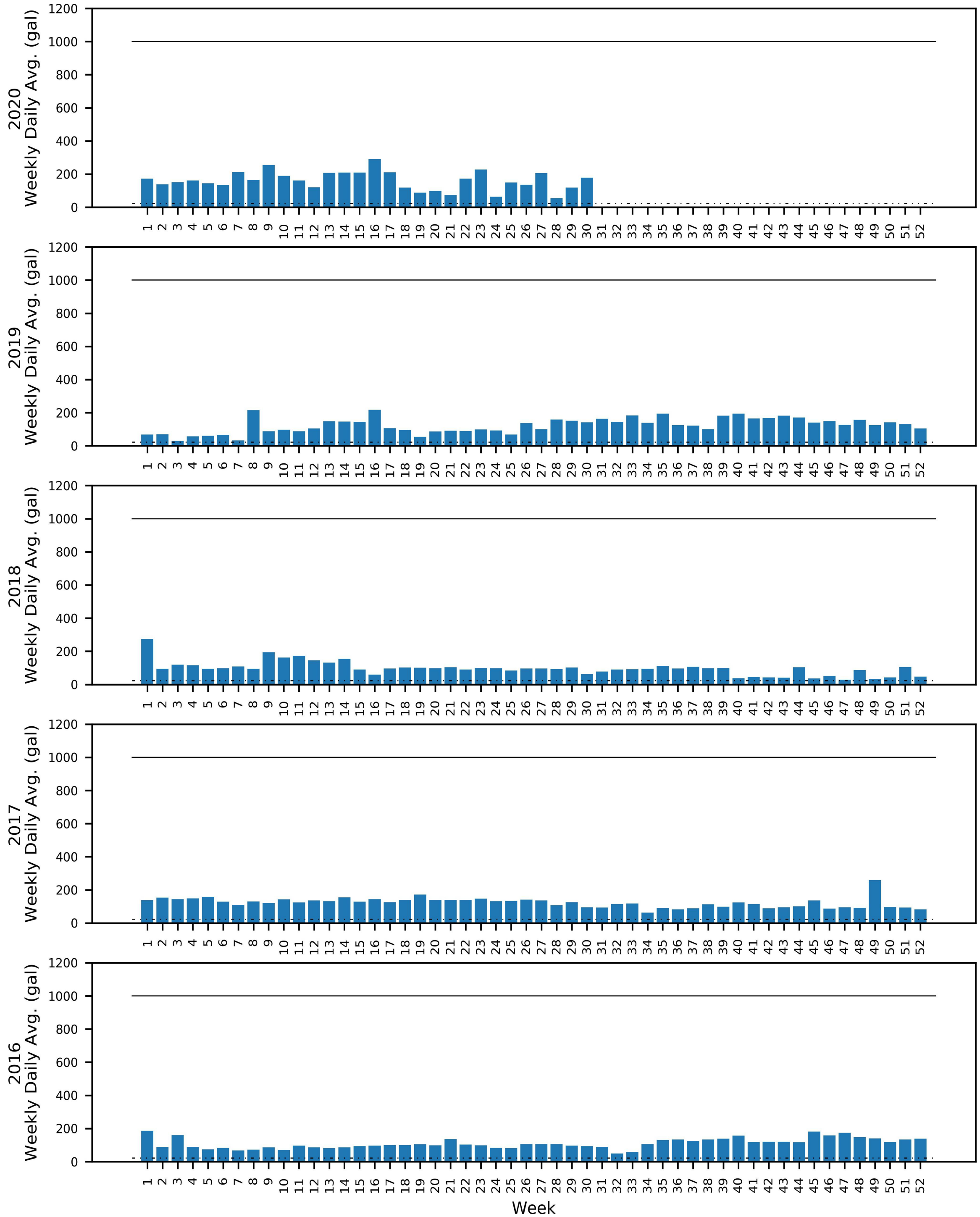
Groundwater Contribution

Clean Harbors Lone Mountain

Figure 12
Weekly LDS Fluid Removed: Cell 10

Drawn By: LA CC Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

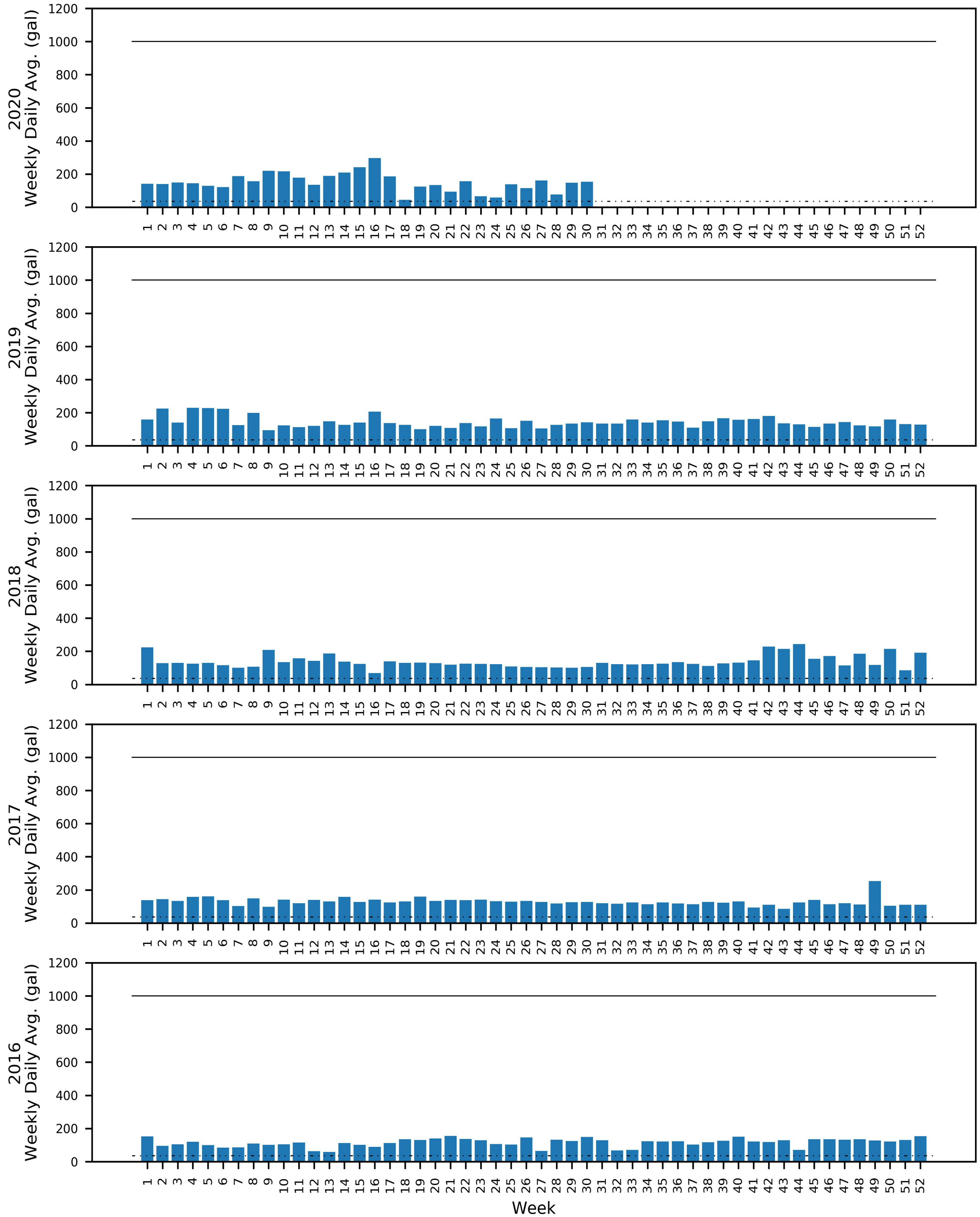
Groundwater Contribution

Clean Harbors
Lone Mountain

Figure 13
Weekly LDS Fluid Removed: Cell 11

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



Legend

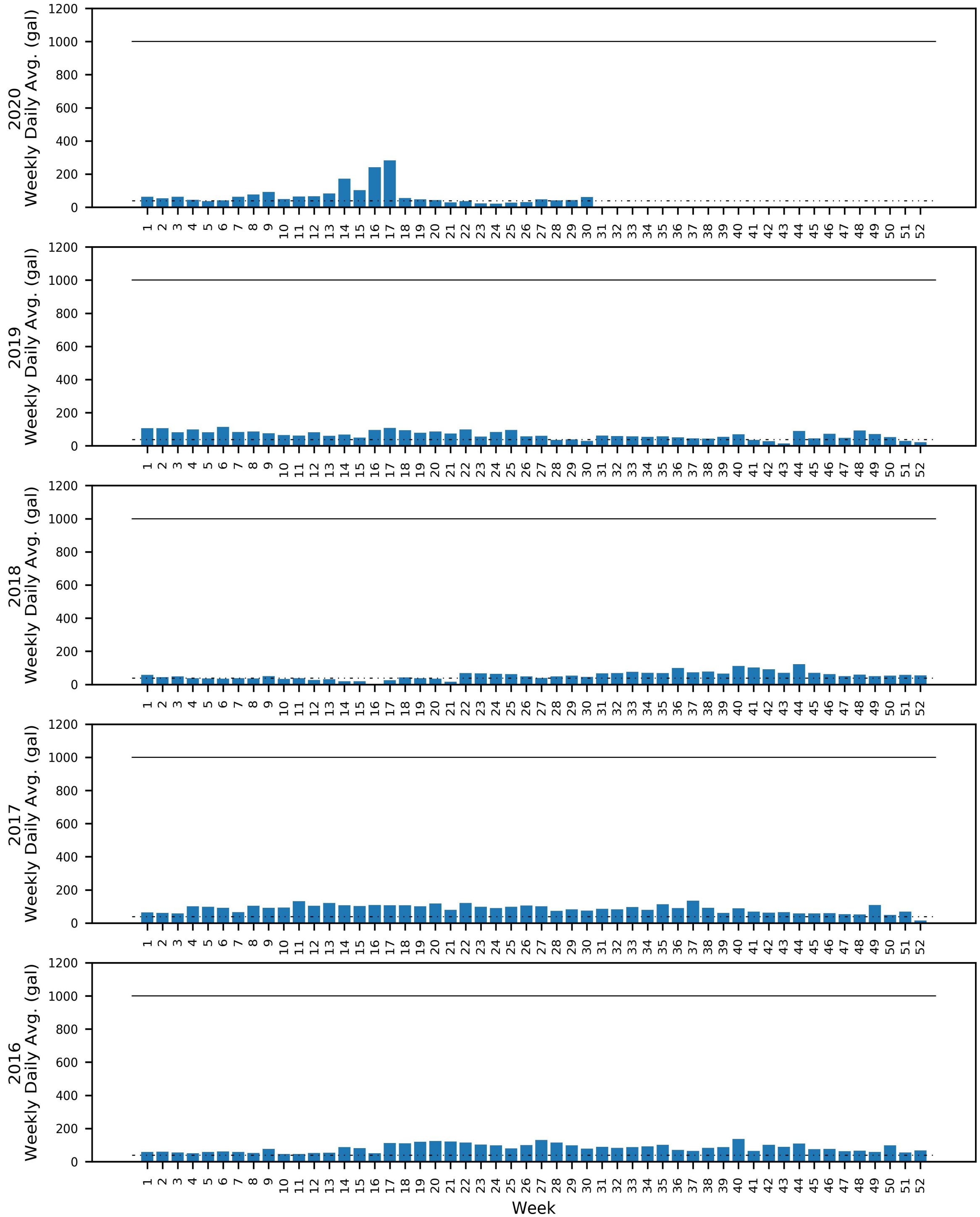
- Tier 1 ALR
- Tier 2 ALR
- Groundwater Contribution

