## Texas Commission on Environmental Quality

**Waste Permits Division**
**Coal Combustion Residuals Landfill**
**Draft Technical Guideline No. 30**
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# Topic: Coal Combustion Residuals (CCR) Landfill

**Contents**



## Introduction

Coal combustion residuals waste are generated from the combustion of coal in a boiler to produce steam for powering a turbine-generator to generate electricity. CCR waste are one of the largest waste streams generated in the United States, with roughly half used for "beneficial reuse" and half disposed in surface impoundments or landfills. CCR waste includes fly ash, bottom ash, boiler slag, and flue gas desulfurization materials, and are generated in a wet or dry condition. Some dry CCR waste may be mixed with water ("sluiced") to facilitate handling/transport of the CCR waste in the power generation facility.

CCR waste are classified by the Texas Commission on Environmental Quality (TCEQ) as a nonhazardous industrial solid waste. This classification is consistent with the EPA's determination of CCR waste as nonhazardous solid waste detailed in 40 Code of Federal Regulation (CFR) 257, Subpart D. The waste classification for CCR waste in Texas is conducted in accordance with TCEQ guidance RG-022 – Guidelines for the Classification and Coding of Industrial and Hazardous Waste.

# Part 1 - Applicable Requirements

## 1.1 General

In accordance with 30 Texas Administrative Code (TAC) Chapter 352, Coal Combustion Residuals Waste Management, the TCEQ prepared this Technical Guideline No. 30 (TG-30) to assist electric utilities and independent power producers with the management and disposal of CCR waste in landfill(s).

TG-30 does not include all requirements applicable to landfill(s) used to store, manage, and dispose of CCR waste. The detailed technical and administrative requirements for managing CCR waste in landfill(s) are contained in 30 TAC Chapter 352. Table 1-1 lists the technical requirements for existing, new, and lateral expansions of CCR landfill(s).

**Table 1-1 CCR Landfill Requirements**

| Requirements | | Existing | New & LE* |
|---|---|---|---|
| Location Restrictions<br>40 CFR §257.60-.64 | Placement above the uppermost aquifer | N | Y |
| | Wetlands | N | Y |
| | Fault areas | N | Y |
| | Seismic impact zones | N | Y |
| | Unstable areas | Y | Y |
| 40 CFR §257.3-1 | Floodplains [1] | Y | Y |
| 40 CFR §257.3-2 | Endangered species [1] | Y | Y |
| Design Criteria<br>40 CFR §257.70-.74 | Composite Liner | N | Y |
| | Leachate collection | N | Y |
| Operating Criteria<br>40 CFR §257.80-.84 | Fugitive dust control plan | Y | Y |
| | Run-on and run-off controls | Y | Y |
| | Weekly inspections by a qualified person | Y | Y |
| | Annual inspection and report by qualified Texas licensed professional engineer | Y | Y |
| Groundwater Monitoring and Corrective Action<br>40 CFR §257.90-.98 | Groundwater monitoring system | Y | Y |
| | Groundwater monitoring sampling and analysis plan | Y | Y |
| Closure and Post-Closure Care<br>40 CFR §257.100-.104 | Closure plan | Y | Y |
| | Deed notations[2] | Y | Y |
| | Post-closure plan | Y | Y |

* LE = Lateral Expansion

[1] Existing regulations in 40 CFR Part §257, Subpart A “Classification of Solid Waste Disposal Facilities and Practices”.

[2] This requirement does not apply if closure is by removal of all CCR waste.

## 1.2 Purpose

30 TAC Chapter 352 establishes a CCR registration and management program to regulate CCR and requires the Owner/Operator to obtain a CCR registration and implement a groundwater detection/monitoring program.

TG-30 provides recommendations for siting, design, operation, inspection, closure and post-closure care (PCC), financial assurance, recordkeeping, notifications, and posting of information to the internet to meet requirements of CCR landfill(s). Facilities are also subject to 30 TAC Chapter 335. Please note, pursuant to Texas Health and Safety Code (THSC) §361.090(c), compliance with this technical guideline does not relieve the Owner/Operator of the facility from compliance with other requirements under Texas Water Code, Chapter 26, and other state and federal regulatory requirements, except 30 TAC Chapter 350, which is not applicable.

## 1.3 Professional Certifications

In accordance with 30 TAC §352.4, all engineering plans, specifications, and related documents submitted to the TCEQ shall be prepared by, or under the supervision of, a qualified Texas licensed professional engineer (Texas P.E.), and shall be signed, sealed, and dated by the Texas P.E., as required by the Texas Engineering Practice Act.

In accordance with 30 TAC §352.4, all geoscientific information submitted to the TCEQ shall be prepared by, or under the supervision of, a qualified Texas licensed professional geoscientist (Texas P.G.), and shall be signed, sealed, and dated by a Texas P.G., as required by the Texas Geoscience Practice Act.

# Part 2 – Landfill Siting Requirements

## 2.1 General

The CCR rules under 30 TAC 352, Subchapter E, Location Restrictions, contain five location restrictions: placement above the upper-most aquifer; wetlands; fault areas; seismic impact zones; and unstable areas.

All five of these location restrictions apply to new CCR landfill(s) and lateral expansions. For existing CCR landfill(s), only one of the location restrictions, unstable areas, apply.

## 2.2 Placement Above the Uppermost Aquifer

All new CCR landfill(s) and lateral expansions must be constructed with a base that is at least 5 feet above the upper limit of the uppermost aquifer; or demonstrate in accordance with 30 TAC §352.601/40 CFR §257.60 that there will not be a hydraulic connection between the base of the CCR landfill(s) and the uppermost aquifer due to normal fluctuations in groundwater elevations (including groundwater elevation variations during the wet season). Demonstration of compliance with this location restriction must be prepared, signed, and certified by a qualified Texas P.G. or a qualified Texas P.E. that the demonstration meets the requirements of 30 TAC §352.601/40 CFR §257.60.

## 2.3 Wetlands

Wetlands refer to areas inundated or saturated by surface or groundwater at a frequency and duration to support vegetation adapted for life in saturated soil conditions. Wetlands include marshes, swamps and bogs commonly located between open water and dry land whose protection has been identified as a high priority. Wetlands are defined in 40 CFR §232.2 and protected under Section 404 of the federal Clean Water Act. The United States Army Corp of Engineers exercises permitting authority over activities that would alter the wetlands environment.

All new CCR landfill(s) and lateral expansions must not be in wetland areas unless the Owner/Operator can demonstrate compliance with the requirements of 30 TAC §352.611/40 CFR §257.61. The Owner/Operator must complete the demonstration and obtain certification from a qualified Texas P.E. no later than the initial receipt of CCR in the CCR landfill.

## 2.4 Fault Areas

All new CCR landfill(s) and lateral expansions of CCR landfill(s) must be located away from active and inactive faults to ensure that the landfill liner will not be damaged by fault movement, and that pathways are not present for rapid leachate migration into the groundwater.

