Topic: Closure and Post-Closure Care Cost Estimates

Applicability

The Texas Commission on Environmental Quality (TCEQ) prepared this technical guideline in accordance with Title 30 Texas Administrative Code (30 TAC) Section (§) 335.3, to promote the proper calculation of financial assurance related to Closure and Post-Closure Care (PCC) of hazardous and nonhazardous industrial solid waste permitted facilities.

Purpose

This technical guideline (TG-10) provides general recommendations addressing closure and PCC cost issues. There may be additional site specific issues that must be considered by applicants in order to comply with applicable TCEQ rules and federal regulations. Applicants should refer to the applicable rules found in or incorporated by 30 TAC Chapter 350, Subchapter B, 30 TAC Chapter 335, Subchapter F, and 30 TAC Chapter 335, Subchapter H.

Note: This guideline does not address corrective action costs. Corrective action costs are separately determined for purposes of meeting the financial assurance requirements for a compliance plan.

Introduction

An owner or operator of a hazardous waste treatment, storage, or disposal facility must prepare detailed written estimates of the current costs of closing the facility or units, of monitoring and maintaining them after closure. These detailed cost estimates must be based on those activities and procedures specified in the facility closure and PCC plans, and are used in determining the financial assurance dollar amounts required by the permit for closure and PCC. The basic assumptions which apply to these cost estimates include the following:

- The estimates are in current dollars for a third party to conduct and complete all closure and PCC activities.
- The estimates must be based on the point in the facility's active life when its operation would make closure the most expensive. This is interpreted as the abandonment of the facility at full capacity, with no operable on-site equipment, and with off-site shipment and disposal of all on-site waste, waste residues, decontamination waste, contaminated stormwater, and leachate.
- The estimates must be based on the maximum inventory of on-site waste over the active life of the facility.
- The estimates must not incorporate any salvage value from the sale of hazardous waste, facility structures, equipment, land, or other assets associated with the facility at the time of closure.
- The contingent closure and PCC costs must be supplied when required for surface impoundments, waste piles, or tank units. The more expensive of the two estimates will be used in calculating the total facility closure and PCC costs.
- Closure costs are one-time costs. PCC costs are developed by multiplying annual costs 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.

- The estimates must include a minimum 10% contingency factor to account for unknowns and omissions.

Cost estimates may be based on engineering line-item estimates or third-party contractor bids. The owner or operator must furnish bid specifications for third-party estimates. Detailed supporting information must be provided to the TCEQ, including the source of cost data used.

The costs of performing specific analytical tasks are established by using bids from commercial laboratories accredited by the state of Texas to perform environmental analyses in the matrices, analytes, and methods required. The estimates must reflect the matrices, the number of samples, the methods to be used, and the data quality objectives for the task.

Third-party cost estimating tools may be used to prepare cost estimates. Cost estimating tools may include published trade journals, books, and software. Examples of cost estimating tools include RS Means Data, Remedial Action Cost Engineering Requirements System (RACER), and so on.

Closure Cost Estimate

The closure cost estimate should include, at a minimum, the applicable following one-time cost line items:

- Design cost to provide construction level design details for the closure;
- Inventory of waste, including consulting fees and analyses required for characterization;
- Investigation to determine the extent of contamination in soil and groundwater, and preparation of related reports;
- Removal or decontamination of waste, equipment, and structures, including removal and management of liquid waste, liner removal from surface impoundments, etc.;
- Management of waste, including off-site disposal of waste, contaminated media and liners, contaminated stormwater and leachate, and related transport costs;
- Management of run-on, run-off, and stormwater including installation of berms, temporary retention ponds to contain stormwater run-off and run-on, etc.;
- Installation of leachate collection and any additional control or monitoring features as necessary;
- Acquisition and installation of final landfill cover material including, as applicable:
    - clay material, placement, and compaction;
    - any geomembranes, drainage layers, or other cover layers;
    - vegetative layer material placement and grading, or placement of other

approved layer to protect the compacted soil layer;

- seeding, fertilization, soil amendments, and mulch; and
- quality assurance and quality control tests;

- Consulting fees for the closure report;
- Survey plat, public notices, and deed notices; and
- Addition of a minimum 10% contingency fee for unknowns and omissions.