Clean Harbors Lone Mountain

Figure 14
Weekly LDS Fluid Removed: Cell 12

Drawn By: LA CC Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR

Tier 2 ALR

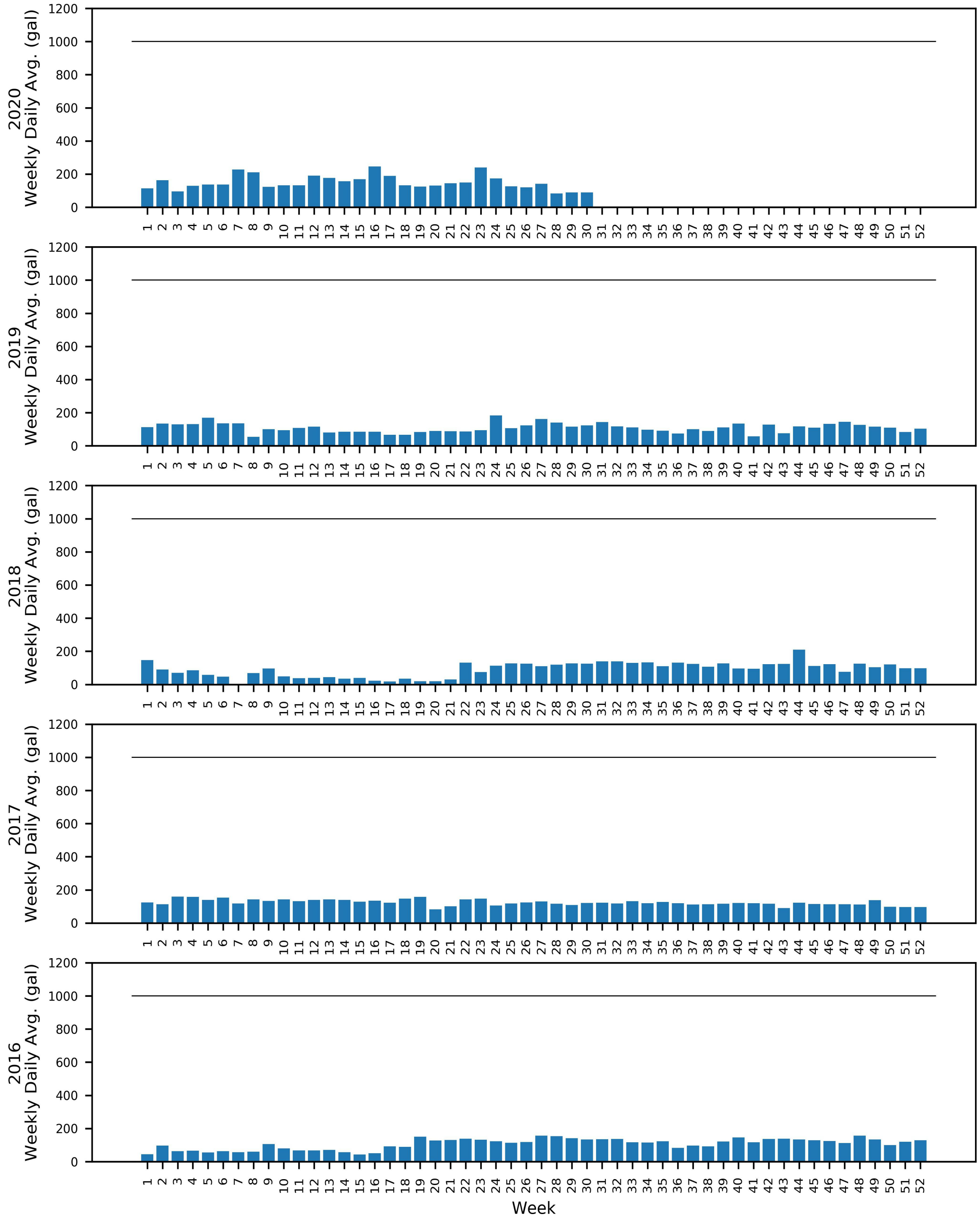
Groundwater Contribution

Clean Harbors
Lone Mountain

Figure 15
Weekly LDS Fluid Removed:
Cell 13

Drawn By: LA CC
Generator
2020-09-28

Leppert Associates



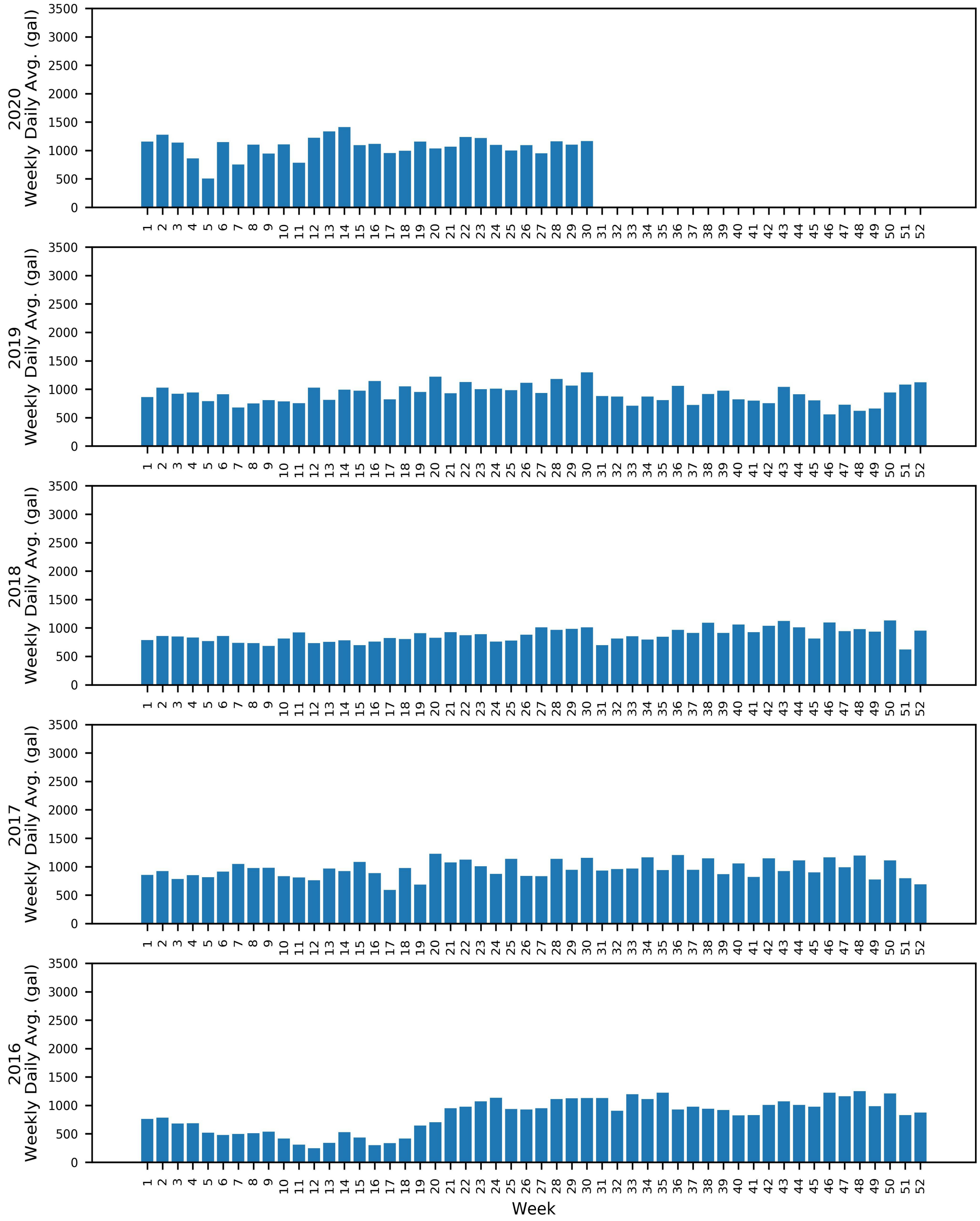
Legend

Clean Harbors Lone Mountain

Figure 16
Weekly LDS Fluid Removed: Cell 14

Drawn By: LA CC Generator
2020-09-28

Leppert Associates



Legend

Tier 1 ALR
Tier 2 ALR
Groundwater Contribution

Clean Harbors Lone Mountain

Figure 17
Weekly LDS Fluid Removed: Cell 15

Drawn By: LA CC Generator 2020-09-28

Leppert Associates

Appendix 1

FEDERAL REGISTER
LINERS AND LEAK DETECTION SYSTEMS

federal register

Wednesday
January 29, 1992

Part II

Environmental Protection Agency

40 CFR Parts 260, 264, 265, 270, and 271
Liners and Leak Detection Systems for Hazardous Waste Land Disposal Units; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 264, 265, 270, and 271

[FRL-4028-2]

RIN 2050-AA76

Liners and Leak Detection Systems for Hazardous Waste Land Disposal Units

AGENCY: Environmental Protection Agency.

ACTION: Notice of final rulemaking.

SUMMARY: The Environmental Protection Agency (EPA) is today amending its current regulations under the Resource Conservation and Recovery Act (RCRA) concerning liner and leachate collection and removal systems for hazardous waste surface impoundments, landfills, and waste piles. EPA is also adding new regulations requiring owners and operators of hazardous waste surface impoundments, waste piles, and landfills to install and operate leak detection systems at such time as these units are added, laterally expanded, or replaced. EPA is promulgating most of these regulations in response to the requirements of the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA.

EFFECTIVE DATE: July 29, 1992.

ADDRESSES: The public docket (docket reference code F-92-LLDF-FFFFF) for this rule is in room M2427, US EPA, 401 M Street SW., Washington, DC 20460, and is open from 9 am to 4 pm, Monday through Friday, excluding holidays. Call 202-260-9327 for an appointment to review docket materials. Up to 100 pages may be copied free of charge from any one regulatory docket. Additional copies are $0.15 per page.

FOR FURTHER INFORMATION CONTACT: The RCRA/Superfund Hotline at 1-800-424-9346 (toll free), or 703-920-9810 in the Washington, DC area. For information on technical aspects of this rule, contact Ken Shuster, Office of Solid Waste (OS-340), U.S. Environmental Protection Agency, 401 M St SW., Washington, DC 20460, 202-260-2214.

SUPPLEMENTARY INFORMATION: Copies of the following documents are available for purchase through the National Technical Information Services (NTIS), U.S. Department of Commerce, Springfield, VA 22161, phone 1-800-553-6847 or 703-487-4650: (1) U.S. EPA, "Compilation of Current Practices at Land Disposal Facilities", January 1992; (2) U.S. EPA, "Action Leakage Rates for Leak Detection Systems", January 1992.

Preamble Outline

I. Authority

These regulations are being promulgated under authority of sections 3004, 3005, 3006, and 3015 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6924, 6925, 6926, and 6936.

II. Background

On November 8, 1984, Congress enacted the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA), placing stringent new requirements on the land disposal of hazardous waste. Among other requirements, Congress amended section 3004 of RCRA and added section 3015 to impose specific design standards for land disposal units.

Section 3004(o)(1)(A) of RCRA, added by HSWA, requires each new landfill and surface impoundment, and each replacement and lateral expansion of a landfill and surface impoundment for which an application for a final permit determination is received after November 8, 1984, to install two or more liners (i.e., a double-liner system) and a leachate collection system above (for landfills) and between the liners. Section 3004(o)(5)(A) of RCRA requires EPA to promulgate regulations or issue technical guidance implementing the requirements of section 3004(o)(1)(A) by November 8, 1986. These HSWA requirements for double liner systems are intended to prevent the migration of hazardous constituents to ground water from land disposal units. Until the effective date of regulations promulgated under section 3004(o)(5)(A), Congress provided that an interim statutory double-liner standard in section 3004(o)(5)(B) could be used to meet the section 3004(o)(1)(A) double-liner system requirement.

Section 3004(o)(4) of RCRA requires EPA by May 8, 1987, to promulgate standards requiring new landfills, surface impoundments, waste piles, land treatment units, and underground hazardous waste tanks to use approved leak detection systems. The statute defines an "approved leak detection system" as a system or technology that EPA determines to be "capable of detecting leaks of hazardous constituents at the earliest practicable time." The term "new units" is defined as those units on which construction commences after the date of promulgation of the Agency's rule for leak detection systems. The impact of this language upon the applicability of this rule between today's promulgation and the effective date July 29, 1992 is discussed elsewhere in this preamble (See Section IV.A.).

Section 3015(a) of RCRA establishes standards for interim status waste piles. Any new waste pile, or replacement or lateral expansion of an existing waste pile at an interim status facility, must comply with requirements for liners and leachate collection systems or equivalent protection provided in regulations issued by EPA under section 3004 of RCRA before October 1, 1982, or revised under section 3004(o) of RCRA with respect to waste received beginning May 8, 1985.

Section 3015(b) of RCRA establishes standards for interim status surface impoundments and landfills. Any new unit, or replacement or lateral expansion of an existing unit at an interim status facility, is subject to the requirements promulgated under section 3004(o)(1) (relating to double-liners and leachate collection systems), with respect to waste received beginning on May 8, 1985.

The HSWA requirements described above either directly amended or directed the Agency to amend the existing RCRA liner standards for new hazardous waste landfills, surface impoundments, and waste piles issued by EPA on July 26, 1982 (47 FR 32282). On July 15, 1985, EPA issued a final rule (50 FR 28702) amending the existing liner standards by codifying the new liner standards of sections 3004(o)(1)(A), 3004(o)(5)(B), and 3015 (a) and (b) that were to become effective immediately or shortly after the enactment of HSWA, as directed by the statute.

On March 28, 1986 (51 FR 10706), under section 3004(o)(5)(A) of RCRA, EPA proposed amendments to the statutory double-liner and leachate collection system standards for surface impoundments and landfills codified in EPA's regulations on July 15, 1985. The proposal set forth two types of designs for double-liner systems. One design consisted of a geomembrane (then referred to as a flexible membrane liner (FML)) as the top liner and a composite bottom liner consisting of a geomembrane underlain by compacted soil material to minimize flow through the geomembrane component should a breach occur, and having a hydraulic conductivity of no more than 1×10^{-7} cm/sec. The other proposed double-liner design consisted of a geomembrane top liner and a bottom liner constructed to prevent migration through the liner through the post-closure period and of at least 3 feet of compacted clay or other compacted soil material with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. On April 17, 1987, EPA published a notice (52 FR 12566) requesting additional comments on certain aspects of the March 28, 1986 proposal. Specifically, EPA requested comments on data that demonstrated the advantages of a composite bottom liner versus a compacted soil material bottom liner. EPA also noticed the availability of two draft technical guidance documents for the design, construction, and operation of single- and double-liner systems and leachate collection systems. EPA solicited comments from the general public on the draft technical guidance documents.

On July 14, 1986 (51 FR 25422), EPA promulgated leak detection system requirements for underground hazardous waste tanks. In promulgating these regulations, EPA partially fulfilled its mandate under section 3004(o)(4) of RCRA to establish leak detection system requirements.

On May 29, 1987 (52 FR 20218), EPA proposed a rule establishing leak detection system requirements to fully implement section 3004(o)(4) of RCRA. The proposal specified design standards for leak detection systems for new and replacement landfills, surface impoundments, land treatment units, and waste piles, and for lateral expansions of these units at both permitted and interim status facilities. The proposal also expanded the double-liner requirements to waste piles. The proposal also included a requirement for construction quality assurance program to be implemented by owners and operators to ensure the proper construction, installation, and closure of these units. Finally, the proposal included a requirement to develop a response action plan specifying actions that would be taken in reaction to liquid flow into the leak detection system above action leakage rates proposed by the owner or operator and approved by the Regional Administrator.

Today's rule finalizes EPA's proposed actions of March 28, 1986 and May 29, 1987, and completes the Agency's statutory rulemaking responsibilities imposed by RCRA sections 3004(o)(4) and 3004(o)(5)(A). EPA has not included additional leak detection standards for permitted land treatment units in today's rule because, as explained later in today's notice, existing unsaturated zone monitoring requirements in §§ 264.278 and 265.278 for such units are sufficient to ensure the detection of leaks at the earliest practicable time.

III. Summary of Today's Rule

A. Summary of Rule

Today's rule modifies the existing double-liner and leachate collection and removal system requirements for new and replacement surface impoundments and landfills and for lateral expansions of these units, including those units at interim status facilities. New surface impoundment and landfill units for which construction commences after January 29, 1992, and replacement units reused after and lateral expansions of existing units for which construction commences after July 29, 1992 must have a double liner consisting of a top liner designed to prevent the migration of hazardous constituents into the liner during the active life and post-closure period (e.g., a geomembrane) and a composite bottom liner consisting of a geomembrane underlain by at least 3 feet of compacted soil material having a hydraulic conductivity of no more than 1×10^{-7} cm/sec. EPA is also extending the revised landfill double-liner and leachate collection and removal system requirements to new waste pile units for which construction commences after January 29, 1992, and replacement units reused after and lateral expansions of waste pile units for which construction commences after July 29, 1992.

Today's rule also requires a leak detection system for each new surface impoundment, waste pile, and landfill for which construction commences after January 29, 1992, and each replacement surface impoundment, waste pile, and landfill reused after, and each lateral expansion of these units for which construction commences after July 29, 1992. The leachate collection and removal system drainage layer immediately above the bottom composite liner at these units must be used as the leak detection system. The drainage layer functioning as the leak detection system must meet minimum design criteria and ensure that leaks are detected at the earliest practicable time. Specifically, the drainage layer bottom slope must be one percent or more. If granular material is used in the drainage layer, it must have a minimum hydraulic conductivity of 1×10^{-2} cm/sec for waste piles and landfills and 1×10^{-1} cm/sec for surface impoundments and a minimum thickness of 1 foot. If synthetic drainage material is used in the drainage layer, the drainage material must have a minimum hydraulic transmissivity of 3×10^{-5} m^2/sec for waste piles and landfills and 3×10^{-4} m^2/sec for surface impoundments. These transmissivities are equivalent to the above hydraulic conductivities and thickness specifications for granular drainage layers. EPA is requiring that each unit have a leak detection sump to collect and remove liquids, sized to prevent liquids from backing up into the drainage layer. In lieu of meeting these requirements, the owner or operator may receive a variance for an alternative leak detection system that functions in an equivalent manner.

EPA is establishing a site-specific action leakage rate that specifies a liquid flow rate detected in the leak detection system sump that warrants followup actions by the owner or operator. Owners and operators are required to develop a response action plan specifying monitoring, inspection, and corrective measures to be implemented if the action leakage rate is exceeded.

The Agency is requiring owners and operators of units affected by today's rule to develop a construction quality assurance (CQA) program for various components of surface impoundments, waste piles, and landfills. The program will be implemented through a construction quality assurance plan that the owner or operator prepares to ensure that the constructed unit meets or exceeds all design criteria, plans, and specifications.

Owners or operators of facilities applying for a permit for new surface impoundments, waste piles, and landfills must submit information on liners and leak detection system designs, the action leakage rate, the response action plan, and CQA plans as part of the permit application. For new and replacement surface impoundment, waste pile, and landfill units, and lateral expansions of existing units at permitted facilities, owners and operators must submit this information as part of a permit modification request. For affected units at interim status facilities, the owner or operator must submit proposed action leakage rates, response action plans, and a certification that construction has been completed according to the design specifications in the CQA plan to the Agency in advance of the receipt of wastes. Liner and leak detection system designs and CQA plans need not be submitted to EPA but must be maintained on site.

B. Achievement of EPA Program Goals

In developing today's rule, EPA paid careful attention to several principles that now guide its environmental programs: Pollution prevention, ground-water protection, cost-effective policies which provide protection of human health and the environment, flexibility in implementation, and fostering of an effective State-Federal partnership. Today's rule incorporates each of these principles.