New and lateral expansions of CCR landfill(s) must not be located within 200 feet of the outermost damage zone of a fault that had displacement in the Holocene time, unless the Owner/Operator demonstrates that the structural integrity of the CCR landfill or lateral expansion will not be compromised at a setback distance of less than 200 feet. The demonstration must be certified by a qualified Texas P.E that the demonstration meets the requirements of 30 TAC §352.621/40 CFR §257.62 before receipt of initial CCR waste in the landfill.

## 2.5 Seismic Impact Zones

New and lateral expansions of CCR landfill(s) must not be located in "seismic impact zones", unless the Owner/Operator can demonstrate in accordance with 30 TAC §352.631/40 CFR §257.63 that all structural components (ex. liners, leachate collection and removal systems, and surface water control) of the landfill are designed to resist the maximum horizontal acceleration in lithified earth material for the site before the initial receipt of CCR in the CCR landfill. The demonstration must be certified by a qualified Texas P.E that the demonstration meets the requirements of 30 TAC §352.631/40 CFR §257.63.

The maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the horizontal acceleration will not exceed in 50 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

30 TAC §330.557/40 CFR §258.14 defines seismic impact zones as areas having a greater than 10% probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10-g in 250 years.

## 2.6 Unstable Areas

Existing, new, and lateral expansions of CCR landfill(s) must not be in an unstable area unless the Owner/Operator can demonstrate in accordance with 30 TAC §352.641/40 CFR §257.64 that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR landfill(s) to ensure that the integrity of the structural components will not be disrupted. Factors to consider when determining whether an area is unstable includes soil conditions, differential settling, and local geologic and human-made features. This demonstration must be conducted before the initial receipt of CCR waste in the CCR landfill(s).

## 2.7 Other Siting Considerations

To further evaluate the siting requirements, the siting selection criteria should include: General Siting Criteria, Technical Siting Criteria, and Other Siting Issues. General siting criteria are those necessary to complete a preliminary assessment of a potential CCR landfill(s) site. Technical siting criteria are those that must be addressed to fully evaluate the suitability of a site. Other siting issues include floodplains (40 CFR §257.3-1), endangered species (40 CFR §257.3-2), surface water (40 CFR §257.3-3), local jurisdiction, public participation, and technical guidelines and resources.

After the initial field investigation, which should include soil test borings and geophysical surveying, the best site can be chosen for comprehensive hydrogeologic evaluation, impact assessment, and engineering analysis. The factors which should be considered in site selection are: safety, enough time to react to groundwater contamination from the landfill, adequate space for containment or corrective action measures, adequate groundwater monitoring distances, and nuisance conditions. Additional concerns which should be considered are: hurricane storm surge, low lying areas with subsidence, sole source aquifer recharge areas, and areas of historic or archaeologic significance. The resources which may be helpful in evaluation of the site may include, but are not limited to: land resource map, soils map, geologic maps, aerial photos and satellite imagery, groundwater map, floodplains and surface water maps, and critical habitat maps. Information sources may include, but are not limited to: U.S. Geological Survey, Texas Bureau of Economic Geology, U.S. Department of Agriculture, TCEQ, Texas Water Development Board, Texas Department of Transportation, Texas State Soil and Water Conservation Board, Federal Emergency Management Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, and Texas Natural Resources Information System.

# Part 3 – Landfill Design Criteria

## 3.1 General

The CCR rules under 30 TAC 352, Subchapter F, Design Criteria, contain requirements for new and lateral expansion of a CCR landfill(s).

A landfill design should provide efficiency, safety, and environmental protection during active operation, and should also specify interim and final landfill(s) closure procedures that will assure long-term waste containment with minimum PCC maintenance.

## 3.2 Waste Characterization

The CCR waste is an industrial solid waste in Texas and must be characterized and classified. TCEQ RG-022, "Guidelines for the Classification and Coding of Industrial and Hazardous Waste" provides information on the waste classification system used by the TCEQ. In addition, if non-CCR waste, i.e., Class 1 or 2 waste, is disposed of in a CCR landfill, the TCEQ recommends testing the effect of the waste on the soils or lining materials to be used as waste containment barriers. One method available for determining the effects of waste leachate on a soil or geosynthetic liner is EPA Method 9090 (see TCEQ Technical Guideline No. 3 “Nonhazardous Industrial Solid Waste Landfills”). This testing will determine if the fluid constituents or the water extractable constituents of the waste have any detrimental effect (causing dissolution, shrinkage, increase in permeability, etc.) on the soils or liner materials that are used. In addition to advancements in manufacturing of liners using polyethylene resin which are resistant to wide variety of chemicals, extensive studies have been done demonstrating compatibility of leachate with the liner system. To verify compatibility of leachate with the liner system, the landfill facilities may submit alternate demonstration in lieu of EPA Method 9090. Industrial solid waste that have a significant detrimental effect on materials being used as permanent barriers for waste containment should not be landfilled unless the waste can be treated to eliminate the detrimental effects. Waste should be evaluated for compatibility with other waste. These wastes should be segregated in storage and disposal operations, as well as in the landfill.

## 3.3 Physical Stability of the Waste

While the possibility does exist of volume changes due to either expansion or contraction, subsidence or settlement of landfill areas will be the most commonly encountered situation. Subsidence of landfill(s) normally is due to dewatering, and differential compaction of the waste materials. The total amount of settlement that will occur at any given landfill will be a function of the total depth of the waste, the initial degree of compaction, and the composition of the waste. Most of the settlement occurs within the first few years of the landfill operation.

Appreciable settlement in a landfill can result in a depression on the landfill surface and could cause rainwater to pool and may affect or damage the liner system. Settlement also can produce cracks in the final cover that, in combination with ponded water, will result in greatly increased infiltration.

Settlement calculations, slope stability calculations and run-on/run-off calculations must be performed using generally accepted engineering practices to ensure physical stability of waste and minimize subsidence, ponding, slope failures and leachate generation. Based on evaluations, steps must be taken to put precautions and procedures in place to minimize settlement.

## 3.4 Landfill Composite Liner Design

This section provides guidance regarding engineering design, including construction and material specifications, of liners for the base and sides of the landfill. TCEQ recommends that the liner for each landfill be designed individually, but that the recompacted or constructed liner of soil materials and the synthetic membrane components must meet the requirements of 30 TAC §352.701/40 CFR §257.70. More stringent facility design features may be warranted if the standard recommended barrier, in combination with the natural geologic setting, do not provide assurance of effective long-term isolation of CCR waste. TCEQ publication, RG-534 September 2017 “Guidance for Liner Construction and Testing for a Municipal Solid Waste Landfill, may be consulted for design and installation of CCR landfill liners. In addition, please consult the EPA Publication EPA/600/R-93/182, "Quality Assurance and Quality Control for Waste Containment Facilities" to generate a quality assurance/quality control program.