Post-Closure Care Cost Estimate

The PCC cost estimate should 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.

Waste management units generally subject to closure and basic actions necessary for closure and PCC:

Landfills:

The closure and PCC requirements for permitted landfills are specified under the Texas Risk Reduction Program (TRRP), 30 TAC Chapter 350, Subchapter B, and 30 TAC § 335.174.

- Remove all accumulated liquids and dispose of properly.
- Identify and remove all surrounding surface soils contaminated with waste due to facility operations, and place in open cells.

- Place clean fill or Class 3 waste in open cells to reach a necessary grade prior to capping. This material should be compacted to minimize long-term settlement.

- Remove or decontaminate all equipment and related structures and dispose of waste generated at an authorized facility.

- Landfills must have a final cover with erosion protection and provisions for long term security and monitoring. Final cover costs for hazardous waste landfills shall be based on landfill cover design as specified in *EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments EPA/530/SW-89/047, Design and Construction of RCRA/CERCLA Final Covers EPA/625/4-91/025, Draft Technical Guidance for RCRA/CERCLA Final Covers EPA 540-R-04-007*, or other more current EPA documents regarding design of hazardous waste landfill covers. Nonhazardous waste landfill cover systems must conform to the design criteria in TCEQ's Industrial Solid Waste Management, *Draft Technical Guideline No. 3: Nonhazardous Industrial Solid Waste Landfills* (Located online at: https://www.tceq.texas.gov/permitting/waste_permits/ihw_permits/tech_guidance_index.html.

- Place a final cover over the entire landfill. The cover should have a permeability less than or equal to that of the bottom liner, and shall be sloped to prevent surface-water ponding, minimize erosion, and to minimize settlement effects.

    - In cases where the bottom liner consists of undisturbed soil or compacted clay, the final cover should consist of compacted clay. Class 1 landfills located in areas of high precipitation should have a drainage layer of sand followed by a layer of topsoil placed above the compacted clay. Class 2 landfills generally may eliminate the drainage layer in the cover design, but should have a layer of topsoil placed above the compacted clay cap.

    - In cases where the bottom liner is a synthetic material, the final cover should consist of the following:

        - a layer of compacted clay covering the waste;

        - a synthetic liner having the same physical and chemical properties as the bottom liner placed over the compacted clay;

        - a layer of sand covering the synthetic liner; and

        - a final layer of topsoil.

    - Stormwater should be managed in accordance with all applicable rules and permit conditions until completion of the above closure activities. Upon their completion, dikes, ditches, berms, and other stormwater control structures should be constructed, removed, or altered as necessary to facilitate prompt drainage of the site on a permanent basis.

- The entire landfill area should have a self-sustaining vegetative cover or other method of erosion control established.

- The PCC period for hazardous waste landfills is 30 years in accordance with 30

TAC § 335.174 and Title 40 Code of Federal Regulations (40 CFR) §§ 264.117 through 264.120, including maintenance and monitoring throughout the PCC period specified in the permit under 40 CFR § 264.117. The PCC period for Class 1 and Class 2 nonhazardous landfills is typically 30 years. Class 3 landfills typically do not require any PCC maintenance. Post-Closure Care should include the following procedures for the entire PCC period unless otherwise noted:

- Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other deterioration;
- Maintain the vegetative cover through periodic mowing, fertilization, and re-establishment of vegetation until the cover becomes self-sustaining;
- Maintain and monitor the leak detection system in accordance with 40 CFR §§ 264.301(c)(3), 264.301(c)(4), and 264.303(c), as required in 30 TAC § 335.174(b)(3), and comply with all other applicable leak detection system requirements of this part;
- Operate the leachate collection and removal system at an appropriate frequency until leachate is no longer detected (if applicable);
- Maintain and operate the groundwater monitoring system at minimum semiannually. Wells or other devices should be inspected, collection of water samples attempted, and recovered samples analyzed for groundwater quality parameters;
- Prevent run-on and run-off from eroding or otherwise damaging the final cover;
- Inspect all boundary fences at minimum annually, and repair or replace as necessary; and
- Protect and maintain surveyed benchmarks used in complying with 40 CFR § 264.309, and as required by 30 TAC § 335.174(b)(6).