The primary focus of today's rule is on pollution prevention and, more specifically, on ground-water protection. Effective liner and leak detection systems will minimize the potential for releases of hazardous constituents from hazardous waste land disposal units to underlying ground water. In this way, today's rule complements the Agency's waste minimization policies, which seek to reduce the quantities of waste produced, and the RCRA land disposal restrictions programs. Today's liner and leak detection standards contribute to pollution prevention by providing for the containment and isolation of hazardous waste after final disposal.

In today's rule, EPA has taken an important step in implementing its Ground-Water Principles, recently published in the Agency's "Protecting the Nation's Ground Water: EPA's Strategy for the 1990's (21Z-1020, July 1991). A central theme in EPA's ground-water policy, enunciated in the principles, is that prevention of ground-water contamination is often more cost effective and environmentally more desirable than remediation of ground-water after contamination. Experience in the RCRA and Superfund programs demonstrates that improperly designed landfills, surface impoundments, and waste piles can result in ground-water contamination. At the same time, remediation of contaminated ground-water has proved to be time-consuming, expensive, and in some cases technically infeasible. On the other hand, the release of hazardous constituents from landfills, surface impoundments, and waste piles can largely be eliminated through good design and construction.

Regarding costs, it should be noted that most of the standards incorporated into today's rule are already widely in use at hazardous waste facilities and are generally considered good engineering practices. Because HSWA required new landfills and surface impoundments, and lateral expansions and replacements of existing landfills and surface impoundments, for which an application for a permit is received after November 8, 1984, and those units in interim status receiving waste after May 8, 1985, to be designed with double-liner and leachate collection systems, most facilities already meet many of the design standards of today's rule. In addition, many facilities have designed units that are in compliance with today's final rule in anticipation of the promulgation of a final rule based on the March 28, 1986, and May 29, 1987 proposed rules. Thus, for a relatively small increase in cost (to those facilities that are not already meeting the standards of today's rule), the rule may save large corrective action costs. However, since all new units must comply with all the provisions of this rule and bear the corresponding costs, EPA has carefully chosen the minimum technical standards that adequately protect human health and the environment.

Although today's rule includes specific design standards, EPA has taken care to ensure that its requirements can be flexibly implemented. The presence of specific standards in the rules will simplify compliance by the regulated community, implementation by EPA and State permit writers, and enforcement by EPA and state officials. EPA, however, recognizes that national design standards may not be appropriate for every site and that technologies may improve. Therefore, today's rule allows EPA or an authorized State to approve alternative designs, as long as they achieve comparable or better levels of performance.

Similarly, today's rule requires construction quality assurance—a critical feature in land disposal unit construction—but it does so through general narrative performance standards. Thus, facility owners or operators can tailor the details of their construction quality assurance plans to the specifics of their facilities. These and similar provisions of today's rule ensure that the rule can be flexibly implemented, in a way that accommodates each regulated unit.

Finally, in today's rule EPA has paid special attention to eliminating the frequent strains resulting from the joint implementation of RCRA by EPA and the States. In proposals for this rule, EPA laid out a complicated State authorization process, which would require EPA to implement some parts of the rule for selected land disposal units and the States to implement other parts for the same units, over different timeframes. After radically simplifying the proposal, EPA is now promulgating most of the rule under HSWA, which avoids much of the confusion of joint implementation at individual units. In this way, today's rule is consistent with the Agency's attempt to simplify and rationalize Federal and State implementation of RCRA. Today's rule also requires fewer reports and mandatory Agency reviews than the proposal while still providing opportunity for Agency reviews.

IV. Detailed Discussion of the Final Rule

A. Scope of the Rule

The double liner and leak detection standards in today's final rule apply to new and replacement landfills, surface impoundments, and waste piles, and lateral expansions of these units. Today's rule applies, as it was proposed in May, 1987, to these units regardless of their permit status, including facilities that were issued permits prior to and after the enactment of HSWA and facilities that are still in interim status. In consideration of the explicit language of section 3004(o)(4) defining a new unit as a unit for which construction commences after the promulgation date of today's rule, the Agency maintains that the permit does not act as a shield with respect to the leak detection requirements under today's rule for new units. Because lateral expansions and replacement units are comparable in their environmental impact, the Agency has, as a policy matter, decided to similarly remove the permit as a shield for leak detection systems at replacement units and lateral expansions of existing units. EPA believes that the opportunity for constructing replacement units and lateral expansions of existing units to meet today's requirements is similar to that for new units. In addition, by requiring replacement units and lateral expansions at existing units to meet today's requirements, EPA is ensuring that these units meet the same minimum technological requirements and provide the same protection of human health and the environment. Therefore, the Agency is amending § 270.4 to require owners or operators to apply for a permit modification to meet the standards of today's final rule. Owners and operators at permitted facilities may not begin construction of units subject to today's requirements, until the permitting Agency has approved the owner or operator's permit modification (see § 270.42).

Today's rule exempts certain replacements of permitted surface impoundment, waste pile, and landfill units from today's double-liner and leak detection system requirements. However, EPA has modified the scope of the exemption since the May 29, 1987 proposal. Sections 264.221(f), 264.251(f), 264.301(f), 265.221(c), 265.254(a), and 265.301(c) in today's rule exempt replacements of surface impoundments, waste piles, and landfills from the double-liner system and leak detection requirements if the replacements meet the following conditions: (1) The existing unit was constructed in compliance with the design standards for double-liner and leachate collection systems in sections 3004 (o)(1)(A)(i) and (o)(5) of RCRA; and (2) there is no reason to believe that the liner system is not functioning as designed. Of course, any replacement surface impoundment, waste pile, or landfill unit that otherwise qualified for a variance from the double-liner and leachate collection system requirements pursuant to sections 3004(o)(2), 3004(o)(3), or 3005(j) of RCRA remains exempt from today's double-liner and leak detection requirements.

In the May 29, 1987 proposed rule, EPA considered exempting replacements that were constructed in compliance with existing part 264 single-liner requirements for surface impoundments, waste piles, and landfills. EPA acknowledges that the arguments for this exemption in the proposed rule were erroneous and has decided not to exempt replacements of permitted single-lined surface impoundments, waste piles, and landfills in today's final rule, because owners or operators of these units have no early method of detecting whether the single liner is leaking. Owners or operators of such units would have to rely on ground-water monitoring to determine if the single liner was leaking. EPA agrees with the commenters that this is inconsistent with the statutory goal of leak detection at the earliest practicable time and of preventing leakage out of the unit.

The May 29, 1987 proposal indicated an effective date for most of the provisions, including the leak detection requirements, of six months after promulgation. The July 29, 1992 effective date of today's rule is consistent with that proposal and with section 3010(b) of RCRA. It is important to note that section 3004(o)(4)(B)(ii) defines "new units" as those units on which construction commences after date of promulgation (versus the effective date) of the Agency's rule for leak detection systems. Therefore, due to the clear language of the statute, construction of new landfills, new surface impoundments, and new waste piles is defined with respect to the promulgation date but today's final regulations become effective 6 months after promulgation. This interpretation is consistent with the Agency's definition of "new tank systems" discussed in the final hazardous waste tank requirements (51 FR 25446).

During the six month time period between promulgation and the effective date, owners and operators of new units have time to determine and then make any necessary adjustments to their designs, contract specifications, and other pre-construction plans so that the requirements of today's rule are satisfied by the effective date. This also allows adequate time, in the Agency's opinion, for preparation and submission to the Agency of documents and requests for approvals that are prerequisites to construction and operation. For permitted facilities, this includes permit modification requests. Similarly, any interim status facility that adds a new unit following the promulgation date is expected to comply with the requirements in today's rule to submit, along with their notification under §§ 265.221(b), 265.254(a), or 265.301(b), proposed action leakage rates and a response action plan, if the due date for that notification (i.e., at least 60 days prior to receipt of waste in the new unit) falls before the effective date.

Thus, the Agency anticipates that at the few facilities (both permitted and interim status) that plan to develop new units during this six month period, most of the effort will be the preparatory design and administrative work needed to comply by the effective date. If owners or operators at interim status facilities should commence construction of new units during this period, the construction would be subject to Agency review upon the effective date of today's requirements.

Replacement landfills, surface impoundment, or waste piles, or lateral expansions to those units are, in the absence of specific statutory direction, subject to this rule after July 29, 1992 (i.e., six months after promulgation as normally provided under section 3010(b) of RCRA).

It should be noted that EPA interprets the term "construction commences," as used in the "new unit" definition of section 3004(o)(4)(B)(ii) and in today's rule, according to its definition within the § 260.10 definitions of "existing hazardous waste management (HWM) facility" and "existing tank system." That is, a unit has commenced construction if (1) the owner or operator has obtained the Federal, State and local approvals or permits necessary to begin physical construction, and either (2)(i) a continuous on-site, physical construction program has begun; or (ii) the owner or operator has entered into a contractual obligation—which cannot be canceled or modified without substantial loss—for physical construction of the facility to be completed within a reasonable time. Therefore, any new unit that has commenced construction, according to this long-standing Agency definition of the term, prior to the promulgation date (i.e., today's Federal Register publication date) is outside the scope of today's rule. Similarly, any replacement unit that is reused (unlike new units and lateral expansions, construction is not a necessary step prior to reuse of a replacement unit) or lateral expansion on which construction commences prior to the effective date (i.e., six months after today's Federal Register publication date) of this rule is also beyond the scope of today's rule.

Today's rule includes a definition of "replacement unit" in § 260.10. EPA is today defining a replacement unit as a unit (1) from which all or substantially all of the waste is removed, and (2) that is subsequently reused after July 29, 1992 to treat, store, or dispose of hazardous waste. This definition, which is similar to the May 29, 1987, proposal, is consistent with the definition EPA has used in implementing the statutory liner requirements of section 3004(o)(5)(B) for replacement units.

In the 1987 proposal, EPA excluded from the definition of replacement units those units from which waste was removed and treated in preparation for closure and only the treated waste was replaced in the unit. EPA explained in the proposal that replacement units are units that remain in service for active waste management, not units that are permanently taken out of service through closure. EPA believed this approach not only reflected statutory intent, but also would encourage (or at least not discourage) environmentally beneficial activities during closure (e.g., waste treatment), because owners or operators would not have to retrofit closing units from which waste was removed and replaced.

Today's definition of "replacement unit," like the proposal, exempts certain units undergoing closure. However, the exemption is slightly expanded in that today's definition of replacement unit would also exempt those closing units that receive compatible wastes from other closing units and/or corrective action areas at the facility, provided that such use of the closing unit is approved by EPA (or an authorized state) in the facility's closure plan or corrective action program. The Agency believes that the expanded exemption is a logical extension of the proposal since it is similarly necessary to encourage environmentally beneficial activities (e.g., treatment and consolidation of compatible wastes from on-site closing units into one unit, waste removal to inspect a liner, expeditious closure of other on-site units) that may not otherwise occur if the owner or operator had to retrofit the closing unit to meet today's liner and leak detection system requirements.

Thus, units and activities qualifying for exemption from the "replacement unit" definition are limited to the following conditions and safeguards: (1) The activity must be reviewed and approved by EPA or an authorized state as part of the closure plan or corrective action approval process, including a corrective action order; (2) only closing units that have notified EPA in accordance with § 264.113 or § 265.112 or notified an authorized State, may qualify; and (3) only compatible waste and debris that are from closing units or corrective action areas on-site may be deposited in these units. For a unit to qualify for this exemption, off-site waste, new waste generated on site, and waste from active units on site may not be disposed of in the unit.

The situations EPA envisions as qualifying for this exemption from the "replacement unit" definition include: (1) Waste is removed from a closing unit, treated (e.g., incinerated, dewatered, or solidified), and returned to the same unit; (2) waste is removed from a closing unit to inspect and/or repair the liner, and the waste is returned to the same unit; (3) scenario 1 or 2, plus waste from other closing units is disposed in the original unit; and (4) scenario 1 or 2, plus waste that is the result of corrective action at the same facility, is placed into the original unit.

Finally, EPA also proposed in the May 29, 1987, rule that the liner and leak detection system requirements apply to significant unused portions of existing units, where those portions did not have double liners and leachate collection systems meeting the minimum technological requirements. Today's rule has dropped this requirement. A number of commenters on the proposal pointed out the difficulty of defining "significant" unused portions of a unit, and EPA was unable to develop an unambiguous definition. Furthermore, after reviewing land disposal units constructed and permitted since 1984 (which is the universe most likely to have portions of units not yet covered by wastes), EPA noted that virtually all of these units were required in their permits to incorporate double liner and leak detection requirements into their respective designs. Therefore, EPA has concluded that it is no longer necessary to extend today's rule to significant unused portions of existing units. It should be noted, however, that lateral expansions of existing units remain subject to today's rule.

B. Standards for Liners and Leak Detection Systems

1. Technical Standards for Liner Systems

Today, EPA is promulgating regulations containing design standards for double liners in accordance with the requirements of section 3004(o)(1) and (o)(5)(A) of RCRA. These standards replace those contained in the interim statutory design provision of section 3004(o)(5)(B) of RCRA that were codified on July 15, 1985 (50 FR 28702).

Today's rule amends the double-liner requirements for surface impoundments and landfills in §§ 264.221(c), 264.301(c), 265.221(a), and 265.301(a). The major change from the existing rule is that the final rule requires owners or operators to install a composite bottom liner. Based on available data and public comments received by the Agency, the double liner system specified in today's rule, with the composite bottom liner, represents the best available technology with respect to: (1) Preventing hazardous constituent migration out of the unit during the active life and post-closure care period, (2) detecting leaks through the top liner at the earliest practicable time, and (3) maximizing the efficiency of the leachate collection and removal system.

Today's rule does not change the existing top liner performance standard for surface impoundment and landfill units. Owners or operators of affected units must still design the top liner to prevent the migration of hazardous constituents into the liner throughout the active life and post-closure period. EPA notes that for purposes of today's rule, the top liner is the liner directly above the leachate collection and removal system serving as the leak detection system (see Technical Standard for Leak Detection Systems in Section IV.B.2 of today's preamble).

The Agency, in the preambles to the July 26, 1982 rule (47 FR 32274) and the March 28, 1986 proposal (51 FR 10709), endorsed geomembranes as meeting the top liner performance standard. EPA was aware of a number of landfill unit designs that included a composite top liner consisting of a geomembrane upper component and a compacted soil or a soil/bentonite blanket lower component. Consequently, EPA raised several questions in the preamble to the May 29, 1987 proposal concerning the use of a composite liner as a top liner and the effect the compacted soil component would have on other components of the double liner system, principally the early detection of a leak through the upper geomembrane.

The Agency received several comments on this issue, all of which were in favor of allowing the use of a composite liner as a top liner. One comment on appropriate standards for a composite liner favored minimum thickness requirements for a compacted soil lower component. Most commenters, however, favored no restrictions on the use of top composite liners.

In response to these comments, EPA is not prohibiting the use of composite top liners in today's rule. A parenthetical reference to geomembranes has been included as an example to illustrate that the performance standard can be met through use of a geomembrane. EPA does not intend that this reference be interpreted to mean that the geomembrane is the only top liner design that will meet the performance standard. EPA does not want to discourage owners or operators from using top composite liners because such liners can provide additional environmental benefits by minimizing the flow rate through a leak in a geomembrane liner and potentially minimizing migration of hazardous constituents by attenuation. Although not specified in today's rule, EPA maintains that the soil component of the top liner, however, should generally not be more than three feet thick since a thickness of 2 to 3 feet adequately serves the purpose of minimizing the flow through the geomembrane component (a lesser thickness may be appropriate for soil/bentonite blankets). EPA finds that this depth balances the increased environmental protection afforded by top composite liners and the ability to detect leaks at the earliest practicable time. The Agency does not intend, however, to imply that multiple liner systems (including multiple composite liners) or that thicker soil components of bottom liners (e.g., 4 or 5 feet) should be precluded.