### 3.4.1 New Landfill Liner Design

New and lateral expansions of CCR landfill(s) must be constructed with a composite liner. Both, a composite liner or an alternate composite liner must consist of two components, meeting the requirements of 30 TAC §352.701/40 CFR §257.70. TCEQ recommends the use of a composite liner composed of compacted soil immediately beneath a synthetic membrane liner (high density polyethylene, polyvinyl chloride, chlorinated polyethylene, butyl rubbers, etc.). The lower component must be a minimum of two-foot thick layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ centimeters per second.

### 3.4.2 Membrane Component of Composite Liner

The upper component must be a low permeable, minimum 30-mil thick geomembrane. If the geomembrane is made of high-density polyethylene (HDPE), the minimum thickness shall be 60-mil. Special precautions should be taken to seal and test all seams, inspect and test the membrane, and ensure that its integrity will be maintained. The TCEQ recommends that synthetic membrane material be thick enough for reliable seaming and for puncture resistance and be protected by a sufficiently thick soil cover.

The geomembrane should be resistant to tear, impact and puncture for long-term mechanical performance. The geomembrane must also be chemically compatible with the CCR leachate and other waste encountered. Continuous polymer sheet geomembranes are the most common type of landfill liners. Textured geomembrane liners can provide increased friction coefficients for steep-sloped applications. The upper geomembrane must be installed in direct and uniform contact with the compacted soil as required by 30 TAC §352.701/40 CFR §257.70(b).

### 3.4.3 Soil Component of Composite Liner

The basis of an effective landfill liner is properly compacted soil material, which is a component of a composite liner. The compacted soil material for CCR landfill liners should contain a significant quantity of clay. The liner soil should have a liquid limit of 30% or greater, a plasticity index of 15% greater, more than 30% by weight passing a number 200 sieve, gravel content less than 30%, and no particles larger than two inches. The hydraulic conductivity of the compacted soil should be $1x10^{-7}$ centimeter per second or less. If a soil meeting these specifications is not available, a common practice is to mix bentonite with the local soil.

The compacted soil component of the liner must be at least two-feet thick, as required by 30 TAC §352.701/40 CFR §257.70(b). Soil material to be compacted for a liner should be placed in lifts not less than six inches nor greater than nine inches in compacted thickness. The soil should be compacted by kneading with a padfoot roller, sheepsfoot roller, etc. The roller-foot length should be approximately equal to lift thickness. Selection of an appropriate molding moisture content and density will depend on the results of permeability tests and should be enough to allow clods to be completely broken-down during compaction. The recommended procedure is as follows:

- Determine compaction curves for the soil using Proctor (ASTM Standard Method D-698), Reduced Proctor (using 15 blows instead of 25), and Modified Proctor (ASTM D-1557) compaction efforts.
- Determine hydraulic conductivity of compacted specimens.
- Plot the compaction curves on a single chart, with a distinctive symbol for specimens with hydraulic conductivities $1x10^{-7}$ centimeter per second.
- Set specifications for molding water content and density to include only acceptable hydraulic conductivities and that meet other site engineering considerations.

In most cases, water content will be somewhat above optimum water content, by ASTM D-698, but in dry climate, a water content at optimum with greater mechanical compaction effort may reduce shrink-swell effects. A summary of borrow source material and soil liner requirements based on general engineering practices is provided in Table 3-1.

**Table 3–1: Soil Liner Requirements**

| Soil Property | Value |
|---|---|
| Plasticity Index (PI) | ≥ 15 |
| Liquid Limit (LL) | ≥ 30 |
| Percent Passing No. 200 Mesh Sieve | ≥ 30% |
| Percent Passing One-Inch Sieve | = 100% |
| Permeability | ≤ $1x10^{-7}$ cm/sec |

## 3.5 Alternative Landfill Composite Liner Design

The upper component must be a low permeable, minimum 30-mil thick geomembrane. If the geomembrane is made of high-density polyethylene (HDPE), the minimum thickness shall be 60-mil. An alternative lower component (must not be a geomembrane) may be used provided it has a liquid flow rate no greater than the liquid flow rate of two feet of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ centimeters per second. A geosynthetic clay liner (GCL) is an example of an alternative liner, provided it meets the hydraulic conductivity requirement. GCLs are factory manufactured hydraulic barriers, held together by needling, stitching, or adhesives. Bentonite, or other expansive clays, are commonly used in GCL construction.

The hydraulic conductivity of any alternative to the two feet of compacted soil must be determined using recognized and generally accepted laboratory or field methods as discussed in Section 3.6. The liquid flow rate comparison must be made using the equation below, which is derived from Darcy's Law for gravity flow through porous media (30 TAC §352.701/40 CFR §257.70(c)(2)).

$$Q/A = q = k\,(h/t + 1)$$

Where,

Q = flow rate (cubic centimeters/second);
A = surface area of the liner (squared centimeters);
q = flow rate per unit area (cubic centimeters/second/squared centimeter);
k = hydraulic conductivity of the liner (centimeters/second);
h = hydraulic head above the liner (centimeters); and
t = thickness of the liner (centimeters).

## 3.6 Hydraulic Conductivity Testing

The TCEQ recommends that prior to construction of a new or lateral expansion of a CCR landfill, the Sealed Double-Ring Infiltrometer (SDRI) test (ASTM D-5093), two-stage bore-hole test, or other field test be performed on a test fill that has been constructed under the same conditions and design as proposed for the landfill. Several other methods of in-situ hydraulic conductivity testing are available for soil liners. These methods include open infiltrometers, borehole tests with a constant water level in the borehole, porous probes, and air-entry permeameters. However, these methods are much less commonly used than the SDRI and two-stage borehole test. In lieu of SDRI test and two-stage borehole test, alternative test methods for hydraulic conductivity testing may be used with the TCEQ approval. In addition to field tests, laboratory hydraulic conductivity tests can be useful for quality control.

The hydraulic conductivity test report should include a description of the test apparatus (flexible wall, double ring, etc.), number of pore volumes passed, the hydraulic gradient during the test, soil sample preparation (compaction method, density, compacted in the tube or trimmed, etc.), and if a flexible wall permeameter is used, the maximum and minimum stress and the back pressure.

## 3.7 Leachate Collection Systems

As required under 30 TAC 352.701/40 CFR 257.70(d), new landfill(s) and lateral expansions of existing landfill(s) must include a leachate collection and removal system. The leachate removal system must be maintained and operated during the active life of the landfill, and during the PCC period.

The leachate collection system must be installed over the membrane liner of a CCR landfill to limit leachate depth to 30 centimeters (one foot) or less. By limiting the depth of leachate over the liner, standing liquid is kept out of the waste and leakage through the liner is minimized. To calculate maximum leachate head, use the following formula which can be found in EPA publications *SW-869* and in *CERI-88-33*:

$$h_{max} = \frac{L\sqrt{c}}{2}\left[\frac{\tan^{2}\alpha}{c} + 1 - \frac{\tan\alpha}{c}\sqrt{\tan^{2}\alpha + c}\right]$$

Where,

$h_{max}$ is the maximum leachate height;
L is the distance between collector drain pipes;
α is the slope angle of the drainage layer; and
c is rainfall inflow rate divided by drainage hydraulic conductivity.