Landfill Closure and Post-Closure Care Cost Assumptions:

- For below-grade units, the active area of the landfill is assumed to be filled to half of the below-grade capacity. The landfill must be filled to near ground surface with Class 3 waste or clean fill. Above-grade landfills need no additional fill.
- Landfills must have a final cover with erosion protection and provisions for long-term security and monitoring. Final cover costs for hazardous waste landfills will be based on constructing a graded final cover of compacted clay (3 feet), a drainage layer, 80 mil synthetic liner, and 2 feet of topsoil cover. Nonhazardous waste landfills may use lesser dimensions.
- No special measures are necessary to allow equipment access to the landfill during closure or PCC.
- Post-Closure Care begins on the closure certification date.

- Several groundwater monitoring wells may need to be replaced during a PCC period.
- No extraordinary procedures for containment of escaped waste are included in this guidance. Releases to groundwater will be addressed in a compliance plan or similar corrective action authorization.
- Data needed to complete a cost estimate for each unit:
    - perimeter dimensions of the active area;
    - fill volume of the active area;
    - local as-delivered costs of imported fill;
    - number of groundwater monitoring wells;
    - analytical cost per well for each sampling event;
    - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only); and
    - equipment rental and labor rates.

Example Worksheet for Landfill Closure Cost Estimates

Project Cost Categories	Cost Estimate
Furnishing, installing, operating, and removing stormwater management equipment	$
Furnishing, excavating, grading, and compacting clay material	$
Furnishing and installing synthetic membrane	$
Furnishing and installing final cover drainage system	$
Furnishing geotextile	$
Furnishing, excavating, grading, compacting fill	$
Furnishing and grading sand cover	$
Furnishing and grading topsoil	$
Furnishing and grading cap fill	$
Sampling and analysis	$
Equipment rental	$
Vegetative cover, seeding, fertilizing	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

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)	$

Groundwater monitoring and analysis:	
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-disposal fee	$
Plug and abandon monitoring wells during 30 yrs. PCC	$
Annual report preparation & submittal to TCEQ	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% Contingency	$
Estimated Annual PCC Cost Total	$__(20__dollars)

Land Treatment Units:

The closure and PCC requirements for permitted land treatment units (LTU) are specified under TRRP 30 TAC Chapter 350, Subchapter B, and 30 TAC § 335.172.

Two general options exist for closure of LTUs at facilities. Facilities which have elevated levels of heavy metals or other persistent toxins in the soil should perform closure according to Option 1 below, unless a satisfactory alternative means of facility closure is established. Please refer to TCEQ's Industrial Solid Waste Management, *Draft Technical Guideline No. 5: Land Treatment* (Located online at: https://www.tceq.texas.gov/permitting/waste_permits/ihw_permits/tech_guidance_index.html and other appropriate guidance documents for information on the concentrations which would call for Option 1. All other facilities should reflect closure according to Option 2.

- Option 1:

  1. Remove sufficient soil such that remaining soil contains background or otherwise acceptable levels of waste constituents, and dispose of all waste generated at an authorized facility; and

  2. Disc and fertilize soil, and establish vegetative cover.

- Option 2:

  1. After waste application ceases, continue all operations (including pH control) necessary to maximize degradation, transformation, or immobilization of waste constituents within the treatment zone;

  2. Continue all operations in the treatment zone to minimize run-off of waste constituents;

  3. Maintain the run-on control system and the run-off management system;

  4. Control wind dispersal of waste if required;

  5. Continue to comply with any prohibitions or conditions

concerning growth of food-chain crops;

6. Continue groundwater monitoring and other applicable monitoring;

7. Establish and maintain a self-sustaining vegetative cover on the portion of the facility being closed at such time that the cover will not substantially impede degradation, transformation, or immobilization of waste constituents in the treatment zone; and

8. Continue to comply with Items 5 through 7 above during the PCC period.

Land Treatment Unit Closure and Post-Closure Care Cost Assumptions:

- All LTUs have recently received the maximum permitted application of waste.
- Post-Closure Care is required when units are closed in accordance with TRRP 30 TAC Chapter 350, Remedy Standard B. Post-Closure Care is also required for units which have a documented release to groundwater, requiring corrective action.