EPA notes that such general performance standards provide flexibility which is essential since liner and leak detection system technologies have advanced significantly over the past several years and are continuing to do so. Some examples include the use of geonets, the use of geotextile fabric filters, and better seaming and construction quality assurance. Recent EPA studies show soil/bentonite blankets may be effective and reliable complements to top liners, resulting in a new type of composite top liner. As technologies improve, today's performance standards will allow different materials and designs to be used and specified in permits as site-specific considerations.

Today's rule amends the requirements for bottom liners at surface impoundment and landfill units to require owners and operators of units subject to today's rule to use a composite bottom liner instead of a compacted-soil bottom liner allowed by the interim statutory design. The composite bottom liner required by today's rule specifies that the upper component of the bottom-liner must consist of a geomembrane, and the lower component of the bottom-liner must consist of a minimum of 3 feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. The compacted soil component must be able to minimize hazardous constituent migration in the event of a breach in the geomembrane.

In the March 28, 1986 proposal, EPA offered two options for the bottom liner of the double-liner system. One option corresponded to a compacted soil liner with a maximum hydraulic conductivity of 1×10^{-7} cm/sec and sufficient thickness (minimum 3 feet) to prevent hazardous constituent migration through the liner during the active life and post-closure care period (51 FR 10710). The other proposed option was the composite liner specified in today's rule, consisting of a top component that would prevent hazardous constituent migration into the top component (a geomembrane) and a bottom compacted-soil component with a maximum hydraulic conductivity of 1×10^{-7} cm/sec and the preamble to the proposal recommended a minimum thickness of 3 feet (90 cm).

EPA received comments supporting both bottom liner options. Several commenters argued that the compacted soil bottom liner, coupled with the leachate collection and removal system between the top and bottom liners, would provide adequate protection of the environment. Some of these commenters also proposed the use of a composite top liner with a compacted soil bottom liner. Others supported the use of composite bottom liners as the design best able to enhance leachate detection, collection, and removal efficiency of the leachate collection and removal system between the liners. Several commenters favored the promulgation of performance standards in the rule and the specification of designs and materials in accompanying guidance documents.

After the proposal, EPA compiled information and data on performance of these two bottom liner systems with respect to maximizing leachate detection, collection, and removal, and preventing hazardous constituent migration out of the unit. The liners were evaluated based on leachate collection efficiency, leak detection capability, and leakage through the bottom liner. Results from computer simulations and engineering calculations showed that, on a comparative basis, the composite bottom liner will perform significantly better than the compacted soil liner with respect to the three criteria. The results were summarized in the April 17, 1987 Notice of Availability of Information (52 FR 12566–12575), with more detailed discussion of the calculations and analytical approach contained in the "Bottom Liner Performance in Double-Lined Landfills and Surface Impoundments" (EPA/530-SW-87-013). In the May 29, 1987 proposed rule on leak detection systems, the Agency indicated that it was likely to finalize a rule on double liners that would require a composite bottom liner as the generally applicable standard (52 FR 20251).

EPA also conducted a review of applications submitted for RCRA hazardous waste facility permits between November 8, 1984 and February 1987 to determine the type of bottom liner selected for installation at new landfills and surface impoundments. Of some 183 units for which permit applications were submitted as of February 1987, only seven units were to be constructed with compacted soil bottom liners. The vast majority of owners or operators selected the composite bottom liner rather than a compacted soil bottom-liner. More recent data available to EPA also confirms that the majority of owners and operators are using composite bottom-liners in their designs of hazardous waste surface impoundment and landfill units (Supporting Document #3 "Compilation of Current Practices of Land Disposal Facilities," 1992).

In summary, today's rule requires composite bottom liners, based on: (1) Available information that composite bottom-liners perform significantly better than compacted soil liners in terms of maximizing leachate detection, collection, and removal, and preventing hazardous constituent migration out of the unit; and (2) evaluation of current hazardous waste industry practices.

Consistent with existing requirements for single liners at surface impoundments and landfills, today's rule in §§ 264.221(c)(1)(ii), 264.301(c)(1)(ii), 265.221(a), and 265.301(a) requires that each liner that is included in the unit's design must be chemically resistant to the waste, placed on a structurally stable foundation, and large enough to cover all areas likely to be exposed to the waste.

Double liner systems must be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including status head and external hydrogeologic forces), physical contact with the waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation. The liners must be placed upon materials capable of providing support to the liners and resistance to pressure gradients above and below the liners to prevent failure of the liners due to settlement, compression, or uplift. They must also be installed to cover all surrounding earth likely to be in contact with the waste or leachate.

2. Technical Standards for Leak Detection Systems

EPA is today establishing design standards for the leak detection systems for new landfills, surface impoundments, and waste piles, and replacements and lateral expansions of these units (§§ 264.221(c)(2), 264.251(c)(3), 264.301(c)(3), 265.221(a), 265.254(a), and 265.301(a)). These leak detection standards are designed to detect a leak through the top liner at the earliest of practicable time. Today's final rule also establishes the following design criteria for leak detection system drainage layers for affected landfills, surface impoundments, and waste piles: (1) A minimum bottom slope of 1 percent; (2) a minimum thickness of 1 foot and a minimum hydraulic conductivity of 1×10^{-2} cm/sec for granular materials used for the drainage layer for waste piles and landfills and 1×10^{-1} cm/sec for granular materials used in surface impoundments; (3) a minimum hydraulic transmissivity of 3×10^{-5} m²/sec for synthetic materials used in drainage layers for waste piles and landfills and 3×10^{-4} m²/sec for synthetic drainage materials used in surface impoundments; and (4) sump design and operating requirements.

Location of leak detection systems. EPA proposed in the May 29, 1987 preamble (52 FR 20229) that the leachate collection and removal system adjacent to and below the top liner and above the bottom liner be designated as the leak detection system, but requested comments on the proper location of the leak detection system in a system with more than two [illegible] commenters on this aspect of the [illegible] stated that the leak detection syst[illegible] should be located immediately above [illegible] bottom liner. These comments [illegible] that specifying additional leachate [illegible] and removal systems abo[illegible] bottom liner as leak detection system [illegible] could create a regulatory disincenti[illegible] owners and operators to design systems with more than two liners by requiring these additional (intermediate) leachate collection and removal systems to meet the requirements for leak detection systems and to implement response actions in accordance with the unit's response action plan. As a result of these comments, EPA is today specifying that the leak detection system is the leachate collection and removal system drainage layer located immediately above the bottom composite liner. Under today's final rule, any additional leachate collection and removal systems located above the leak detection system are not required to meet the design and performance standards for leak detection systems.

Leak detection time. The design standards being promulgated today for leak detection systems will ensure that these systems meet the requirement in section 3004(o)(4) of RCRA for the detection of leaks of hazardous constituents at the "earliest practicable time". EPA has interpreted the term "earliest practicable time" to be the time lapse from the time a liquid has passed through a breach in the top liner to the time a technology-based leak detection system can detect the liquid, assuming saturated, steady-state flow. Without these simplifying assumptions, modelling flow rates in the leak detection system is difficult given the complexity and uncertainty of fluid flow under unsaturated conditions. After careful consideration of public comments on the proposal, EPA has decided not to specify 1 day (i.e., 24 hours) as the earliest practicable time for the detection of a leak through the top liner.

Commenters on the proposed 1-day leak detection time requirement argued that it was unnecessary and overly restrictive. Another commenter stated that the detection time could not be verified by field measurements. EPA agrees with the commenters that the proposed 1-day leak detection time requirement is unnecessary given that the Agency is promulgating minimum design specifications for leak detection systems. In addition, the Agency acknowledges that field measurement of leak detection times is a problem. EPA has determined that a leak detection system meeting today's design requirements will be capable of detecting leaks "at the earliest practicable time" consistent with the statutory mandate. Therefore, EPA is simplifying the rule by deleting the 1-day performance standard.

Leak detection sensitivity. EPA is also not finalizing the proposed leak detection sensitivity value of 1 gallon per acre per day (gpad) that was proposed. When developing a leak detection sensitivity performance standard for the May 29, 1987 proposed rule, EPA conducted comparative studies between the performance of composite bottom liners versus compacted soil bottom liners (Background Document "Bottom Liner Performance in Double-Lined Landfills and Surface Impoundments", 1987). These studies showed that composite bottom liners have a much more sensitive leak detection capability than do compacted soil-only bottom liners. For example, a compacted soil liner with a hydraulic conductivity of 1×10^{-7} cm/sec will allow some liquid migration into the liner; as a result, a simple, one-dimensional theoretical model predicts that a leak will not be detected until the flowrate through the top liner is approximately 80 gpad. In contrast, simple, one-dimensional theoretical models predict that the leak detection sensitivities of landfills and surface impoundments with composite bottom liners similar to those required in today's rule range from 0.001 to 0.1 gpad. Because EPA is today stipulating the use of a composite bottom liner, the Agency is confident that lower leak detection sensitivities will be achieved for all units affected by today's rule. Consequently, a separate requirement for leak detection sensitivity is no longer necessary and EPA has dropped this requirement from the final rule.

Slope. EPA is today finalizing a minimum slope requirement for the leak detection system. After further consideration of the slope requirement, the Agency has determined that a minimum 1 percent slope will provide adequate drainage at land disposal units at which proper construction quality assurance is used to minimize settlement (§§ 264.221(c)(2)(i), 264.251(c)(3)(i), 264.301(c)(3)(i), 265.221(a), 265.254(a), and 265.301(a)). The purpose of the requirement is to promote good drainage in the leak detection systems of units affected by today's rule. This slope requirement applies to all planar components of the leak detection system.

In the May 29, 1987 proposed rule, EPA proposed a 2-percent minimum slope but requested comments on whether the minimum bottom slope should be increased to a value between 2 and 4 percent. One commenter preferred that a 3-percent bottom slope be used to account for settlement in the final slope value. However, most commenters argued that the minimum should not be above 2 percent, expressing opposition to raising the minimum slope value above 2 percent. Many of these commenters pointed out that other improvements included in the proposed rules, such as construction quality assurance and an increased transmissivity value for synthetic drainage materials, would obviate the need for a slope greater than two percent. One commenter argued that slopes of less than 2 percent should be allowed for certain circumstances provided that the leak detection system meets other minimum design criteria and performance goals and the owner or operator can demonstrate that post-construction settlement/consolidation will be minimized or eliminated. The Agency agrees that with good CQA a lesser slope can be adequate.

Based on these comments, EPA carefully evaluated the minimum bottom slope requirement for today's rule. EPA recognizes that slope is one of several factors that will affect the performance of the leak detection system. For example, the hydraulic conductivity of materials used in the drainage system is important. In addition, the appropriate minimum slope required will also depend on the spacing of leachate collection laterals in the leak detection system; closer spacing will allow for a flatter slope. All of these design factors should be considered in selecting the appropriate slope for the system.

EPA agrees with commenters that today's rule sets in place improvements that affect the minimum slope that is needed to construct an effective leak detection system. First, the new requirement to install a composite bottom liner provides a smooth impermeable base on which to install the leak detection system. The decreased permeability of the composite bottom liner over that of a soil liner required under previous regulations allows for a reduced slope while at the same time continuing to promote good drainage. Second, today's enhanced construction quality assurance requirements enable owners or operators the flexibility to build a flatter slope by maintaining consistent drainage without significant ponding of liquids. In addition, some of the new, rapidly draining synthetic draining materials promote more rapid drainage on flatter slopes.

Because of these improvements, EPA believes that minimum bottom slopes of less than 2 percent should be allowed where the owner or operator uses proper construction quality assurance to minimize settlement and resultant ponding of any leachate, as required by §§ 264.19 and 265.19 of today's rule. Such construction quality assurance should include surveying and other inspection techniques to measure the horizontal and vertical alignment of the bottom slope to minimize ponding and ensure leachate flow to the sump. Some owners or operators may elect to design leak detection systems using bottom slopes of greater than 1 percent. EPA emphasizes that the requirements promulgated today are minimum technical standards; owners and operators can always adopt more stringent designs at their discretion.

Thickness of granular drainage layer. Today's rule also requires that a granular drainage layer be a minimum of 12 inches in thickness for use in leak detection systems of new and replacement landfills, surface impoundments, and waste piles, and for lateral expansions of these units (§§ 264.221(c)(2)(ii), 264.251(c)(3)(ii), 264.301(c)(3)(ii), 265.221(a), 265.254(a), and 265.301(a)). EPA received no comments on this requirement in the May 29, 1987 proposed rule, and therefore is finalizing the 12-inch thickness requirement as proposed. The purpose of this minimum thickness is to decrease the chance that the underlying geomembrane will be damaged by equipment during placement of the drainage material. Current equipment used to install granular layers can only place drainage material to an accuracy of a few inches. The Agency is concerned that if granular drainage layers are designed to less than 12 inches, this equipment could damage underlying liners in areas where the drainage material is thin.

Further, this requirement for granular layer thickness is consistent with current EPA policy. A 12-inch granular layer thickness is specified in current Agency guidance (Background Document "Draft Minimum Technology Guidance Document on Double Liner Systems", 1985). In addition, a recent EPA evaluation of existing hazardous waste land disposal units (Background Document "Compilation of Current Practices at Land Disposal Units", January 1992) showed that 24 out of 28 landfills, surface impoundments, and waste piles with granular drainage layers, had a specified thickness of 12 inches.

Hydraulic conductivity of granular drainage materials. EPA proposed to require that granular materials used in leak detection systems have a minimum hydraulic conductivity of 1 cm/sec. The Agency contended that greater permeability afforded by granular materials having 1 cm/sec hydraulic conductivity was necessary to minimize capillary tensions present in leak detection system granular materials and to satisfy the proposed leak detection time performance standard of 1 day.

EPA requested and received comments on the proposed hydraulic conductivity requirement. Commenters opposed the 1 cm/sec requirement for several reasons. Several commenters stated that the requirement would force them to use rounded gravels or other granular materials meeting the hydraulic conductivity value. These commenters maintained that such materials were either not available or only available at significantly higher costs in many areas of the country. One commenter suggested that EPA should provide a variance to owners or operators in areas where suitable granular drainage materials having the proposed hydraulic conductivity are unavailable. Another commenter stated that the Agency should continue to require granular materials to have minimum hydraulic conductivities of 1×10^{-2} cm/sec as currently specified in EPA guidance. This commenter asserted that sand, which is the most common granular material used in leak detection systems, generally has a hydraulic conductivity of 1×10^{-2} cm/sec. Other commenters argued that using granular materials with hydraulic conductivities on the order of 1 cm/sec would significantly increase the susceptibility of geomembranes (above and below the drainage layer) to puncture, because it would be difficult to remove angular materials from the materials used to construct the drainage layer. Another commenter argued that by requiring granular materials to have a 1 cm/sec hydraulic conductivity, EPA was forcing owners or operators to use synthetic drainage materials that are incompatible with many materials used for synthetic liners.

The Agency acknowledges that the availability of granular materials meeting the proposed hydraulic conductivity requirement may be limited. The Agency is also concerned with the greater potential for geomembranes to be damaged from the use of granular materials having hydraulic conductivities of 1 cm/sec. In response to the commenters concerns, the final rule (§§ 264.221(c)(2)(ii), 264.251(c)(3)(ii), 264.301(c)(3)(ii), 265.221(a), 265.254(a), and 265.301(a)) requires that granular materials used in leak detection systems at waste pile and landfill units subject to today's rule have a minimum hydraulic conductivity of 1×10^{-2} cm/sec consistent with current Agency guidance. However, the final rule specifies that granular materials used in leak detection systems at surface impoundments subject to today's rule must have a minimum hydraulic conductivity of 1×10^{-1} cm/sec.