The results of the leachate depth calculations depend upon what rainfall inflow rate is used. The design inflow rate should ignore any retardation or absorption of liquids by waste or cover material, other than that which is implicitly included in the following inflow rate assumptions. For the active life, the design calculations should assume an inflow rate into the leachate collection system equal to the average precipitation rate during the 5-year, 7-day rainfall, spread out over 7 days.

For the leachate collection layer, TCEQ recommends at least one foot of sand or gravel with a hydraulic conductivity of at least 0.01 cm/sec, overlain by a fabric or granular filter layer, to prevent clogging. High Density Polyethylene (HDPE) drainage net, which also is called geonet, could be substituted, provided that maximum leachate mounding is kept within the thickness of the geonet. Leachate mounding usually can be kept within the geonet on sidewalls of the leachate collection system and removal system of facilities that are in arid regions of Texas. The sand and gravel portion of the leachate collection system should be designed so that after closure, it can remove the leachate, assuming a daily inflow rate equal to the mean annual rainfall divided by 365 days.

If a design is found to allow excessive mounding, mounding can be reduced by design changes such as moving collector drain pipes closer together, increasing the bottom slope of the liner, having multiple layers of geonet, or increasing the hydraulic conductivity of the granular drainage layer.

In accordance with 30 TAC §352.701/40 CFR §257.70(d), the leachate collection system must be constructed of materials that are chemically resistant to the CCR and any non-CCR waste managed in the landfill and the leachate expected to be generated. In addition, the leachate collection system must be designed such that it has sufficient strength and thickness to prevent collapse under pressures exerted by overlying waste, waste cover materials, and equipment used at the CCR landfill, and the system must be operated to minimize clogging during the active life and PCC period of the landfill.

# Part 4 - Operating Criteria

## 4.1 General

The CCR rules under 30 TAC 352, Subchapter G, Operating Criteria, contain requirements for existing, new, and any lateral expansion of a CCR landfill.

For continuing evaluation and future planning, detailed records should be kept of all incoming material: volume, waste analysis and characterization, and source or origin. It is also important to record accurately the location of final disposal of all CCR waste buried at the site.

The on-site roads to the unloading area should be of all-weather construction. These roads should be maintained in full operating condition all times and routinely inspected for spills.

## 4.2 Treatment or Stabilization of Free Liquids

CCR waste that contain free liquids should not be placed in a landfill without adequate treatment. Wastes that are liquid or semisolid should be mixed with clay-rich soil, cement, boiler fly ash, cement kiln flue dust, or other effective sorbent prior to their placement in landfill(s). Granular soil materials are not recommended as sorbents due to the potential for waste mobilization by infiltrating fluids. Sorbents for CCR waste should not be subject to future decomposition or to the release of liquids after compaction.

## 4.3 Working Face

The size of the working face of the landfill is determined somewhat by the rate of unloading of incoming vehicles. The working face should be as narrow as possible to minimize the exposed area and reduce contaminated stormwater runoff, but not so small as to interfere with the unloading operations and the movement of landfill equipment.

## 4.4 Wet Weather Operation

Wet weather can seriously hamper the operations of a landfill by making the soil too soft or slippery for equipment operation. Wet weather can also seriously interfere with trenching, covering, and general traffic flow to and from the working face. For these reasons, all-weather roads and adequate drainage should be provided.

## 4.5 Maintenance

Routine maintenance of all facilities (roads, dikes, ditches, fences, spill control, safety, emergency, and operating equipment, etc.) at the landfill site is essential to maintain a clean, orderly, safe, and environmentally acceptable operation. All components should be inspected frequently and kept in good condition.

## 4.6 Fugitive Dust Control Plan

The Owner/Operator of CCR landfill(s) must comply with 30 TAC 352, Subchapter G, Operating Criteria, and adopt control measures that will effectively minimize CCR dust from becoming airborne at their facility. The Owner/Operator must select, and include in the CCR fugitive dust control plan, the CCR fugitive dust control measures that are most appropriate for site conditions, along with an explanation of how the measures selected are applicable and appropriate for site conditions. Examples of typical control measures that may be appropriate include (40 CFR §257.80(b)(1)):

- Locating CCR waste inside an enclosure or partial enclosure;
- Reducing speed of vehicles;
- Covering truck beds used in transporting CCR;
- Operating a water spray or fogging system;
- Reducing fall distances at material drop points;
- Using wind barriers, compaction or vegetative covers;
- Establishing and enforcing reduced vehicle speed limits;
- Paving and sweeping roads;
- Reducing or halting operations during high wind events;
- Maintaining tree lines and vegetative covers; or

- Applying a daily cover.

The written CCR fugitive dust control plan must be placed in the facility's operating record and amended when there is a change in operating conditions. An initial Fugitive Dust Control Plan must be developed and include procedures for:

1. Logging citizen complaints involving CCR fugitive dust events, and
2. How the Owner/Operator will periodically assess the effectiveness of dust control.

The Owner/Operator must have the initial CCR Fugitive dust Control Plan in place by October 19, 2015 for existing units, or by initial receipt of CCR waste in any new or lateral expanding CCR landfill(s) at the facility. The Owner/Operator must obtain certification from a qualified Texas P.E. that the initial CCR fugitive dust control plan, and any subsequent amendment, meets the requirements of 30 TAC §352.801/40 CFR §257.80. The Annual Fugitive Dust Control Plan must meet the requirements of 30 TAC 352, Subchapter K, Recordkeeping, Notification, and Posting of Information to the Internet.

### 4.6.1 Annual Fugitive Dust Control Report

The Owner/Operator must also prepare Annual CCR Fugitive Dust Control Reports no later than 14 months after the initial fugitive dust control plan is placed in the facility's operating record. Reports should include drawings, maps and/or aerial photographs identifying the location of the CCR landfill(s) and potential sources of CCR fugitive dust. Subsequent annual reports are due one year after the date of completing the previous report as required by 30 TAC §352.801/40 CFR §257.80(c). The Annual Fugitive Dust Control Report must meet the requirements of 30 TAC 352, Subchapter K, Recordkeeping, Notification, and Posting of Information to the Internet.

## 4.7 Run-on and Run-off Controls

The Owner/Operator must prepare initial and periodic run-on and run-off control system plans to prevent the run-on onto active portion of the landfill and to collect and control the run-off from active portion of the landfill to satisfy the requirements of 30 TAC §352.811/40 CFR §257.81.

### 4.7.1 Run-on and Run-off Control System Plan

The plan must document the following:

- Design of run-on and-run-off control system;
- Engineering calculations for run-on and run-off control system; and
- Construction of run-on and run-off control system.

The initial plan must be prepared no later than the date of initial receipt of CCR waste in the new CCR landfill(s) and any lateral expansion of a CCR landfill. The plan may be amended at any time provided a revised plan is placed in facility operating records. The written plan must also be amended if there is substantial change in conditions after the current plan was placed in facility operating records. The plan must be revised every five years as required by 30 TAC §352.811/40 CFR §257.81(c)(4).