  Use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs as a landfill.
- Data needed to complete a cost estimate for each unit:
  - estimated length of time to incorporate last waste application into LTU;
  - amount of tilling and watering during final waste incorporation;
  - total surface area of the unit;
  - equipment rental and labor rates; and
  - analytical costs for soil core and soil pore moisture samples.

Example Worksheet for Land Treatment Unit Closure Cost Estimates

Project Cost Categories	Cost Estimate
Annual unsaturated zone monitoring:	
Geoprobe	$
Soil sample collection	$
Lysimeter sample collection	$
Chemical analysis	$
Annual groundwater monitoring:	
Groundwater sample collection (# wells x # hrs./sampling event x # sampling events)	$
Groundwater sample analysis (# wells x 4 samples/well x # events/yr.)	$
Sampling and analysis:	
Soil core sampling	$
Soil core analysis	$

Geoprobe	$
Chemical analysis	$
Sample evaluation and risk-based closure	$
Prepare assessment report	$
Establish vegetative cover	$
Tilling and watering equipment rental	$
Decontamination of ancillary equipment	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% Contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Waste Piles:

The closure and PCC requirements for permitted waste piles are specified under 40 CFR § 264.258, as adopted by 30 TAC § 335.152(a)(19), and TRRP30 TAC Chapter 350, Subchapter B.

The closure and PCC plan requirements for waste piles are dependent upon the liner system employed to control waste migration. A new waste pile should have a liner designed, constructed, and installed to prevent any migration of waste into the adjacent subsurface soils, groundwater, or surface water at any time during the active life (including the closure period) of the unit. The owner or operator of an existing facility should demonstrate the current liner system satisfies this requirement. If this demonstration cannot be made, the owner or operator should develop a closure plan satisfying the requirements of Option 1 and contingent closure and PCC plans as outlined in Option 2. In this case, the cost estimate calculations are only required to represent the cost of complying with the contingent closure and PCC plans. Please be aware that owners or operators of waste piles will be required to remove all waste and contaminated soil as practicable at closure.

- Option 1 - New and existing waste piles which comply with liner requirements:

  1. Remove all waste and contaminated soil, and dispose at an authorized facility. The amount of contaminated soil to be removed should be based on the service life of the waste management unit, and the permeability of the liner;

  2. Remove or decontaminate all containment system components, subsoils, structures, and equipment which are contaminated with waste or leachate. Dispose of all waste generated at an authorized facility; and

  3. Verify proper decontamination with representative soil sampling and analyses.

- Option 2 - Existing waste piles which do not comply with liner requirements:

  1. Prepare a closure plan for complying with the requirements in Option 1 above; and

  2. Prepare contingent closure and PCC plans complying with all

closure and PCC requirements that apply to landfills. These plans are intended for use in the event that all reasonable efforts to remove or decontaminate all waste, contaminated subsoils, structures, and equipment are unsuccessful.

Waste Piles Closure and Post-Closure Care Cost Assumptions:

- Waste piles are full to permitted capacity.
- Closure includes removal of waste, liners, and contaminated soil, which are then sent off-site for disposal. During closure, waste piles with non-rigid liners or no liners also require soil or liner removal. Rigid liners require cleaning after waste removal.
- Slab areas are decontaminated by a hot wash after removal of waste and contaminated stormwater. You can reasonably assume a wash water generation rate of 0.1 gallons per square foot of area.
- Representative soil samples should be collected from beneath the waste pile or, for rigid liners, as close as diagonally practical. This sampling is part of the demonstration that all waste is removed.
- In 40 CFR § 264.258(b), if all contaminated subsoils cannot be practically removed or decontaminated, the owner or operator must close the facility and perform PCC in accordance with requirements that apply to landfills (30 TAC § 335.174).