The Agency has determined that granular materials used in leak detection systems at surface impoundments must have a higher hydraulic conductivity (one order of magnitude greater than what is currently specified by Agency guidance) to account for the potentially greater hydraulic heads imposed on the top liner in surface impoundments. Surface impoundments are typically used to manage liquids, therefore the hydraulic heads on the liner systems of these units are often much higher than those in waste piles and landfills, which are not allowed to manage wastes containing free liquids and must have a leachate collection system above the top liner. Consequently, if a leak occurs in the top liner of a surface impoundment, and is not rapidly drained to the detection sump, areas of the bottom-liner system will potentially be subjected to hydraulic heads in excess of one foot, increasing the probability of migration of hazardous constituents out of the unit. A greater permeability in the leak detection system will drain any leak more rapidly and thus reduce the head on the bottom liner system. Although granular materials having hydraulic conductivities of 1×10^{-1} cm/sec will typically be coarser sands and fine gravels, the Agency feels that two common construction techniques can be used in combination to prevent any damage to geomembranes adjacent to the drainage materials. First, facilities may select rounded drainage materials; these materials are less likely to puncture or otherwise damage geomembranes. Second, owners or operators may use additional layers of synthetic materials (e.g., a needle-punched nonwoven geotextile) next to the liner to provide a cushion for the drainage materials and reduce the probability of puncturing. In addition, today's construction quality assurance requirements help to ensure against such punctures.

The Agency's recent evaluation of current industrial practices (see "Compilation of Current Practices at Land Disposal Facilities", January 1992) revealed that many facilities are selecting synthetic drainage materials, such as geonets, for their leak detection systems. Synthetic drainage materials are often selected instead of granular materials because they typically require less space and are easier to install than granular materials. Also, as discussed below, virtually all synthetic drainage materials have permeabilities greater than 10^{-1} cm/sec.

Transmissivity of synthetic drainage materials. EPA proposed a minimum transmissivity value of 5×10^{-4} m^2/sec for synthetic drainage materials that are used in lieu of granular drainage materials. This value was selected because it provides equivalent drainage capacity to that of a granular drainage layer meeting the requirements of the proposed rule; that is, 12 inches of a granular drainage layer with a hydraulic conductivity of 1 cm/sec. The minimum value of 5×10^{-4} m^2/s for hydraulic transmissivity was based on numerical simulations of typical leak detection systems. In these simulations, EPA considered a range of synthetic drainage materials, including nets, mats, and waffles. From the results of these simulations ("Liner and Leak Detection Rule Background Document", 1987), EPA concluded that a hydraulic transmissivity value of 5×10^{-4} m^2/sec would enable the leak detection system to collect and remove relatively large amounts of leakage while maintaining gravity flow conditions. This specification was to ensure that the liquids in the leak detection system would be rapidly collected while the hydraulic head on the bottom liner would be minimized.

One commenter objected to the transmissivity standard, claiming that a value of 5×10^{-4} m^2/sec is not achievable with a single layer of currently available netting, and that performance may be worse when creep, loading, and rib layover come into effect. EPA disagrees. The Agency has data (Liner and Leak Detection Rule Background Document, 1987) showing transmissivities of single layers of synthetic drainage materials produced by four major manufacturers under the conditions of ASTM Test Method D 4716–87 (that is, a pressure of 100 kilopascals (kPa) and a hydraulic gradient between 0.1 and 0.25). At the time of the proposal, these transmissivities ranged from approximately 2×10^{-4} m^2/sec to 4×10^{-4} m^2/sec. Improvements in geonets since then have resulted in typical transmissivities of 2×10^{-3} to 4×10^{-3} m^2/sec using the same ASTM test method. The Agency maintains that the conditions at which ASTM D 4716–87 is conducted are representative of the pressures and hydraulic gradients in many land disposal units, and as a result, a transmissivity value of 5×10^{-4} m^2/sec can be obtained with typical commercially available synthetic drainage materials. However, the Agency recognizes that the requirements for synthetic drainage materials should be consistent with the requirements for granular drainage systems in leak detection systems. Thus, the Agency has revised the transmissivity requirements in today's rule (§§ 264.221(c)(2)(ii), 264.251(c)(3)(ii), 264.301(c)(3)(ii), 265.221(a), 265.254(a), and 265.301(a)) to require that synthetic drainage materials achieve equivalent flow rates to drainage layers utilizing granular materials.

Other performance requirements. Today's final rule also includes several general performance standard requirements for leak detection systems that are simply restatements of what is already required in existing regulations for leachate collection and removal systems at surface impoundments, waste piles, and landfills subject to today's final rule. Under today's rule, leak detection systems for affected units must be constructed of materials that are chemically resistant to wastes and leachate in the unit, and be of sufficient strength to resist pressure gradients generated within the unit (§§ 264.221(c)(2)(iii), 264.251(c)(3)(iii), 264.301(c)(3)(iii), 265.221(a), 265.254(a), and 265.301(a)). These requirements are designed to ensure that leak detection systems are not damaged from chemical and physical stresses associated with the unit. Also, these requirements are simply an extension of the performance standards for liners.

Leak detection systems for units regulated under today's rule must also be designed and operated to minimize clogging during the active life and post-closure period (§§ 264.221(c)(2)(iv), 264.251(c)(3)(iv), 264.301(c)(3)(iv), 265.221(a), 265.254(a), and 265.301(a)). This requirement is to ensure that drainage in leak detection systems is not impeded over time. EPA is concerned about the potential for drainage layers to become clogged as a result of physical, chemical, or biological mechanisms. EPA data indicate that the potential for clogging increases as the hydraulic conductivity of drainage material decreases. Examples of techniques to minimize clogging include: Using properly graded granular filter materials, filter fabrics (geotextiles), or other filter materials to reduce fines; using poorly graded (i.e., uniform) granular drainage material; increasing collection pipe slot numbers or size; reducing liquid residence time by increasing slope, decreasing pipe spacing, or increasing the size of granular drainage material; and cleaning collection system pipes and drainage media using hydraulic jetting, steam, or acidic solutions.

In addition, today's rule requires that leachate collection and removal systems immediately above the top liner (for landfill and waste pile units) be capable of ensuring that the leachate depth over the top liner does not exceed 1 foot (30 cm) as proposed in the March 28, 1986 proposed rule. EPA received no comments on these requirements and is therefore finalizing them as proposed.

EPA is today also promulgating several requirements for sumps that are part of a leak detection system. Owners or operators of new and replacement landfills, surface impoundments, waste piles, and lateral expansions of such units must use sumps of sufficient size to collect and remove liquids efficiently and prevent these liquids from accumulating on the drainage layer. In addition, the design of the sump and removal system must provide a method for measuring and recording the volume of liquids present in the sump and of liquids removed. EPA received no comments on these requirements and is therefore finalizing them as proposed (§§ 264.221(c)(2)(v), 264.251(c)(3)(v), 264.301(c)(3)(v), 265.221(a), 265.254(a), and 265.301(a)).

EPA is today promulgating a requirement for owners or operators of units affected by today's rule to collect and remove pumpable liquids in leak detection sumps to minimize the head on the bottom liner (§§ 264.221(c)(3), 264.251(c)(4), 264.301(c)(4), 265.221(a), 265.254(a), and 265.301(a)). The Agency had proposed, in the May 29, 1987

Federal Register, that the head in the sump for the leak detection sump be minimized; in the preamble, the Agency suggested that the average liquid levels in the sump should be below 12 inches. One commenter on the proposed rule stated that the 12-inch maximum was unachievable in many instances because of the size and geometry of most sumps and the pumps used to empty them. The commenter also mentioned that automated level control systems and minimum submergence requirements make the 12-inch maximum level an impossible performance standard. EPA agrees that the geometry of sumps may vary and that minimum pumping levels may be greater than 1 foot. Thus, the Agency is not setting a maximum level of liquids in the sump, but specifying only that the head on the bottom liner must be minimized by requiring owners and operators to remove pumpable liquids from the sump. "Pumpable liquids" means any amount of liquids that can be reasonably pumped out of the sump, based on sump dimensions, pump operating levels for automated pump systems, and the goals of minimizing head in the sump and backup of liquids (from the sump and drainage tile or pipes) into the drainage layer.

Today's rule also modifies the definition of the term "sump" in § 260.10 to redefine sumps used as part of leak detection systems for waste piles, surface impoundments, and landfills. The purpose of this modification is to make clear that the regulations for hazardous waste tanks that are otherwise applicable to certain sumps do not apply to those sumps used at land disposal units that function as part of the leak detection system. These sumps serve fundamentally different purposes than many other types of sumps. Sumps used at land disposal units are usually surrounded by one or more liners; therefore, many requirements, especially secondary containment, are not practicable for these units. The Agency maintains that subjecting these units to the requirements for hazardous waste tanks will not provide a substantial environmental benefit and has therefore modified the definition of the term sump to redefine sumps used as part of leachate collection and removal or leak detection systems for surface impoundments, waste piles, and landfills.

Finally, today's rule includes a requirement applicable only to those leak detection systems installed at new, replacement, or lateral expansions of landfills, surface impoundments, and waste piles that are not located above the seasonal high water table. EPA received no comments on this requirement and is finalizing it as proposed. The Agency is therefore requiring in today's rule that owners or operators of leak detection systems not located completely above the seasonal high water table demonstrate that the operation of the leak detection system will not be adversely affected by the presence of ground water (§§ 264.221(c)(4), 264.251(c)(5), 264.301(c)(5), 265.221(a), 265.254(a), and 265.301(a)).

3. Alternative Systems

Alternative designs. The existing rules (§§ 264.221(d), 264.251(b), 264.301(d), 265.221(c), and 265.301(c)) already provide for alternative designs to the liners and leachate collection and removal systems if an owner or operator can demonstrate that an alternative design will prevent the migration of any hazardous constituent into the ground water or surface water at least as effectively as the requirements in §§ 264.221(c), 264.251(a), and 264.301(c), as appropriate. Today's rule adds §§ 264.221(d), 264.251(d), 264.301(d), 265.221(a), 265.254(a), 265.301(a) to allow alternative designs for leak detection systems that are capable of detecting leaks of hazardous constituents at least as effectively as the new leak detection system requirements in §§ 264.221(c)(2), 264.251(c)(3), 264.301(c)(3), 265.221(a), 265.254(a), and 265.301(a). EPA feels that variance procedures allow owners or operators flexibility in designing their leak detection systems without discouraging the use of new leak detection systems.

In order to be granted a variance from the leak detection requirements of today's final rule, an owner or operator must demonstrate to the Regional Administrator that the proposed design detects leaks through the top liner at least as effectively as a leak detection system designed to meet today's minimum design standards. In deciding whether to allow a variance for an alternative leak detection system or technology, the Regional Administrator will consider: (1) The ability of the proposed system or technology to operate as effectively through the active life and post-closure period of the unit as a unit designed using the minimum design specifications; (2) the nature and quantity of the wastes to be managed in the unit; and (3) the ability of the system to detect leaks, and in combination with response actions to be taken upon discovery of leakage, prevent migration of hazardous constituents out of the unit during the active life and post-closure care period. For example, an alternative leak detection system that did not provide information about leakage until after the leakage migrated through the bottom liner would be deemed unacceptable, because such a system would trigger an owner or operator response after hazardous constituents migrated into the environment.

Owners or operators may apply for a variance if they wish to propose a leak detection system design that deviates from today's design parameters. For example, if an owner or operator specified that the drainage layer of a surface impoundment would utilize granular materials having a hydraulic conductivity of 1×10^{-1} cm/sec (instead of the minimum required value of 1×10^{-1} cm/sec), the owner or operator would have to describe how other components of the system (e.g., depth of impoundment, bottom slope, flow path to a collection pipe or sump or pipe spacing) or the action leakage rate or response action plan would detect leaks at the earliest practicable time, minimize head on the bottom liner, and prevent migration of potentially hazardous constituents out of the unit as effectively as the design required in today's rule.

Temporary units. In the May 29, 1987 proposal EPA invited comment about whether double liners and leachate collection systems are necessary for all waste piles, or if alternative systems might provide adequate environmental protection at some units. In response to the Agency's request, a commenter questioned whether double liner and leachate collection systems are necessary for short-term waste piles created during corrective action. The same commenter also suggested that EPA should propose an overall policy in its upcoming corrective action rule as to what technological requirements will apply to units used for corrective action.

The Agency agrees with these comments. There are circumstances where the Agency believes it should allow temporary units constructed as a part of corrective action pursuant to a permit or 3008(h) enforcement order, or an approved closure plan, to be constructed without a double liner and a leachate collection system. Due to the limited time these units are in operation, in concert with alternative design, location and operating practices, there are situations which are equally effective as double lined units in preventing migration of constituents to ground water or surface water. Many waste piles (as well as some temporary storage surface impoundments) may thus qualify for the double liner waiver found in §§ 264.221(d), 264.251(d), 265.221(a), and 265.254(a).

These provisions provide for a generic waiver of the double liner system, but do not specifically address temporary units. In response to the special needs posed by corrective action and facility closure (e.g., rapid cleanup and short-term operation) the Agency has published a proposed "Subpart S" rule (55 FR 30798) that, among other things, specifically addresses standards for temporary units. That proposal outlines Agency guidance on what factors to consider in determining what constitutes a temporary unit.

4. Applicability to Waste Piles

EPA is requiring that new and replacement waste piles, and lateral expansions of waste piles, install, operate, and maintain double liner and leak detection systems (§§ 264.251 and 265.254). The Agency is extending the double liner and leachate collection and removal system requirements to waste piles, as discussed in the preamble to the May 29, 1987 proposal (52 FR 20250), because the Agency maintains, for several reasons, that these units pose threats similar to or greater than landfills concerning leakage through the top liner and releases of hazardous constituents. First, waste piles are often exposed to precipitation for longer periods of time than landfills. Many owners or operators of landfills provide an intermediate cover to minimize leachate generation; this practice is not as common for waste piles. Second, waste piles have a higher potential for equipment-related damage than do landfills, because equipment is frequently used to add and remove waste from piles during these units' active lives. This increased equipment activity at waste piles increases the risk of damage to the primary liner and merits use of a secondary liner for these units. Finally, waste piles typically have much longer active lives than landfills: Waste piles are typically used for 20 years or more, whereas landfill units are more common used for periods of 6 months to 5 years before being closed.

Today's rule provides a waiver from the double liner and leachate collection and removal system requirements for certain waste piles that are monofills. In the May 29, 1987 proposal rule, EPA proposed a variance for monofills when (1) the monofill contains only hazardous wastes from foundry furnace emission controls or metal casting molding sand, (2) such waste do not contain constituents which would render the wastes hazardous for reasons other than EP toxicity characteristic, (3) the monofill has at least one liner for which there is no evidence that such liner is leaking, (4) the monofill is located more than a quarter mile from an underground source of drinking water, and (5) the monofill is in compliance with generally applicable ground-water monitoring requirements for facilities with permits. The Agency proposed this waiver to codify the language in section 3004(o)(3) of RCRA and to be consistent with regulations for landfills and surface impoundments. Because EPA received no comments on this proposed waiver, it is being finalized as proposed in today's rule (§§ 264.251(e)(1) and 265.254(a)).

Today's rules do not affect the existing exemption in § 264.250(c) and now in § 265.254 for certain indoor waste piles. These units continue to be excluded from today's double-liner and leak detection requirements because they contain no free liquids and are protected from precipitation and surface water run-on and are therefore unlikely to have any leakage.

5. Applicability to Land Treatment Units

EPA proposed a number of leak detection requirements for land treatment units in the May 29, 1987 proposed rule. These requirements included (1) a 95-percent confidence level for detecting hazardous constituents in the treatment zone, (2) monitoring conducted above the seasonal high water table, (3) response action plans, and (4) inspection of unsaturated zone monitoring equipment. Today's rule does not include additional leak detection requirements for land treatment units. EPA has concluded that the current regulatory requirements for unsaturated zone monitoring at land treatment units are sufficient to ensure that leakage of hazardous constituents will be detected at the earliest practicable time. Therefore, EPA finds that additional regulations for such units are not needed to meet the statutory requirements of section 3004(o)(4) of RCRA for these units.