Run-on/run-off from the landfill can be controlled using the natural drainage patterns of the surrounding topography, and by using man-made structures such as perimeter berms, diversion channels, drainage ditches, and other stormwater management structures. For additional guidance, refer to RG-417 revised "Surface Water Drainage and Erosional Stability Guidelines for a Municipal Solid Waste Landfill".

“Run-on” applies to rainwater (stormwater) and leachate that drains over land onto any part of a CCR landfill, or lateral expansion of a CCR landfill. Run-on controls should be designed to prevent water from entering the active portion of the landfill.

“Run-off” applies to rainwater and leachate that drains over land away from any part of a CCR landfill, or lateral expansion of a CCR landfill. Run-off controls should be designed to collect and control the volume of water leaving the active portion of the landfill. Run-off from the active portion of the CCR landfill must be addressed by either coverage through the TCEQ Multi-Sector General Stormwater Permit (TXR050000), or by an individual stormwater discharge permit in accordance with the Texas Pollutant Discharge Elimination System (TPDES), issued by the TCEQ.

“Active portion” of the landfill means the part of the landfill that has received or is currently receiving CCR or non-CCR waste and has not completed closure.

The landfill run-on/run-off control system must be designed, constructed and maintained to handle the peak discharges and water volume from a 24-hour, 25-year storm as required by 30 TAC §352.811/40 CFR §257.81(a) and must be used for:

- Calculations and designs of drainage structures to address run-off control;
- Calculations and designs of drainage structures to address run-on control;
- Calculations for maximum velocities; and
- Any other drainage design aspects requiring a storm frequency and duration.

Run-on/run-off controls may be permanent or temporary, as functions may change over time as landfill development and operation changes.

New and lateral expansions of existing CCR landfill(s) should be engineered and designed to prevent new surface water drainage patterns that will not adversely affect the existing area drainage patterns, peak flows, water velocities, volumes and facility boundary discharge points.

### 4.7.2 Calculating Run-on and Run-off

Direct run-off is the fraction of total precipitation that is not lost as hydrologic abstraction (effective precipitation), but flows overland, through drainage structures, and to the facility boundary. Direct run-off is expressed in terms of specific depth of stormwater spread uniformly over the sub-drainage area of interest after subtraction of all abstractions. Direct run-off depth depends on rainfall duration, frequency, and total abstraction. It is necessary for estimation of run-off volumes and peak discharge rates.

Precipitation design data can be obtained from the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Data Server (PFDS), and the United States Geologic Survey (USGS) Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas.

An acceptable method for determining the volume of water lost and excess volume run-off is the Natural Resources Conservation Service Runoff Curve Number Method. This method can be found in TR-55, available at:

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf

A typical curve number for an undeveloped site may vary between 65 for a sandy soil that is located near a coastal region to 84 in a hilly region with clay soils in North Central Texas. Typical curve number values for final cover systems range from 85 to 90. Therefore, if the drainage subarea does not change for a specific discharge point, the expected volume increase could vary from 5% to 60%.

Accepted methods for calculating stormwater run-off are: Rational Method; United States Army Corps of Engineers (USACE) HEC Models; an alternative method which must be shown to result in run-off values equal or greater than values achieved using the Rational Method, or a USACE HEC Model.

## 4.8 Perimeter Containment Dike

Maximum recommended CCR waste elevations are considered in relation to a design topographic surface that is termed as the design grade. The design grade is either the natural ground surface elevation or the crest elevation of a containment dike that effectively raises the ground surface around the landfill. The containment dike should be constructed with an exterior slope no steeper than 4:1 (horizontal: vertical) for CCR waste, and with a minimum crest width of eight feet. The overall performance objectives for the dike are:

- Prevent washout, release, or exposure of CCR waste;
- Physical stability against slope failure, with a safety factor of 1.5;
- Hydrostatic and hydrodynamic stability against storms and floods;
- Prevent stormwater from reaching the waste to contribute to leachate;
- Minimize the release of leachate; and
- Minimize long-term maintenance.

Generally, a dike is constructed of compacted clay-rich soil, but functionally equivalent materials that meet the following minimum standards would be acceptable for CCR waste landfill(s). The outer part of the dike, which underlies the crest and outer slope of the dike, acts primarily to facilitate run-off and provide protection against erosion. It may be necessary to use lined conveyance structures to route run-off to the natural grade elevation. The portion of the outer part is most critical in preventing erosion.

The erosion-critical portion should be constructed of clean soils that will support vegetation and that will resist erosion. If available, a soil with a lower erosivity than clay should be used with this design. The core portion routinely may consist of any clean soil that has suitable physical strength.

The inner part of the dike includes part of the liner that is equivalent to the bottom liner. The liner, and the leachate collection system should extend continuously from the bottom liner up the sides to a level above the CCR waste at the edge and should isolate the waste from the outer part of the dike. Any portion of the inner part of the dike that is outside of the liner should meet the standards of the core portion. Any material within the inner part of the dike must have enough strength to produce a stable inner slope. The design should not put an undue stress on any liner component. The dike must be designed based on sound engineering practices.

## 4.9 Maximum Recommended CCR Waste Elevations

The TCEQ prefers that CCR waste remain below design grade, which is below the potential base line of gully erosion. The TCEQ recommends that CCR waste not be placed above grade in a part of a landfill that could be exposed by gullying. CCR waste should be placed no higher than three feet below the design grade elevation at the outer edge of the waste but could slope up at a maximum slope of 3% toward the center of the landfill.

If a landfill is to be placed over an existing landfill, the predicted effect of this additional weight on the existing liners and leachate collection system due to consolidation should be determined.

## 4.10 Inspection Requirements

CCR landfill(s) must be regularly inspected in accordance with 30 TAC §352.841/40 CFR §257.84.

### 4.10.1 Weekly Inspection

CCR landfill(s) and lateral expansions must be visually inspected by a qualified person at intervals not exceeding seven days. Qualified persons during inspections look for signs of structural weakness or damage that could compromise the safety or operation of the landfill.

The scope of visual inspections should include:

- Vegetation cover and topsoil condition;
- Surface erosion;
- Animal burrows;
- Sinkholes;
- Standing water/ponding;
- Landfill identification marker signage;
- Cross-contamination of stormwater and leachate;
- CCR release to adjacent surface water bodies;
- Sediment buildup in drainage works;
- Groundwater monitoring wells;
- Instrumentation and alarms;
- Pump and piping condition; and
- Leachate collection system.

The Owner/Operator of new and any lateral expansion of a CCR landfill must initiate the inspection upon initial receipt of the of CCR by the CCR landfill(s). Written documentation of the inspection activity must be recorded in the facility's operating record. If a CCR release or deficiency is found during the inspection, the Owner/Operator must prepare written documentation detailing a corrective action plan to remedy the release or deficiency as soon as feasible. The inspection must meet the requirements of 30 TAC §352.841/40 CFR §257.84(a).