  A contingent PCC plan is required if hazardous waste piles do not have liners that satisfy 40 CFR § 264.251(a)(1) or are not exempt from the liner requirement.

  Use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs for closure of a waste pile as a landfill.
- Data needed to complete a cost estimate for each unit:
  - maximum permitted waste pile capacity;
  - estimated total volume of contaminated liner and soil;
  - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);
  - round-trip distances and costs to off-site processing and disposal sites; and
  - waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Waste Pile Closure Cost Estimates

Project Cost Categories	Cost Estimate
Removal and off-site disposal of accumulated waste(s)	$
Verification sampling and analysis	$

Removal and disposal of contaminated soils for off-site disposal	$
Equipment decontamination	$
Earth construction (excavation, backfilling, and compaction of soils)	$
Closure verification report	$
Deed certification	$
Equipment rental	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Surface Impoundments:

The closure and PCC requirements for permitted surface impoundments are specified under TRRP 30 TAC Chapter 350, Subchapter B, and 30 TAC § 335.169.

The closure and PCC plan requirements for surface impoundments are dependent upon the liner system employed to control waste migration. New impoundments should have a liner designed, constructed, and installed to prevent any migration of waste from the impoundment into the adjacent subsurface soil, groundwater, or surface water at any time during the active life (including the closure period) of the impoundment. If the owner or operator of an existing facility intends to remove all waste at closure and is unable to demonstrate compliance with the liner requirements for new facilities, they should prepare a closure plan which complies with the requirements in Option 1, and contingent closure PCC plans which comply with the requirements in Option 2. In this case, the cost estimate calculations are only required to include the cost of complying with the contingent closure PCC plans. It should be noted that owners or operators who prepare a closure plan for removal of all waste and a contingent closure and PCC plan for closure as a landfill will be required to remove all waste and contaminated soil as practicable at closure.

- Option 1: Storage and Treatment Impoundments (all waste is removed at closure):

    1. Remove all waste and contaminated soil, and dispose at an authorized facility;

    2. Remove or decontaminate all containment system components, subsoils, structures, and equipment which are contaminated with waste or leachate, and dispose of all waste generated at an authorized facility; and

    3. Verify proper decontamination with representative soil sampling and analyses.

- Option 2: Disposal Impoundments (waste remains at closure):

    1. Treat, evaporate, or remove all free liquid, and dispose of any removed waste at an authorized facility;

    2. Stabilize remaining sludges and contaminated soil to a bearing capacity sufficient to support the final cover;

3. Remove or decontaminate all equipment, piping, and related structures contaminated with waste or leachate, and dispose of all waste generated at an authorized facility;

4. If necessary, add clean fill or Class 3 waste to reach final elevation prior to capping;

5. Install a cover system in accordance with the requirements that apply to landfills; and

6. Comply with all PCC requirements that apply to landfills, including maintenance and monitoring throughout the PCC period.

Surface Impoundment Closure and Post-Closure Care Cost Assumptions:

- Surface impoundments are full to permitted capacity. Contents by volume are based on 10% sludge and 90% liquid.

- Closure involves removal of liquid and sludge waste, liners, and contaminated soil. The liquid waste, sludge, liners, and contaminated soil are then transported off-site for disposal.

- A minimum of four soil samples should be collected from beneath the surface impoundment. This sampling is part of the demonstration that all waste is removed.

- Close the surface impoundment in accordance with 30 TAC § 335.169, and provide PCC for a landfill under 30 TAC § 335.174, and TRRP 30 TAC Chapter 350, Subchapter B. Post-Closure Care is also required for units which have documented a release to groundwater, necessitating corrective action plans such as compliance plans or institutional controls. Please use the appropriate portion of the landfill closure activities table for estimating costs.

  Contingent PCC plans are required for hazardous waste surface impoundments that do not have synthetic liners that satisfy 40 CFR § 264.221(a), or are not exempt from the liner requirements.

  Use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs for closure of a surface impoundment as a landfill.