In the preamble to the 1987 proposal, EPA noted that unsaturated zone monitoring systems serve as effective leak detection systems for land treatment units. The Agency received no comments challenging this position or suggesting more effective alternatives. The existing regulations, however, already require unsaturated zone monitoring—i.e., leak detection systems—at all land treatment units, both new and existing. Specifically, §§ 264.278 and 265.278 contain detailed technical standards for soil and soil-pore liquid monitoring in the unsaturated zone below the land treatment unit to ensure detection of any hazardous constituents migrating out of the treatment zone. Furthermore, when releases are detected, the owner or operator of a permitted facility is required to modify operating procedures at the land treatment unit to prevent further release. EPA has implemented these requirements through two guidance documents: "Permit Guidance Manual on Hazardous Waste Land Treatment Demonstrations" and "Guidance Manual on Unsaturated Zone Monitoring for Hazardous Waste Land Treatment Units." After reviewing public comments and its experience in permitting land treatment units since the proposal, EPA concluded that the current regulatory requirements, coupled with existing guidance, are sufficient to ensure that leak detection systems in new land treatment units are capable of detecting releases at the earliest practicable time.

In the May, 1987 proposal, EPA did not propose to change the basic regulatory requirements for unsaturated zone monitoring, but added several relatively minor amendments. For example, the proposal would have added a requirement that constituents migrating out of the treatment zone be detected at a 95% confidence level and that the unsaturated zone monitoring take place above the seasonal high water table as well as below the treatment zone (as the current standards specify). EPA has concluded that these minor changes are unnecessary, either to meet the statutory standard or to protect human health and the environment. Available guidance documents already specify a 95% level of confidence for monitoring, and EPA and the States have successfully incorporated this standard into permits. Therefore, it is unnecessary to impose this requirement as a matter of regulation. Similarly, monitoring below the seasonal high water table is already prohibited by the existing regulations, because monitoring below the water table would not qualify as unsaturated zone monitoring. Therefore, the regulatory requirement that the monitoring be above the seasonal high water table is also unnecessary.

Today's final rule also does not finalize requirements for a response action plan describing remedial action if releases are detected in the unsaturated zone. EPA has concluded that a response action plan for permitted land treatment units is superfluous, because the current regulations (§ 264.278(g)) already require facility owners or operators to take specific responses in the case of hazardous constituents detected in the unsaturated zone monitoring system. EPA also notes that migration found in the unsaturated zone monitoring system would constitute migration from the unit, and therefore would be addressed by the Agency, if necessary, under RCRA corrective action requirements. Finally, EPA notes that, because of the RCRA land disposal restrictions, most if not all hazardous waste land treatment units in the future will be able to operate only if wastes placed in them meet applicable treatment standards before placement in the unit or if they are granted a no-migration variance. A unit granted a no-migration variance that then releases hazardous constituents from the unit would have to cease receipt of prohibited wastes (§ 268.6(f)). In this case, a unit found to be releasing hazardous constituents to the unsaturated zone would be required to cease operating. For these reasons, EPA has concluded that a response action plan is not necessary for land treatment units.

A December 6, 1991 decision of the United States Court of Appeals, District of Columbia addressed the soil-pore water monitoring requirements for interim status land treatment facilities (*Shell Oil Company v. EPA*, No. 90-1532). As of the date of this rule, the Court's mandate was not yet issued and the regulation remains in place. The Agency is still considering what response to take to the Court's decision.

. Response to Leaks

. Action Leakage Rate

The final rule requires owners or operators to establish one action leakage rate (ALR) for each unit affected by today's rule (§§ 264.222, 264.252, 264.302, 265.222, 265.225, and 265.302). The action leakage rate is a leakage rate that requires implementation of a response action to prevent hazardous constituent migration out of the unit. The Agency has determined, the public comments support, the need for an ALR and response actions that the ALR triggers. EPA believes that the ultimate goal of the liner and leak detection system requirements is to prevent the release of hazardous constituents from the unit, thereby protecting the ground water and surface water. A system in place to detect leaks at the earliest practical time should be complemented by early follow-up actions to effectively minimize the chance for migration of hazardous constituents from the unit. Furthermore, it is often more effective to address leaks within the liners than to later address ground-water contamination through corrective action.

Today's final rule requires owners or operators to monitor the rate of leakage into the leak detection sump and to determine whether the measured rate of leakage over a specified period of time exceeds the action leakage rate (see Section IV.D. of the preamble for further discussion of today's monitoring requirements). If the owner or operator determines that the measured rate of leakage exceeds the ALR, the owner or operator must notify EPA and implement procedures contained in a response action plan that owners or operators must prepare for units affected by today's rule.

The proposed rule allowed the owner or operator a choice in establishing an action leakage rate. EPA proposed to specify an action leakage rate between 5–20 gallons/acre/day (gpad). Alternatively, the owner or operator could propose a site-specific action leakage rate for EPA approval. The proposed rule required owners and operators to develop and submit a plan for responding to the action leakage rate.

The proposed rule also required owners and operators to establish a value and a response action plan for a rapid and large leakage rate (RLL). The RLL was defined as the maximum design leakage rate (plus a safety factor) that the leak detection system can remove under gravity flow conditions (i.e., without the fluid head on the bottom liner exceeding one foot in granular leak detection systems and without the fluid head exceeding the thickness of synthetic lead detection systems). EPA also considered in the proposal the possibility of owners or operators developing responses to leakage rates between the action leakage rate and rapid and extremely large leakage rate (referred to as an intermediate leakage rate). In addition, the Agency considered requiring owners or operators to develop responses to "significant changes" in the flow rate (EPA suggested a 100 gpad or 25–50 percent increase, whichever was larger), leakage that exceeded health-based concentrations of hazardous constituents, and a leakage rate exceeding 50 gpad for any one-day period. In summary, EPA discussed six leakage rates in the proposal that could trigger various response actions by owners or operators.

Although no commenters objected to the establishment of an action leakage rate, EPA received many comments on the proposed action leakage rate value. Several commenters favored EPA setting an action leakage rate within the proposed range of 5–20 gpad. Some suggested that EPA should not finalize a specific value within the proposed range, but keep the range of 5–20 gpad and allow the permit writer to select a specific value within the range to apply to the unit. Some commenters suggested an action leakage rate of 90 or 100 gpad. Another commenter suggested that EPA set an action leakage rate at 75 percent of the proposed rapid and extremely large leakage rate. One commenter stated that the action leakage rate should be decreased over the life of the unit according to a formula, thus allowing a higher action leakage rate during initial operation of the unit to account for presence of liquids in the sump from sources other than leaks (e.g., construction water).

In general, most commenters stated that EPA had little or no field data to set an action leakage rate within the proposed range, and argued that the Agency should allow site-specific action leakage rates to be set by the permit writer, especially to account for other potential sources of liquids in the leak detection sump (e.g., soil liner construction water, precipitation during construction, and ground-water infiltration). Although the proposed rule would allow site-specific variances to the proposed action leakage rate, commenters expressed concern that EPA would not allow many site-specific action leakage rates. These commenters claimed that site-specific action leakage rates based on the design and operation of the unit should be common.

EPA also received many comments on other leakage rates that would require owners or operators to develop response actions. Commenters opposed using "significant changes" in the flow rate or health-based concentrations of hazardous constituents in liquids entering the detection sump to trigger a response by the owner or operator. Commenters felt that the proposed "significant change" concept was unclear and difficult to define. Commenters felt using leachate quality analysis at flow rates below the rapid and extremely large leakage rate to trigger a response was costly, time-consuming, and provided no additional environmental benefit. These commenters generally felt that liquid flow rates into the detection sump should be the sole trigger of an owner or operator's response. Many of these commenters also disagreed with the use of health-based levels (e.g., maximum contaminant levels) in the leachate to trigger a response. They argued that EPA's assumptions in proposing such levels were overly conservative and unrealistic because such liquid was still contained in the leak detection system and migration to the environment was controlled by the bottom-liner and drainage system.

Many commenters maintained that EPA was proposing too many leakage rates without a clear distinction between them as to the differences in response associated with the leakage. These commenters claimed that some of the responses actions discussed by EPA in the preamble seemed to be redundant for different leakage rates, and that EPA's requirements were confusing, burdensome, and provided no additional benefit. As an example, the commenters cited that flow rates above the proposed action leakage rate (5–20 gpad) would trigger many of the same responses that exceedance of other leakage rates, such as the rapid and extremely large leakage rate (an example in the preamble showed a RLL of 3000 gpad) or significant change in leakage rate, would mandate. Some of these commenters stated that leakage rates less than the rapid and extremely large rate did not necessarily indicate a failure of the top liner, and that leakage would still be contained within the unit by the bottom liner. Therefore, they felt that the Agency should not stipulate excessive and redundant responses on the part of owners or operators for leakage rates that do not pose environmental concerns.

EPA requested and received field data on actual leakage rates from commenters on the proposed rule, and obtained additional data from more recent studies of leakage rates through top liners at land disposal units. However, these data are limited and furthermore, indicate that a portion of units (>25%) with CQA could exceed 20 gpad, the highest end of the proposed range for action leakage rates. Therefore, the Agency agrees with commenters that existing field data do not support establishment of an action leakage rate within the proposed range of 5–20 gpad for all units.

In response to EPA's request for comments on the appropriateness of the proposed range for surface impoundments, commenters argued that it was inappropriate for the Agency to set the same action leakage rate for landfills and surface impoundments and that the Agency should take into account the type, size, and operation of the unit when establishing an action leakage rate. EPA agrees with the commenters that the size, type, and operation of the unit should be accounted for in establishing a leakage rate that will trigger a response by the owner or operator, and that a standard leakage rate value for all units is not appropriate at this time.

In addition, EPA acknowledges commenters' concerns about the proposed number of leakage rates triggering a response by the owner or operator, and the lack of distinction among them for purposes of implementation. To simplify the final rule, EPA has chosen to establish one leakage rate that will trigger a response by the owner or operator, account for the site-specific design of the unit, and indicate significant evidence that there is problematic leakage through the top liner that mandates a response. EPA is requiring owners or operators to propose an action leakage rate for each unit subject to today's rule based on an approach that is similar to the proposed definition of the rapid and extremely large leakage rate. That is, owners or operators must calculate an action leakage rate based on the maximum design leakage rate that the leak detection system can remove without the fluid head on the bottom liner exceeding one foot. This leakage rate must account for an adequate margin of safety for uncertainties in design, construction, and operation of the leak detection system. The action leakage rate must not be greater than the flow capacity of the drainage layer in order to assure detection of leaks (e.g., if the ALR is 500 gpad and the flow capacity is 400 gpad then the ALR would never be exceeded no matter how large the leak). The action leakage rate should always be less than or equal to the pumping capacity of the leak detection sump since the pumping capacity is required to be greater than the maximum leak detection system flow rate under which gravity flow conditions prevail (i.e., to prevent liquids from backing up into the drainage layer). If the owner or operator determines that the action leakage rate is exceeded, the owner or operator must implement the procedures contained in the response action plan.

EPA believes that flow rates in excess of the action leakage rate indicate a major localized or general failure of the top liner, thus increasing the potential for a buildup of head on the bottom liner and increasing the potential for migration of hazardous constituents into the bottom liner. For this reason, it is necessary to maintain leak detection flow rates below the action leakage rate and for the owner or operator to take response actions for leaks greater than the action leakage rate.

Under today's rule, as in the May 29, 1987 proposal, the owner or operator must propose an action leakage rate based on calculations of the maximum flow capacity of the leak detection system design so as not to exceed one foot head on the bottom liner (called rapid and extremely large leak in the proposal). The proposal background document "Liner and Leak Detection Rule Background Document", (EPA/530-SW-87-015, May 1987) presented a number of mathematical models for making such a determination. All of these models are based on Darcy's Law for non-turbulent flow through saturated media. Of these models, the Agency finds that the following formula for flow originating through a hole in the liner is the most likely leak scenario for a geomembrane liner:

$$Q = k \cdot h \cdot \tan\alpha \cdot B$$

where

Q = flow rate in the leak detection system (drainage layer),
h = head on the bottom liner,
k = hydraulic conductivity of the drainage medium,
α = slope of the leak detection system,
B = width of the flow in the leak detection system, perpendicular to the flow.

SAND

Using this formula, the Agency calculated the maximum flow rates using the minimum specifications in today's rule: 1% slope, and 1×10^{-1} cm/sec hydraulic conductivity for surface impoundments and 1×10^{-2} cm/sec hydraulic conductivity for landfills and waste piles. Assuming that the head is 1 foot and the width of flow (B) is 100 feet, the results show maximum flow rates of 2,100 gpad for surface impoundments and 210 gpad for landfills and waste piles. Using a safety factor of two, as suggested in the proposed rule preamble, yields about 1,000 gpad for surface impoundments and 100 gpad for landfills and waste piles as the Agency recommended action leakage rates. Because this calculation used the minimum technical requirements and other design assumptions to maximize potential head on the bottom liner, the Agency believes that the units meeting the minimum technical requirements would not require action leakage rates below 100 gpad for landfills and waste piles and 1000 gpad for surface impoundments. The final background document on action leakage rates ("Action Leakage Rates for Leak Detection Systems," January 1992) provides further discussion and background on these recommended action leakage rates. As discussed earlier in the preamble, this document is available from the docket for this rule or from NTIS, U.S. Department of Commerce.

While EPA recommends the above action leakage rates for the minimum design specifications, the Agency recognizes that a number of site-specific factors affect the maximum flow capacity of a leak detection system, and owners or operators may want to propose alternative action leakage rates. For example, the leak detection system design may be different than the minimums specified in today's rule. As indicated above and in the background document, hydraulic conductivity is a factor that significantly affects the flow capacity of the system. The Agency believes that leak detection systems with greater hydraulic conductivities would have higher action leakage rates. In additional, owners or operators may have information to justify a different width of flow in the above calculation. Owners or operators also may justify a higher action leakage rate by using a different formula or model. While the Agency recommends the use of the above model for defining the maximum flow capacity of the leak detection system and action leakage rate, EPA recognizes that there may be alternative models available now or in the future that may more accurately predict system flow capacity to justify higher action leakage rates. Therefore, owners or operators may propose to use an alternative model that they believe more accurately predicts the maximum flow capacity of the leak detection system. Further, owners or operators may want to do a flow (pump) test on the leak detection system to show actual flow capacity, which may justify a higher action leakage rate. Finally, the owner or operator may have flow rate data on similarly designed units to use to justify a different level. As more and more units are built, the Agency as well as owners or operators will develop a better data base that may be used to establish appropriate action leakage rates.

For facilities seeking a permit, the action leakage rate will be set after the Regional Administrator reviews the rate proposed by the owner or operator in either the facility's part B permit application or permit modification. For interim status facilities, the owner or operator must submit a proposed action leakage rate for the affected unit to the Regional Administrator 60 days prior to the receipt of waste in the unit. The Regional Administrator will either approve, modify, or deny the proposed leakage rate. The Regional Administrator may extend the review period to evaluate the owner or operator's proposed action leakage rate for up to 30 more days. If none of these actions occur within 60 days (or if the review period is extended, within 90 days), the proposed rate can be considered approved.