### 4.10.2 Annual Inspection and Report

An annual inspection by a qualified Texas P.E is required for existing new and lateral expansions of CCR landfill(s). The purpose of the annual inspection is to ensure the continued, environmentally safe operation of the CCR landfill. The inspection must ensure that the design, construction, operation, and maintenance of the CCR landfill is consistent with recognized and generally accepted good engineering standards. The inspection must include review of available plant information regarding the status and condition of the landfill, a visual walk-down to identify areas of distress or structural weakness, approximate volume of CCR material contained in the landfill, and changes in the geometry of the unit since the last inspection.

The Owner/Operator must complete the initial inspection no later than 14 months following the date of initial receipt of CCR in CCR landfill for new and any lateral expansion of the CCR landfill. All subsequent inspections must be conducted within one year of the previous inspection. Any deficiency or release must be remediated and documented detailing the corrective measures taken as soon as feasible. The inspections must meet the requirements of 30 TAC §352.841/40 CFR §257.84(b). The executive director must be verbally notified within 24 hours and in writing within five days if a deficiency under 40 CFR §257.84(b)(5) could result in harm to human health, the environment, or has resulted in a release. All other deficiencies must be notified in writing within 14 days. Inspection reports must meet the recordkeeping, notification, and internet posting requirements of 30 TAC 352, Subchapter K.

# Part 5 - Landfill Groundwater Monitoring and Corrective Action

The CCR rules under 30 TAC 352, Subchapter H, Groundwater Monitoring and Corrective Action, are applicable to all CCR units, including all CCR landfill(s), new and lateral expansion of a CCR landfill.

All information and data required by 30 TAC 352, Subchapter H, concerning the establishment of a groundwater monitoring system, a sampling and analysis program, and monitoring data must be included in the facility Annual Groundwater Monitoring and Corrective Action Report.

See Technical Guideline No. 32 Groundwater Monitoring and Corrective Action, for more information on groundwater monitoring, sampling, and corrective action.

# Part 6 - Closure and Post-Closure Care

## 6.1 General

Closure and PCC requirements for CCR landfill(s) are found in 30 TAC 352, Subchapter J, Closure and Post-Closure Care. The Owner/Operator of CCR landfill must use one of two options to close a landfill.

First option, ‘Clean Closure’ requires the removal of all CCR waste along with affected soils. For this option, opportunities for beneficial use should be considered early in the closure planning process. The Owner/Operator should include an evaluation of the chemical and physical properties of the CCR waste. Other factors for consideration are the amount (volume) of CCR waste, the haul distance and resulting cost, and the suitability of the CCR properties for the intended beneficial use.

Second option, ‘Close in Place’ requires the waste are left in place and stabilized, and a cap or cover meeting the requirements of this subchapter is placed on top of the waste. It is recommended that a geosynthetic and/or clay-rich soil cap be graded, contoured, and overlain with vegetated topsoil to prevent erosion. Continued safe containment of the CCR waste primarily depends on maintaining the integrity of the cover system. Therefore, the cover must be designed and constructed to minimize the need for maintenance. TCEQ recommends that covers with long slopes be designed with terraces, protected waterways, and other structures to prevent or limit excessive runoff velocities during storm events.

Closing in place requires the Owner/Operator to take certain precautions for a minimum of 30 years after closure, known as PCC in accordance with 30 TAC §352.1241/40 CFR §257.104. PCC activities include inspections of the closed CCR landfill(s), monitoring of the groundwater, and maintenance and repair. The Closure and Post-Closure Plan must meet the requirements of 30 TAC 352, Subchapter K, Recordkeeping, Notification, and Posting of Information to the Internet.

The Owner/Operator who elects to remove the CCR waste from the unit (clean close) are not subject to the PCC requirements of 30 CFR §352.1241/40 CFR §257.104.

## 6.2 Closure and Post-Closure Care Plan

### 6.2.1 Closure Plan

A written closure plan, including all steps and schedules identifying major milestones, is required for CCR landfill(s) in accordance with 30 TAC §352.1221/40 CFR §257.102. The written closure plan must be amended whenever there is a change in operation of the CCR landfill, or unanticipated events necessitate a revision.

The closure plan must be certified by a qualified Texas P.E. that the plan meets the requirements of 30 TAC 352, Subchapter J, Closure and Post-Closure Care.

The closure plan must include, at a minimum, the following information:

- A narrative description how the CCR landfill(s) will be closed;
- A description of the removal and decontamination procedure, if the unit is closed by removal of the CCR;
- Design and installation procedure for the final cover system, if the CCR waste is left in place;
- Maximum inventory of the CCR ever on-site and largest area of the landfill requiring final cover; and
- A schedule for completion of all activities, including an estimate of the year in which all closure activities for the CCR unit will be completed.

Initial written closure plan for new CCR landfill(s), and any lateral expansion of a CCR landfill(s) must be placed in the facility operating record, no later than the date of the initial receipt of CCR waste in the CCR unit. The closure plan must be certified by a qualified Texas P.E., that the plan meets the requirements of 30 TAC §352.1221/40 CFR §257.102 and be prepared in a manner consistent with recognized and generally accepted good engineering practices. The Owner/Operator has completed the written closure plan when the plan, including the certification, has been placed in the facility's operating record. The written closure plan may be amended before or after closure activities have commenced, if unanticipated events necessitate a revision.

### 6.2.1 Post-Closure Care Plan

A written PCC plan, including all steps and schedules identifying major milestones, is required for CCR landfill(s) in accordance with 30 TAC §352.1241/40 CFR §257.104. The closure plan must include, at a minimum, the following information:

- A narrative description of the monitoring and maintenance activities, including maintaining integrity and effectiveness of final cover system, maintaining the integrity and effectiveness of leachate collection system, and maintaining and monitoring the groundwater monitoring system;
- A description providing information about subsequent PCC activities if the CCR landfill is operating under assessment monitoring at the end of the 30-year post closure period;
- Provide contact information about the facility during the PCC period; and

- A description of the planned uses of the property during the PCC period.

The PCC plan may be amended any time, if unanticipated events necessitate a revision. The PCC plan must be certified by a qualified Texas P.E. that the plan meets the requirements of 30 TAC §352.1241/40 CFR §257.104 and be prepared in a manner consistent with recognized and generally accepted good engineering practices.

## 6.3 Initiation and Completion of Closure

### 6.3.1 Landfill Cover

The cover or cap, which is the component of the landfill that overlies waste, serves to minimize water infiltration, promote good surface drainage, maximize runoff, and to separate waste from animals, plant roots, and surface exposure.

Before the final cover is placed for the closure of the landfill, by applying an interim cover over waste as each section is filled, the active area is minimized, contaminated stormwater and leachate production are decreased, and liability for closure costs is reduced. When waste settlement and consolidation have stabilized and the area with interim cover is large enough to allow effective and efficient construction, the interim cover should be incorporated into or replaced by the final cover.

Where necessary to prevent air pollution problems, public health hazards (particulates, etc.), and excessive leachate production, intermediate cover should be applied to deposited waste. Operator of landfill(s) accepting CCR waste should cover this waste daily with a minimum of six inches of soil. At a minimum, this type of waste should be covered once a week. CCR waste that pose no problem from short-term open exposure may not require daily or weekly cover.