- Data needed to complete a cost estimate for each unit:

  - maximum permitted surface impoundment volume;

  - estimated total volume of contaminated liner and soil;

  - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);

  - round-trip distances and costs to off-site treatment and disposal sites; and

- waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Surface Impoundment Closure Cost Estimates

Project Cost Categories	Cost Estimate
If clean closure:	
Sludge dewatering equipment rental	$
Sludge, liner, and contaminated soil disposal	$
Sludge, liner, and contaminated soil incineration	$
Transportation of bulk sludge, liner, and contaminated soil	$
Disposal of sludge	$
Soil samples beneath unit	$
If waste is left in place:	
Sludge stabilization equipment rental	$
Stabilization reagents	$
Physical tests (stability, bearing capacity)	$
Sampling and analysis	$
Install clay cap	$
Equipment rental (spreaders, compactors)	$
Seeding, fertilizing, and watering vegetative cover	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Container Storage Area:

The closure and PCC requirements for permitted container storage areas are specified under 40 CFR § 264.178, as adopted by 30 TAC § 335.152(a)(7), and TRRP 30 TAC Chapter 350, Subchapter B.

- Remove all waste and dispose of at an authorized facility. When calculating the volume of waste subject to proper disposition at closure, assume that all on-site storage and processing facilities are at maximum permitted capacity, and that stormwater resulting from the average of the two wettest consecutive months has accumulated within each diked area used for secondary containment.

- Remove or decontaminate all equipment, piping, containment structures, and any associated spill residues, and dispose of all waste generated at an authorized facility.

- Inspect storage and/or processing units and appurtenant equipment and piping to verify that leakage has not occurred and that decontamination has been completed.

Container Storage Area Closure Cost Assumptions:

- Container storage areas are full to permitted capacity. Container storage areas may have drums or other types of portable containers, such as tank trailers,

dumpsters, roll-off boxes, etc.

- No escape of waste outside of containment areas has occurred. Decontamination involves container and stormwater removal followed by a hot wash of the containment areas. You can reasonably assume a wash water generation rate of 0.1 gallons per square foot of area.
- All waste, wash water, and stormwater are sent off-site for processing and disposal.
- No PCC is required.
- Data needed to complete a cost estimate for each unit:
  - maximum permitted number of drums or containers, and the total volume of the waste;
  - total surface area of the permitted container storage area;
  - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);
  - round-trip distances and costs to off-site disposal sites; and
  - waste treatment and disposal costs, equipment rental rates, and labor.

Example Worksheet for Container Storage Area Closure Cost Estimates

Project Cost Categories	Cost Estimate
Removal of waste	$
Decontamination of the container storage area and equipment	$
Sampling and analysis	$
Transportation of waste	$
Treatment and disposal of waste	$
Demolition and removal of the containment system	$
Removal of contaminated soils	$
Backfilling	$
Equipment rental	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Tank Systems:

The closure and PCC requirements for permitted tank systems are specified under 40 CFR § 264.197, as adopted by 30 TAC § 335.152(a)(8), and TRRP 30 TAC Chapter 350, Subchapter B.

- Remove all waste and dispose of at an authorized facility. When calculating the volume of waste subject to proper disposition at closure, assume that all on-site

storage and processing facilities are at maximum permitted capacity and that stormwater resulting from the average of the two wettest consecutive months has accumulated within each diked area used for secondary containment.

- Remove or decontaminate all equipment, piping, containment structures, and any associated spill residues, and dispose of all waste generated at an authorized facility.

- Inspect storage and/or processing units and appurtenant equipment and piping to verify that leakage has not occurred and that decontamination has been completed.

Tank Systems Closure Cost Assumptions:

- Tanks are full to permitted capacity.

- Tank systems are well maintained with no leakage or spillage.

- Closure involves removal of waste and ancillary equipment decontamination.

- After removal of waste and contaminated stormwater, secondary containment areas are decontaminated by a hot wash. You can reasonably assume a wash water generation rate of 0.1 gallons per square foot of area.

- All waste, wash water, and stormwater is sent off-site for processing and disposal.

- Representative soil samples should be collected from beneath the secondary containment, or as close as diagonally practical. This sampling is part of the demonstration that all waste is removed.