Owners and operators of units affected by today's rule must monitor the leak detection sump and use the monitoring information to determine if the action leakage rate has been exceeded. The final rule sets forth the procedures owners or operators must use in determining whether the action leakage rate has been exceeded §§ 264.222(b), 264.252(b), 264.302(b), 265.222(c), 265.255(c), and 265.302(c)). To calculate the flow rate into the leak detection sump, owners, or operators must convert flow rate data into an average daily flow rate per acre (i.e., gpad) for each leak detection sump. This calculation must be performed weekly during the active life and closure period of the unit, unless the Regional Administrator approves otherwise. Upon closure (installation of the final cover for the unit), owners or operators will monitor the leak detection sump monthly, or in some cases quarterly or semi-annually (see Section IV.D. for further discussion). While on a monthly monitoring schedule, owners or operators will have to convert the monitoring data to an average daily flow rate to determine if the action leakage rate has been exceeded. If an owner or operator is monitoring quarterly or semi-annually no calculations are needed unless liquids are detected in the sump above the pump operating level, in which case the owner or operator must resume monitoring the sump on a monthly basis. Such an owner or operator would then have to convert monitoring data to an average daily flow rate per acre for the purpose of determining if the action leakage rate has been exceeded.

2. Response Action Plan

The final rule requires owners or operators of affected units to develop a response action plan for leaks exceeding the action leakage rate §§ 264.223, 264.253, 264.304, 265.223, 265.259, and 265.303). The response action plan is a site-specific plan that the owner or operator develops to address leakage through the top liner to assure that it does not migrate out of the unit. It is based on an assessment of the capability of the total design, construction, and operation of the unit rather than of individual components of the unit.

The majority of commenters on the proposed response action plan requirements stated that there were too many potential triggers (i.e.,leakage rates) that the response action plan must potentially address in the proposed rule. These commenters argued that these trigger levels lacked distinction as to the responses they would necessitate. Other commenters felt that the response action plan requirements were confusing and inconsistent in certain cases. The commenters noted that many of the response actions for leaks above the proposed rapid and extremely large leakage rate were similar to actions for leaks above the proposed action leakage rate. In response to these comments, EPA has simplified and clarified the response action requirements in today's final rule.

The final rule specifies minimum response actions that the owner or operator must take when the owner or operator determines that the action leakage rate has been exceeded. The minimum response actions are included in the response action plan that the owner or operator must prepare. Although minimum response actions are required to be in the response action plan, the content of a response action plan is determined by site-specific factors. The minimum responses required under today's rule are typical of response action plans EPA has identified at operating facilities and incorporate comments EPA received on the proposed response action plan requirements. Although today's rule only requires the owner or operator to initiate response actions upon exceedance of the action leakage rate, owners or operators may want to implement some types of response actions for leakage rates less than the action leakage rate, because these actions will lower the probability that leakage will exceed the action leakage rate and trigger today's final response action requirements.

An owner or operator's response action plan must include notifying EPA within 7 days that the action leakage rate has been exceeded. EPA received no comments on the proposed notification requirement and thus, is finalizing this requirement. The Agency is also requiring that the owner or operator submit a preliminary written assessment to the Regional Administrator within 14 days of the determination as to amount and source of the liquids in the detection sump, information on possible size, location, and cause of the leak, and any immediate and short term actions the owner or operator will take (e.g., additional pumping and removal of the leachate, changes in operating practices to reduce the leakage). As stated above, the Agency believes that exceedance of the action leakage rate is significant and indicates a major localized or general failure of the top liner, thus increasing the potential for a buildup of head on the bottom liner and increasing the potential for migration of hazardous

Appendix 2

LANDFILL OPERATIONS PROCEDURES

Written by:	Manal Salem	Date:	08 /11 /24 (YY MM DD)	Reviewed by:	Scott M. Graves	Date:	08 /11 /24 (YY MM DD)
Client:	Clean Harbors	Project:	Lone Mountain Cell 15	Project/Proposal No.:	FL1230	Task No:	01

LEACHATE DETECTION SYSTEM DESIGN,

ACTION LEAKAGE RATE (ALR)

REGISTERED PROFESSIONAL ENGINEER
SCOTT M. GRAVES
19710
OKLAHOMA

11/24/2008

Scott M. Graves, P.E.
State of Oklahoma Registration # 19710
Geosyntec Consultants
Oklahoma Certificate of Authorization No. 1996
Exp. 06/30/2010

INTRODUCTION

According to 40 CFR §264.301(c), landfill disposing hazardous waste must have two or more liners with a Leachate Collection and Removal System (LCRS) above the top liner and a Leak Detection System (LDS) between the two liners. Clean Harbors Lone Mountain Landfill, Cell 15 has a triple liner system with a total of three leachate collection and detection systems:

- Upper Leachate Collection and Removal System (ULCRS);
- Middle Leachate Collection and Removal System (LCRS); and
- Bottom Leachate Detection and Removal System (LDCRS).

The HA&L Design Engineering Report dated 1996 evaluated the ALR for Cell 15, subcells 1 through 8. Cell 15 footprint was reconfigured by Envirotech in January 2007 to have only a total of 6 subcells instead of 8. The ALR for subcells 1 through 6 is re-evaluated in this package. The purpose of the LDCRS is to detect, collect, and remove any leachate leaks through the middle liner system at the earliest practicable time underneath all areas subject to waste or leachate throughout the life and post closure period of the landfill [40 CFR §264.301(c)].

The LDCRS for Cell 15, subcells 1 through 6 consists of a geonet drainage layer designed to have a minimum slope of 1% and a minimum transmissivity of 5×10^{-4} m^2/sec and extends underneath all floor and side slope areas of the landfill. It is noted that the transmissivity of the geonet in the LDCRS is the minimum required value, and the actual transmissivity of the geonet reported in the construction report is much greater than this value (see attached test results). The geonet of the LDCRS is placed between two layers of 60-mil HDPE geomembrane

Landfills accepting hazardous waste are required under 40 CFR §264.302(a) to have a specified Action Leakage Rate (ALR). The ALR, as defined in 40 CFR §264.302(a), is the maximum design flow rate that the LDCRS may remove without the fluid head on the bottom liner exceeding 1 foot. Lone Mountain Landfill, Cell 15 has a monitoring and inspection program set in compliance with 40 CFR §264.303 to track leakage rates in the LDCRS throughout the active life and post closure period of the landfill. In case the ALR is exceeded, a Response Action Plan (RAP) is set to describe actions to be taken if the ALR is exceeded during the active life or post-closure period of the landfill as required under 40 CFR §264.304(a). The RAP is described in details in the HA&L Design Engineering Report dated 1996 and is not discussed herein.

PURPOSE

Based on the above description, the purpose of this document is to:

- estimate the ALR through the middle liner of the triple liner system at which response action is initiated;
- verify that the hydraulic capacity of the LDCRS is sufficient to accommodate the ALR; and
- describe the LDCRS monitoring program.

METHODS

Action Leakage Rate Calculation

The leak detection drainage layer for Cell 15 consists of a geonet drainage layer. The maximum flow rate from a single hole in the middle liner that a geonet drainage layer can convey without the fluid head on the bottom liner exceeding 1 ft is calculated using the method proposed by Giroud et al. (1997). The method assumes that the LDCRS is filled with leachate in a certain area around the hole due to the relatively small thickness of the LDCRS compared to the leachate head. The leachate phreatic surface in the LDCRS at the hole is assumed to be a truncated cone as shown in the following figure (after Giroud et al., 1997).

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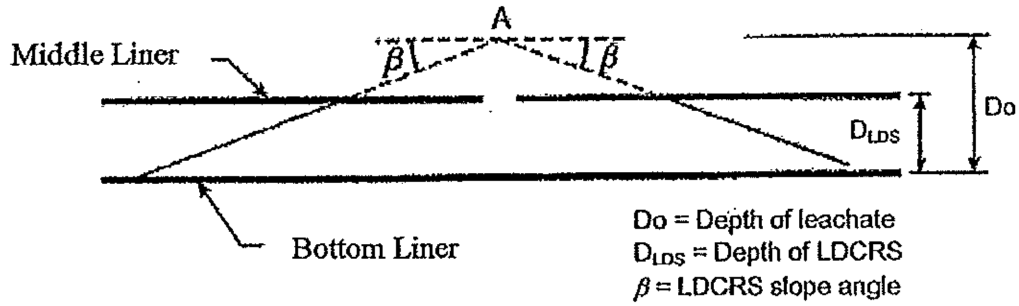

The flow through the LDCRS can then be calculated from Darcy's law as:

$$Q = k\ i\ A = k\ t_{LDS}\ (2t_o - t_{LDS}) \qquad \text{(Eqn. 1)}$$

where: Q = the flow rate of leachate in the LDCRS due to a hole in the middle liner;
k = long-term hydraulic conductivity of the geonet drainage layer;
i = hydraulic gradient (i.e., slope of the LDCRS) = $\sin\beta$;
A = cross-sectional area of flow;
t_o = thickness of leachate = $D_o \cos\beta \approx D_o$; and
t_{LDS}= thickness of the LDCRS = $D_{LDS} \cos\beta \approx D_{LDS}$.

Note that the head of leachate on the bottom liner $h = t_o \cos\beta \approx t_o$, and the hydraulic transmissivity of the geonet $\theta = k \times t_{LDS}$. Therefore, equation (1) could be re-written as:

$$Q = \theta\ (2h - t_{LDS}) \qquad \text{(Eqn. 2)}$$

The ALR is estimated by applying a factor of safety to the calculated flow rate taking into consideration the effect of potential creep, and chemical and biological clogging on the transmissivity of the geonet.

<u>Hydraulic Capacity of the Leachate Detection System</u>

The LDCRS for Cell 15 consists of a geonet drainage layer, which collects the leachate and conveys it directly to the sump. The leachate generated on three sideslopes of the each landfill subcell is conveyed to the cell floor, which has a slope of 1%. The fourth sideslope (along east side), which has a slope of 3H:1V, drains directly to the sump. The LDCRS flow capacity should be greater than the maximum calculated ALR. The flow capacity is calculated using Darcy's equation as follows:

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$$Q = k \cdot \sum i_i \cdot A_i \qquad \text{(Eqn. 3)}$$

where:

- Q = the LDCRS flow capacity;
- k = long-term hydraulic conductivity of the geonet drainage layer, which equals the hydraulic transmissivity (θ) of the geonet divided by the thickness of the geonet (t);
- i_i = hydraulic gradient, which equals the slope of the geonet layer draining into each of the four sides of the bottom sump = $\sin\beta_i$; and
- A_i = cross-sectional area of flow, which equals the cross-sectional area of the geonet drainage layer on each of the four sides of the bottom sump.

CALCULATIONS

Action Leakage Rate Calculation

The technical specifications for construction of Cell 15 require that over the base and side slopes of the subcells the geonet of the LDCRS have a hydraulic transmissivity of at least 5×10^{-4} m²/s when subjected to testing conditions which includes stress, hydraulic gradient, and boundary conditions similar to those anticipated in the field. The thickness of the geonet of the LDCRS is 0.2 in. Hydraulic transmissivity test results confirming that the specified geonet has this calculated hydraulic conductivity are required in the specifications and Construction Quality Assurance (CQA) Plan.

Federal regulations 40 CFR §264.302 require that the head on the bottom liner should not exceed 1 foot. Therefore 1-foot of head will be assumed to calculate the ALR. The middle liner is assumed to contain a single hole per acre, as recommend by USEPA (1992).

The flow rate of leachate in the LDCRS due to a hole in the middle liner is calculated using equation (2) as follows:

$$Q = \theta\,(2h - t_{LDS}) = [5\times10^{-4}\ \text{m}^2/\text{s} \times 10.764\ \text{ft}^2/\text{m}^2] \times [2\times1\text{ft} - 0.2\ \text{in} \times 1/12\ \text{ft/in}]$$
$$= 1.06\times10^{-2}\ \text{ft}^3/\text{acre/s} = 6899\ \text{gpad}$$

A combined factor of safety (FS) of 4 is assumed on the calculated flow capacity to account for uncertainties in the design (FS=1.25), long term creep (FS=1.4), chemical clogging (FS=1.5), and biological clogging (FS=1.5) as required by 40 CFR §264.302. Note that this factor of safety is larger than the overall factor of safety of 2 suggested by the rule preamble (USEPA, 1992); and therefore is conservative. Accordingly, the ALR is calculated as follows:

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$ALR = Q / FS = 6899 / 4 \approx$ 1725 gpad

The cell-specific ALR in gpd is calculated for subcells 1 through 6 based on each subcell's area multiplied by the unit-basis ALR, and is summarized in Table 1 below.

Table 1. Summary of ALR in gpd for Subcells 1 through 6.

Subcell	Sump Service Area	ALR
	acre	(gpd)
Subcell 1	4.92	8486
Subcell 2	3.16	5450
Subcell 3	2.84	4898
Subcell 4	3.51	6054
Subcell 5	4.94	8521
Subcell 6	5.22	9004

Hydraulic Capacity of the Leachate Detection System

The ALR calculated above is compared to the capacity of the LDCRS to ensure that the calculated LDCRS flow capacity is greater than the calculated maximum expected ALR. The parameters needed for the LDCRS flow capacity calculation are:

k = long-term hydraulic conductivity of the geonet drainage layer = θ/t = $[5\times10^{-4}\ m^2/s \times 10.764\ ft^2/m^2] / [0.2\ in \times 1/12\ ft/in] = 0.32\ ft/s$

i_i = hydraulic gradient of geonet layer = 1% for floor slope = $\sin(0.573^\circ) = 0.01$
= 33.3% for east sideslope = $\sin(18.4^\circ) = 0.316$

A_i = cross-sectional area of the geonet drainage layer on each of the four sides of the bottom sump = $L_i \times t$, where L_i = the length of each of the four sides of the bottom sump. The length of each of the four sides of the smallest bottom sump is:
$L_{north\ side}$ = 18.2 ft;
$L_{west\ side}$ = 37.4 ft;
$L_{south\ side}$ = 18.2 ft; and
$L_{east\ side}$ = 37.4 ft.

Based on the parameters above, the flow capacity of the LDCRS is calculated as follows:

$$Q = k \cdot \sum i_i \cdot A_i$$

Q_p = (0.32 ft/s) x [(0.01 x (37.4 ft + 18.2 ft + 18.2 ft) x 0.2 in × 1/12 ft/in) + (0.316 x 37.4 ft x 0.2 in × 1/12 ft/in)]

$Q_p = 0.068\ ft^3/s = \underline{43,661\ gpd}$

Given that the ALR is calculated to be 1725 gpad and the maximum service area for a LDCRS is approximately 5.22 acres (subcell 6, the most critical subcell in terms of hydraulic capacity), therefore, the maximum ALR equals 9004 gpd, which is less than the calculated LDCRS flow capacity of 43,661 gpd. Accordingly, the leachate detection system is adequate to detect leakage rates in excess of the proposed ALR.

MONITORING PROGRAM

The volume of liquids removed from each LDCRS in the Lone Mountain Cell 15 Landfill will be monitored and recorded according to a schedule that complies with 40 CFR §264.303. The amount of liquid removed from each LDCRS sump will be recorded according to the following schedule:

- At least once each week during the active life and closure period;
- Following a storm;
- At least once each month after final cover is installed;
- At least quarterly during post-closure if the liquid level in any sump stays below the pump operating level for at least two consecutive months;
- At least semi-annually during post-closure if the liquid level in any sump stays below the pump operating level for at least two consecutive quarters; and
- If at any time during the post-closure period the pump operation level is exceeded at units on quarterly or semi-annual schedules, the recording schedule will return to monthly until liquid level stays below pump operating levels for two consecutive months.

The pump operating level is proposed to be six inches. In the event the ALR is exceeded, response action will be taken as described in details in the HA&L Design Engineering Report dated 1996.

CONCLUSIONS

- The ALR in terms of gallons/acre/day is calculated to be 1725 gpad.
- The ALR for each subcell, based on the subcell areas, is presented in Table 1 previsously presented in this calculation package.