In accordance with 30 TAC §352.1221/40 CFR §257.102(d)(3), the final cover system must meet the following requirements:

- The permeability of the final cover must be less than or equal to the permeability of any bottom liner or natural subsoil or a permeability no greater than 1x$10^{-5}$ centimeter per second whichever is less;
- The cover system must have an infiltration layer of a minimum of 18 inches of earthen material;
- The final cover system must have a minimum of 6 inches of erosion layer of earthen material that is capable of sustaining native plan growth; and
- The final cover system must be designed to accommodate settling and subsidence.

Cover material should consist of a well-graded, fine-grained, clay-rich soil having low cracking potential and good workability and compaction characteristics. The TCEQ recommends a soil containing at least 20% of material passing a No. 200 sieve, having a plasticity index between 10% and 35%, having less than 10% gravel, and that includes no rocks larger than two inches in diameter. Based on general engineering practices, the TCEQ recommends that the compacted soil should have a hydraulic conductivity of 1x$10^{-7}$ centimeters per second or less. If a suitable soil is not available on the site, it will be necessary to import the appropriate cover material or modify on-site material. The cover should be constructed and maintained to avoid ponding and erosion.

A composite cover system should have at least two feet of compacted soil underlying the membrane. An alternative cover system could include a Geosynthetic Clay Liner (GCL) layer. The GCL should be placed over at least two feet of compacted soil. Compacted soil beneath a GCL will provide a barrier if the thin GCL is damaged. In addition, a cap should be at least as impermeable as the liner; that is, if the liner includes a membrane, the cap also should have a membrane.

The relationship between moisture content, compacted density, and hydraulic conductivity should be determined for compacted soil cover material, using the procedures that were described in this guideline for the liner soil component. Compacted soil cover material should be placed in lifts not less than six inches nor greater than nine inches, compacted with a fully-penetrating footed roller to appropriate density and water content, and scarified to a minimum depth of two inches prior to placement of the following lift. The final cover should be graded to have a crown with slopes between 3% and 5%.

The TCEQ recommends a drainage layer beneath the topsoil, both to reduce infiltration through the cover and to increase slope stability. The entire surface of the landfill should be covered with a minimum of eighteen inches of earthen material to minimize infiltration of liquids through the closed CCR landfill.

An unvegetated rock or gravel surface is resistant to erosion, but it greatly increases net infiltration of stormwater. Rock or gravel should be considered only at very arid sites. TCEQ does not recommend concrete or asphalt paving as they become less effective (cracks, spalls, brittle, etc.) over time.

An alternate cover may be used if it meets the requirements of 30 TAC §352.1221/40 CFR §257.102(d)(3)(ii)(A) through (D). The final cover must be certified by a qualified Texas P.E.

### 6.3.2 Erosion Control

The landfill design must provide effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, closure, and PCC. The estimated peak velocities for top surfaces and external embankment slopes should be less than the permissible non-erodible velocities.

The design should avoid stormwater concentration that could promote serious erosion in the long term. Soil loss predictions based on the Universal Soil Loss Equation (USLE) or its revisions, the Water Erosion Prediction Project (WEPP), and the Wind Erosion Equation (WEQ) are primarily useful in active-management situations, such as agriculture or active landfilling operations, where periodic regrading evens out soil loss from sheet and rill erosion and prevents the establishment of gullies. During and after the PCC period, although sheet, rill, and wind erosion should be kept at low levels, gully erosion will be of the greatest concern. Even if overall areal soil loss is not excessive, deep gullies could reach down to expose deep cover components and the waste.

Whether a vulnerable slope develops gullies depends on the amount of time between rainstorms, geological origin of the soil, and many factors other than the layout of the slope. Both the USLE and WEPP are incapable of predicting gullying. However, if a slope is designed to restrict water flow velocities on all parts of a slope overlying above-grade CCR waste to those velocities where gullying is unlikely to occur, other risk factors may be disregarded. TCEQ recommends that long slopes should be designed with terraces, protected waterways, and other structures to prevent excessive runoff velocities during storms.

A procedure the TCEQ recommends for calculating storm water velocity down a slope is based on field data (Gilley et al., T. ASAE 33(6):1900-1906, 1990) that was used to develop the WEPP.

- Conduct a hydrologic study, using site-appropriate rainfall data and assuming conditions that maximize runoff rate, to determine the maximum downslope flow rate for various parts of the slope;
- Considering that typical rill spacing is about 1 rill per meter of field width, use the flow rate per meter of slope width as the flow rate in a rill;

- Calculate the rill width as:
  - Width (meters) = $1.13*(Qe^{.303})$;
  - Where Qe is the discharge rate in a rill in cubic meters per second; and
- Assuming a rectangular channel, use Manning's equation to compute flow velocity in the rill.

The landfill should be designed to limit stormwater flow velocity on all parts of the slope, including in rills, to no more than 1.5 feet per second (0.46 meter per second) over sand, silt, sandy loam, or silty loam, to no more than 2.0 feet per second (0.61 meter per second) over silty clay loam or sandy clay loam, and to no more than 2.5 feet per second (0.76 meter per second) over clay. If the site has dispersive clays, which are much more prone to erode, please contact the TCEQ for additional site-specific guidance. The design should limit velocities, even if the vegetation were to receive no care after post closure. The lack of care could shift the mix of plant species and probably would develop some bare spots. A gully that begins in a bare spot can undercut and advance uphill into vegetated areas. The slope design should include a safety factor of at least 1.5 for CCR landfill(s).

### 6.3.3 Slope Stability

Slopes of the liner, cover, and lateral containment dike should be evaluated for stability against mass movements. Calculations should use actual measured shear strengths of the slope materials and of the interfaces between slope materials as they will occur at the landfill, rather than using general figures from a manufacturer or from other sites. Of particular concern is the interface between a geomembrane and (saturated) soil or between a geomembrane and another manufactured product. The analysis should consider seepage forces, especially if the cap does not have a drainage layer. The design should have a safety factor under representative or typical conditions of at least 1.5 for CCR landfill(s). The safety factor for other potential conditions, including development of residual strength, should be at least 1.0.

### 6.3.4 Climate Considerations

If a landfill is in an area of recurring storms (coastal high hazard areas) its design should provide adequate protection from storm surge, tropical storm rainfall, and wave action during flooding.

Any facility within the 100-year floodplain should be designed so that it does not significantly restrict flood flow, reduce the temporary water storage capacity of the floodplain, or allow washout of waste.

Where annual rainfall is high, especially where it exceeds gross evapotranspiration, the leaching potential of a landfill could be high. A calculation of water-balance and infiltration is recommended to show if the cover design and leachate collection system design are adequate.

## 6.4 Alternative Closure Requirements

Alternative closure requirements of 30 TAC 352, Subchapter J, Closure and Post-Closure Care, provides the Owner/Operator of CCR landfill(s) subject to closure the ability to continue to receive CCR waste provided certain conditions are met (30 TAC §352.1231/40 CFR §257.103).