- Contingent PCC plans are required for hazardous waste tanks that do not have secondary containment that satisfies the requirements of 40 CFR §264.193(b)-(f), or have not been granted a variance from the secondary containment requirement. Use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs for closure of a tank as a landfill.

- In 40 CFR § 264.197, if the owner or operator demonstrates that all contaminated soils cannot be practicably removed or decontaminated as required, then the owner or operator must close the tank system and perform PCC in accordance with the closure and PCC requirements that apply to landfills (30 TAC § 335.174). Please see the appropriate portion of the landfill closure activities table for estimating costs.

- Data needed to complete a cost estimate for each unit:

    - maximum permitted tank capacity;

    - total surface area of the permitted secondary containment area;

    - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);

- round-trip distances and costs to off-site treatment and disposal sites; and
- waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Tanks Closure Cost Estimates

Project Cost Categories	Cost Estimate
Removal of waste	$
Purging of the tank system	$
Decontamination of the tank system and equipment	$
Sampling and analysis	$
Transportation of waste	$
Treatment and disposal of waste	$
Flushing the tank and ancillary piping	$
Disassembly and loading of the tank and ancillary piping	$
Demolition and removal of the containment system	$
Removal of contaminated soils	$
Backfilling	$
Equipment rental	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Incinerator, Boiler and Industrial Furnace Units:

The closure requirements for a permitted incinerator or boiler and industrial furnace are specified under 40 CFR § 264.351, as adopted by 30 TAC § 335.152(a)(13); 40 CFR § 266.102(e)(11), as adopted by 30 TAC § 335.221(a)(6); and TRRP 30 TAC Chapter 350, Subchapter B.

- Remove all waste and dispose of at an authorized facility. When calculating the volume of waste subject to proper disposition at closure, assume that all on-site storage and processing facilities are at maximum permitted capacity and that stormwater resulting from the average of the two wettest consecutive months has accumulated within each drainage control area used for secondary containment.
- Remove or decontaminate all equipment, piping, containment structures, and any associated spill residues, and dispose of all waste generated at an authorized facility.
- Inspect storage and/or processing units and appurtenant equipment and piping to verify that leakage has not occurred and that decontamination has been completed.

Incinerator, Boiler, and Industrial Furnace Unit Closure Cost Estimate Assumptions:

- At closure, the incinerator, boiler, or industrial furnace is assumed to be mechanically inoperative.
- Drainage control areas associated with the combustion device and its ancillary components are assumed to contain a volume of drainage equivalent to the average rainfall amount occurring during the two wettest consecutive months, or the maximum storage volume, whichever is the smaller quantity.
- No escape of waste outside of control areas has occurred. Decontamination involves stormwater removal, hot wash of drainage control slabs, and removal of combustion unit refractory.
- No PCC is required.
- Data needed to complete a cost estimate for each unit:
    - drainage control area and maximum storage volume;
    - estimated refractory volume;
    - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);
    - round-trip distances and costs to off-site processing and disposal sites; and
    - waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Incinerator, Boiler, and Industrial Furnace Unit Closure Cost Estimates

Project Cost Categories	Cost Estimate
Removal of slag and ash	$
Hydroblasting of combustion chamber and containment area	$
Transportation of wash water and rainwater	$
Refractory disposal and transportation	$
Decontamination of ancillary equipment	$
Sampling and chemical analysis	$
Equipment rental	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Drip Pads Closure and Post-Closure Care Cost Assumptions:

The closure and PCC requirements for permitted drip pads are specified under 40 CFR §

264.575, as adopted by 30 TAC § 335.152(a)(15), and TRRP 30 TAC Chapter 350, Subchapter B.

- Closure involves removal of waste residues, liners, and contaminated soil, which are then transported off-site for disposal.

- A minimum of two soil samples should be collected from beneath the drip pad, or as close as diagonally practical. This sampling is part of the demonstration that all waste is removed.

- Post-Closure Care is required when units are closed in accordance with the TRRP 30 TAC Chapter 350, Subchapter B. If the unit has a documented release to groundwater which requires corrective action, such as a compliance plan or institutional controls, then PCC must be provided.