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- The LDCRS has a flow capacity 43,661 gpd, which is sufficient to accommodate the ALR from the maximum service area of 5.22 acres; and
- A leak detection monitoring program have been proposed and a RAP is included in the HA&L Design Engineering Report dated 1996 in accordance with federal regulations.

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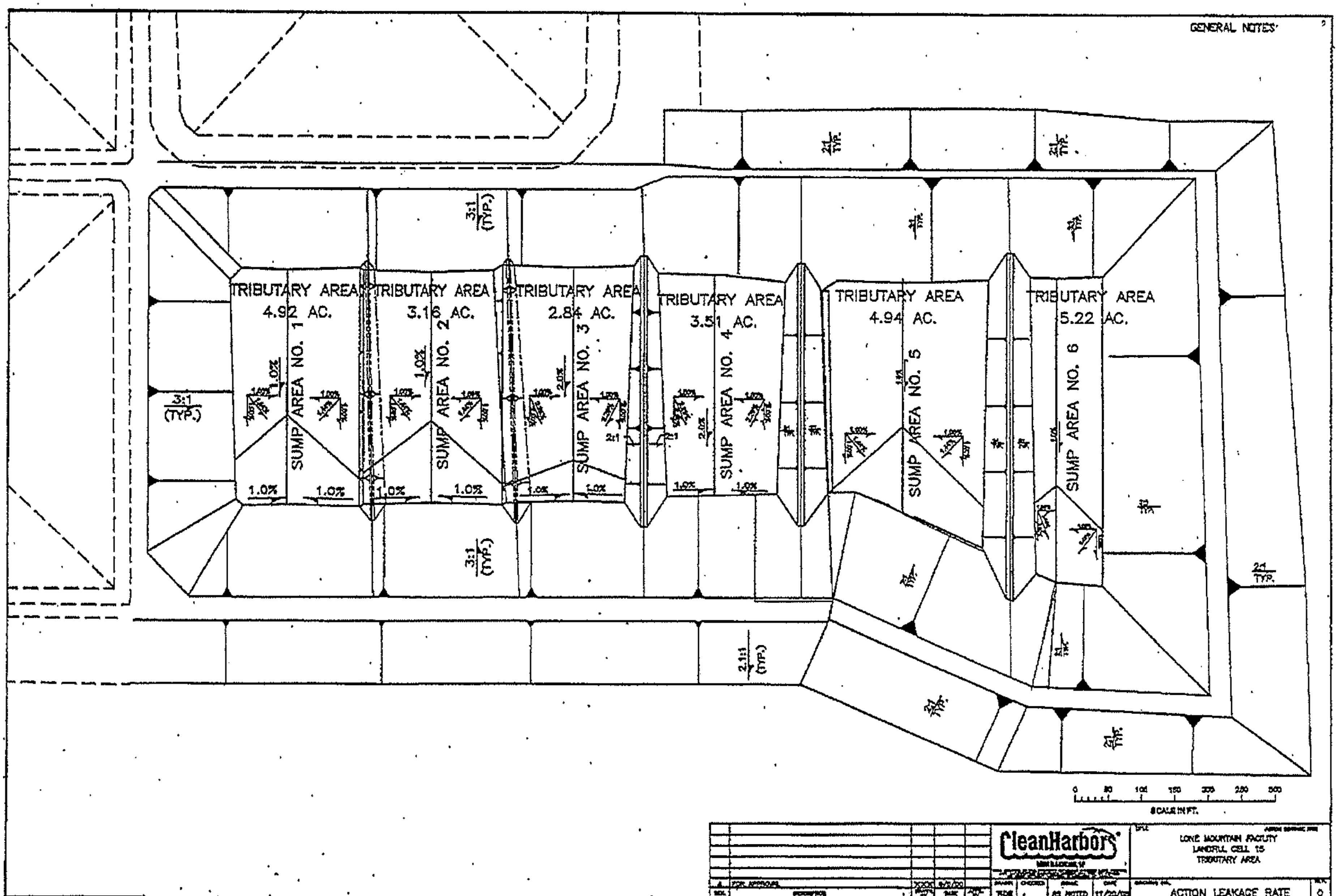
GENERAL NOTES:
TRIBUTARY AREA 4.92 AC.
SUMP AREA NO. 1
TRIBUTARY AREA 3.16 AC.
SUMP AREA NO. 2
TRIBUTARY AREA 2.84 AC.
SUMP AREA NO. 3
TRIBUTARY AREA 3.51 AC.
SUMP AREA NO. 4
TRIBUTARY AREA 4.94 AC.
SUMP AREA NO. 5
TRIBUTARY AREA 5.22 AC.
SUMP AREA NO. 6
3:1 (TYP.)
2:1 TYP.
2.1:1 (TYP.)
1.0%
2.0%
SCALE IN FT.
CleanHarbors
LONE MOUNTAIN FACILITY
LANDFILL CELL 15
TRIBUTARY AREA
ACTION LEAKAGE RATE
FOR APPROVAL
AS NOTED

6.2

Leachate Sampling and Analysis Standard Operating Procedures

Table of Contents

1.0 Leachate Collection and Detection System Monitoring

Monitoring of the leachate collection and detection systems is a requirement that is conducted in addition to the normal sampling and analysis of groundwater at the facility. Per Operating Permit Section VI.D.3, leachate sampling may also be conducted in support of determining if the leachate meets the water quality standard for use as dust suppressant.

1. Per Section VI.D.2 of the Operating Permit, Clean Harbors Lone Mountain, LLC (Lone Mountain Facility) shall inspect the leachate lines located between the pumps and the leachate storage tank weekly and after storms to ascertain the integrity of the lines. If the inspections detect a break or breach of the leachate lines, Lone Mountain Facility shall report the failure and repair the line.

2. Per Section IV.D.4 of the Operating Permit, the Lone Mountain Facility shall inspect the leachate detection, collection, and removal system in all existing Landfill Cells for the presence of a liquid on a weekly basis and after storms. The results of the inspection, including the amount of liquid found, shall be entered in the operating record. If liquid is found in the leachate collection system, the liquid shall be removed from the landfill unit, to the extent practicable, within eight (8) hours of the time such liquid is found. The liquid shall be managed as hazardous waste. First approved in the April 1, 2011 Operating Permit Part VI.F: *Capacity and Leachate Collection and Leak Detection Rates*, The Lone Mountain Facility is utilizing a three tier assessment plan of the Action Leakage Rate (ALR). The tiered approach describes levels of action and response corresponding to an increase in leachate production in the Leachate Detection System (LDS). The normal operating range of the LDS is between 0 and 100 gallons per acre per day (gpapd) and within this range, notification is not required by the Oklahoma Department of Environmental Quality (DEQ).

    a. Under Tier 2 for applicable Landfill Cells, the Response Action to an accumulation rate greater than the calculated Cell specific Tier 2 limit is as follows. The Facility must notify the DEQ in writing within three (3) days that the Facility has exceeded the 100 gpapd leachate accumulation rate. In addition, a sample shall be collected within three (3) days and a metals and general chemistry analysis shall be performed. The general chemistry analysis shall include specific conductivity, pH, cations (Na, Ca, Mg, Mn,) and anions (Cl, $S0^4$, and $N0^3$). The written notice and the analysis described must be submitted to the DEQ within thirty (30) days of the first exceedance of the 100 gpapd leachate production rate.

b. Under Tier 3 for applicable Landfill Cells, the Response Action to an accumulation rate greater than the applicable Tier 3 limit requires the Facility be subject to Permit Conditions VI.F.3 through VI.F.9. For a Tier 3 exceedance the Facility is to immediately increase the pumping rate of leachate from the primary leachate collection system in order to minimize the amount of accumulated leachate.

Permit Conditions VI.F.3 through VI.F.9 describe the Action Response to be conducted in response to a Tier 3 exceedance. These steps include:

c. (IV.F.3; *Paraphrased) The Lone Mountain Facility shall notify the DEQ in writing within three (3) days;

d. (IV.F.4*) The Lone Mountain Facility shall submit a preliminary written assessment to the Oklahoma DEQ within seven (7) days of the determination, describing the amount and likely sources of the liquids; the possible location, size, and cause of any leakage; and the short term actions already taken and those planned within the next 14 days;

e. (IV.F.5*) The Lone Mountain Facility shall test a sample of the liquid removed from the Leak Detection, Collection and Removal System (LDCRS) for Permit Condition VI.F.2.b, and compare these results to the results of samples obtained from all other Leachate Systems (LCRS) from the same Cell or Subcell. The analytical results from the Leachate Systems may also be compared to the analytical results from the groundwater monitoring wells, for the purposes of determining if the leachate is actually groundwater infiltrating into the system.

f. (IV.F.6*) The data obtained by the implementation of Permit Condition VI.F.5 will be submitted to the DEQ along with a recommendation regarding further investigations, if any. This report shall be made, in writing, to the DEQ within fourteen (14) days of the receipt of analytical results, with documentation as part of the formal report required by Permit Condition VI.F.8.

g. (IV.F.7*) Any additional investigations will be performed in accordance with the recommendations approved by the DEQ. If it is determined that the fluid in the LDS is leachate, the Lone Mountain Facility shall prepare and submit a Leachate Escape Assessment Plan (LEAP) to the DEQ within thirty (30) days.

h. (IV.F.8*) The Lone Mountain Facility shall prepare and submit a report to the DEQ within thirty (30) days after the initial agency notification that the ALR has been exceeded, which gives the results of the actions and analyses specified above and lists other actions planned. Action required by Permit Conditions VIF.2a and VIF.7 may be ongoing at the time that this report is submitted.

i. (IV.F.9*) The Lone Mountain Facility shall submit monthly reports thereafter to the Oklahoma DEQ summarizing the results of any actions taken, and outlining actions planned, for as long as the flow rate in the Leachate System exceeds the Tier 1 gpapd. Once leachate production decreases to less than Tier 1 gpapd for six (6) consecutive months, the Lone Mountain Facility will revert to Tier 1 status.

3. In the event that the leachate detection systems detect a failure of the liner(s), the unit will be managed as directed in the Landfill Operations Procedures Response Action Plan.

Leachate Recycling

As of May 20, 1999 the Lone Mountain Facility has been approved by the DEQ to assess the suitability of leachate for use as dust suppressant with numerical limits. Recycling efforts would cease when the analytical analysis results are above the limits for TOC, TOX, and Total Metals including Arsenic, Barium, Cadmium, Chromium, Lead, Nickel, Selenium, and Silver. To provide timely detection of a constituent increase and to observe trends, the Lone Mountain Facility will analyze weighted composite leachate samples monthly for the constituents. As an alternative to composite samples, individual quadrant or Subcell samples may be analyzed. The numerical limits and details regarding Leachate Recycling are provided in Volume 12, Section 6.7: *Leachate Recycling SOP* of this RCRA/HSWA Permit Renewal Application.

2.0 Sampling Guidelines

Collection of the leachate samples will be conducted using the sampling guidelines in the following three Sections which include Health and Safety, Sampling Equipment, and Sampling Strategy.

2.1 Health and Safety

All leachate collection and detection systems are inside the hazardous waste management unit area of the facility. Therefore, it is important that all health and safety rules be followed per the facility procedures. At a minimum, any leachate sampling will be done with personnel wearing a hard hat, steel toe boots, safety glasses, and appropriate gloves. Fluid from the leak detection and collection may also be collected.

2.2 Sampling Equipment

Leachate systems at the facility may be one of two types, collection and removal or detection. Both of these systems are closed systems and are accessed with a dedicated or non-dedicated pumping system, although other means of sampling may be employed. The mechanical and engineering design of these systems is discussed in the applicable permit applications.

Leachate samples are collected using the pump system or a bailer. The sample is then transferred to a clean sample container. For pumping systems, the sample is caught through the use of a sample valve installed just before the hose fitting at the riser or the end of the discharge line.

2.3 Sampling Strategy

The sampling strategy shall be similar to that found in the Groundwater Sampling and Field Analyses Standard Operating Procedure. Samples collected with a bailer will be handled so that a minimum of agitation occurs as the leachate is transferred from the sampler to the sample container. All collection and detection systems with multiple collection points may be composited into one individual sample (e.g., Cells 11, 12, 13, and 14 have four (4) sump riser collection points which may be composited into one sample). Composite samples will be volume weighted based on the relative percentage of leachate removed from each collection point.

3.0 Leachate Analytical Parameters

Analytical parameters for leachate samples are as follows. Unless indicated, the analytical methods specified in the *Groundwater Sampling and Field Analyses Standard Operating Procedures* or the Waste Analysis Plan will be utilized.

a. Date, time of sampling, and location will be recorded on the sample container.

b. pH may be performed in the field or at the facility laboratory and recorded as field data. pH analysis will be performed in conjunction with a Tier 2 exceedance of the ALR. If the sample is to be subsequently analyzed for Total Organic Halides (TOX), the pH will be then reduced to <2.

c. Specific conductance analysis may be performed in the field or at the facility laboratory. Specific conductance analysis will be performed in conjunction with a Tier 2 exceedance of the ALR.

d. Total Organic Carbon (TOC) analysis may be performed by the facility laboratory or an outside laboratory. TOC analysis will be performed as required to determine leachate recycling suitability.

e. Analysis for TOX may be performed by the facility laboratory or an outside laboratory using the most up-to-date version of SW 846 9020 accepted by the DEQ. TOX analysis will be performed as required to determine leachate recycling suitability.

f. Analysis for the following Total Metals will be performed in conjunction with a Tier 2 exceedance of the ALR and in conjunction with leachate recycling analysis and may be performed by the facility laboratory or an outside laboratory. The list of Total Metals includes Arsenic, Barium, Cadmium, Chromium, Lead, Nickel, Selenium, and Silver.

g. Sampling for additional parameters may be conducted during the normal semi-annual groundwater sampling event or at other times as required.

4.0 Sample Containers

Sample Containers for the designated parameters will be supplied and managed by the facility or an outside laboratory.

5.0 Sample Integrity, Handling, and Documentation

Sample Integrity, including all appropriate paperwork and chain-of-custody documentation, if required, will be the responsibility of the facility.

In the event that samples are sent to an outside laboratory for analysis, the collection, handling, and security of samples will be conducted as outlined in *Groundwater Sampling and Field Analyses Standard Operating Procedure*. Documentation to be sent with the samples will include the time and date of sample collection and the appropriate chain-of-custody documentation. Field data generated at the facility such as pH and specific conductance could also be submitted with the sample in order to be included with the final report.

6.3

Closed Landfill Cells

Section 6.3 – Closed Landfills

1.1 Closed Landfill Cells

For more information on closed Landfill Cells at the CHESI Lone Mountain Facility, please refer to the Lone Mountain Facility Post Closure Permit Number OKD065438376-PC. The Drum Cell and Cells 1 through 8; Cells 10 through 14; and Cell 15 Subcells 1 through 8 have been certified closed. Per the CHLM Post-Closure Permit May 2018, The Facility began post-closure care for the closed units listed in Table II.G.1, copied below as Table 1. The date of approval is listed here as the "Post Closure Date". As additional Cells or Subcells at the Lone Mountain Facility are deemed ready for closure, the Lone Mountain Facility will follow the procedures listed in the Lone Mountain Post Closure Permit.

Table 1: Closed Landfill Cells

Landfill Cells	Status	Post Closure Date
Drum Cell	Closed	July 1987
Cell 1	Closed	July 1989
Cell 2	Closed	July 1989
Cell 3	Closed	July 1989
Cell 4	Closed	June 1990
Cell 5	Closed	July 1987
Cell 6	Closed	March 1992
Cell 7	Closed	June 1990
Cell 8	Closed	June 1990
Cell 10	Closed	February 1994
Cell 11	Closed	February 1994
Cell 12	Closed	March 1999
Cell 13	Closed	January 1999
Cell 14	Closed	June 2002
Cell 15	Subcells 1-8 Closed	Portions Active