# Part 7 - Financial Assurance

Financial assurance is required of the Owner/Operator required to perform PCC as set out in 30 TAC 352, Subchapter J. Financial assurance must be established and maintained for the duration of the PCC period (30 TAC §352.1241), except for CCR units in which waste is removed and undergoing clean closure.

## 7.1 Post-Closure Care Cost Estimate

The Owner/Operator is required to perform PCC and shall submit a written cost estimate when submitting the registration application (30 TAC §352.1101). The cost estimate shall be in current dollars for the 30-year PCC period to perform maintenance as required by 30 TAC §352.1241/40 CFR §257.104. The cost estimate shall be based on the costs of hiring a third-party to perform maintenance during the PCC period. When the Owner/Operator is unable to make a successful demonstration for ending the PCC period, they must provide a written cost estimate in current dollars for continuing the PCC period in accordance with 30 TAC §§352.1101 and 352.1241.

A final landfill cover system must be installed in accordance with the requirements that apply to landfill(s); and comply with all PCC requirements, including maintenance and monitoring throughout the PCC period.

A detailed estimate, in current dollars, of the annual cost of monitoring and maintenance of the facility in accordance with the applicable PCC regulations must be included in the report.

There may be additional site-specific issues that must be considered by applicants in order to comply with applicable TCEQ rules and federal regulations. Costs should be developed in detail for a minimum of 30 years of PCC activities to be conducted by a third party, for each applicable unit.

The applicant must submit details of item costs and number of each item for off-site disposal of leachate and bailed monitor well water, labor and supervision, monitor well sampling and analyses, inspection and repair of the cap(s), mowing and re-seeding of the vegetative cover, maintaining site security, etc. Provide an itemized cost estimate for the CCR landfill(s) PCC.

The PCC cost estimate must include, at a minimum and as applicable, the following annual cost line items:

- Final cover maintenance and repair, including erosion and vegetation repair, ongoing mowing, and reseeding, etc.;
- Maintenance of run-on, run-off, and stormwater control structures;
- Maintenance of signs, fencing and other security systems, survey monuments, etc.;
- Maintenance and operation of leachate collection systems, including sampling and analysis, treatment, and off-site disposal;
- Maintenance and operation of groundwater monitoring well systems, including monitoring well replacement as necessary, sampling and analysis, treatment and off-site disposal of purged water, preparation of periodic reports as required by the permit, and any consulting fees;
- The sum of the total annual costs multiplied by either the full 30-year PCC period, or the PCC period remaining at the time the estimate is prepared, provided that a minimum of 10 years PCC costs is maintained;

- PCC notices, surveys, and deed notices; and
- The addition of a minimum 10% contingency fee for unknowns and omissions.

As units are added or deleted from these tables through future registration amendments or modifications, the remaining itemized unit costs should be updated for inflation in accordance with 30 TAC §37.131 when re-calculating the revised total cost in current dollars.

Total annual cost of PCC for the facility including costs of contingent PCC should be multiplied by 30 years.

The TCEQ has published Technical Guideline No. 10, "Closure and Post-Closure Care Cost Estimates", for calculating post-closure costs which should be consulted.

Example Worksheet for Landfill Post-Closure Care Cost Estimates

| Project Cost Categories | Cost Estimate |
|---|---|
| Inspection: security (signs and fencing, benchmarks, final cover) | $ |
| Maintenance: vegetative cover (mowing, re-seeding, fertilizing vegetative cover, and dike), etc. | $ |
| Groundwater sample collection (# wells x # hrs./sampling event x # sampling events) | $ |
| Groundwater sample analysis (# wells x 4 samples/well x # events/yr.) | $ |
| **Leachate characterization sample:** | |
| Contaminated leachate disposal-profiling | $ |
| Contaminated leachate disposal-transportation | $ |
| Contaminated leachate disposal fee | $ |
| Plug and abandon monitoring wells during 30 years of PCC | $ |
| Annual report preparation & submittal to TCEQ | $ |
| Engineering, mobilization, site preparation, etc. | $ |
| Any other costs | $ |
| Subtotal | $ |
| Minimum 10% Contingency | $ |
| Estimated Annual PCC Cost Total | $__(20__dollars) |

## 7.2 Financial Assurance Mechanism

The financial assurance for PCC is required in accordance with 30 TAC §352.1101. The applicant shall demonstrate the financial assurance within 90 days after approval of the registration with a financial mechanism acceptable to TCEQ in compliance with 30 TAC §352.1101(c) /30 TAC 37, Subchapters A-D, except as indicated in 30 TAC §352.1111, in an amount no less than the amount specified in the approved PCC cost estimate.

# Part 8 - Landfill Recordkeeping, Notifications, and Posting of Information to the Internet

## 8.1 Recordkeeping Requirements

The CCR rules under 30 TAC 352, Subchapter K, Recordkeeping, Notification, and Posting of Information to the Internet, contain requirements for CCR landfill(s).

The Owner/Operator of CCR landfill(s) must maintain records (files) generated in response to 30 TAC §352.1301/40 CFR §257.105 for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record or study, and submit to the TCEQ I&HW Permits Section any demonstration or documentation, if requested. Information on any demonstration or documentation will include, but not limited to location restrictions, design criteria, certification, construction, operating criteria, groundwater monitoring, corrective action, closure, PCC, and retrofit criteria. Design and construction records must be kept until closure. Corrective action effectiveness reports must be kept until the completion of the remedy. Facilities need only retain the most recent revision in the record for many of the reoccurring plans and reports. 30 TAC §352.1301(b) requires that groundwater monitoring and associated elevation records must be kept for the active life and the PCC period of a CCR landfill(s). Any report, record, demonstration, or other application material provided as part of an application must be kept for the life of the facility.

## 8.2 Notification Requirements

The Owner/Operator of CCR landfill(s) must notify the TCEQ within 30 days of placing in the facility's operating record and Owner/Operator's publicly accessible website, the information on demonstrations or documentation regarding location restriction, design criteria, operating criteria, groundwater monitoring and corrective action, closure and PCC, and retrofit criteria (30 TAC §352.1311/40 CFR §257.106). In addition, the Owner/Operator of CCR landfill(s) must provide notification to the TCEQ of the availability of design information and certification within 60 days of commencing construction of a new landfill and the design certification. The Owner/Operator must also place the information on receipt of CCR waste, by the new CCR landfill(s), no later than the initial receipt date and the construction certification of the landfill.

## 8.3 Internet Site Requirements

The Owner/Operator of CCR landfill(s) must maintain a publicly accessible website titled "CCR Rule Compliance Data and Information" (30 TAC §352.1321/40 CFR §257.107). Information must be posted to the publicly accessible website within 30 days of placing the information in the operating record, as required by 30 TAC §352.1301/40 CFR §257.105. In addition, 30 TAC §352.1321 identifies items the Owner/Operator must post to comply with public participation requirements.