  A contingent PCC plan is required if the hazardous waste drip pads do not have synthetic liners that satisfy 40 CFR § 264.573(b)(1).

  Use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs for closure of a drip pad as a landfill.

- Data needed to complete a cost estimate for each unit:

  - total area of the permitted drip pad;

  - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);

  - round-trip distances and costs to off-site disposal sites; and

  - waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Drip Pad Closure Cost Estimates

Project Cost Categories	Cost Estimate
Disposal of waste (if applicable)	$
Transportation of waste (if applicable)	$
Decontamination of contaminated stormwater/wash water	$
Equipment rental (portable pressure washer and detergent)	$
Soil samples beneath the unit	$
Sampling and chemical analysis	$
Equipment rental	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Containment Building Closure and Post-Closure Care Cost Assumptions:

The closure and PCC requirements for permitted containment buildings are specified under 40 CFR § 264.1102, as adopted by 30 TAC § 335.152(a)(20), and TRRP 30 TAC Chapter 350,

Subchapter B.

- Closure involves removal of waste residues, liners, and contaminated soil, which are then transported off-site for disposal.

- A minimum of two soil samples should be collected from beneath the containment building, or as close as diagonally practical. This sampling is part of the demonstration that all waste is removed.

- Per 40 CFR § 264.1102, close the drip pads and provide PCC for a landfill under 30 TAC § 335.174, and TRRP 30 TAC Chapter 350, Subchapter B. If the unit has a documented release to groundwater which requires corrective action, such as a compliance plan or institutional controls, then PCC must be provided.

  Use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs for closure of a containment building as a landfill.

- Data needed to complete a cost estimate for each unit:

  - maximum permitted volume of waste;

  - total surface area of the permitted containment building;

  - round-trip distances and costs to off-site disposal sites; and

  - waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Containment Building Closure Cost Estimates

Project Cost Categories	Cost Estimate
Removal of waste	$
Decontamination of the containment building	$
Sampling and chemical analysis	$
Transportation of waste	$
Treatment and disposal of waste	$
Demolition and removal of the floor	$
Demolition and removal of the building	$
Removal of the containment building	$
Removal of contaminated soils	$
Backfilling	$
Equipment rental	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)

Miscellaneous Units Closure and Post-Closure Care Cost Assumptions:

The closure and PCC requirements for permitted miscellaneous units are specified under 40 CFR § 264.601 and § 264.603, as adopted by 30 TAC § 335.152(a)(16), and TRRP 30 TAC Chapter 350, Subchapter B.

- Closure involves removal of waste residues, liners, and contaminated soil that are then transported off-site for disposal.
- Cost assumptions can be based on applicable assumptions of other comparable unit types.
- Post-Closure Care is required when units are closed in accordance TRRP 30 TAC Chapter 350, Subchapter B. If the unit has a documented release to groundwater which requires corrective action such as a compliance plan or institutional controls, then PCC must be provided.

  If the miscellaneous unit is a disposal unit, use the appropriate portions of the landfill closure and PCC activities table when estimating closure and PCC costs as a landfill.
- Data needed to complete a cost estimate for each unit:
  - maximum permitted volume of waste;
  - total square feet of the permitted area;
  - local average monthly rainfall amounts for the two wettest consecutive months (applicable to uncovered areas only);
  - round-trip distances and costs to off-site disposal sites; and
  - waste treatment and disposal costs, equipment rental rates, and labor rates.

Example Worksheet for Miscellaneous Unit Closure Cost Estimates

Project Cost Categories	Cost Estimate
Incineration or landfilling (if applicable)	$
Transportation of bulk waste	$
Decontamination of waste	$
Disposal of liner (if applicable)	$
Equipment rental (portable pressure washer and detergent)	$
Disposal of wash water	$
Transportation of wash water	$
Sampling and chemical analysis	$
PE Closure Certification	$
Engineering, mobilization, site preparation, etc.	$
Subtotal	$
Minimum 10% contingency	$
Estimated Unit Closure Cost Total	$___(20__dollars)