SOLID WASTE
FINANCIAL ASSURANCE PROGRAM REPORT

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
WASTE MANAGEMENT DIVISION

December 22, 2000

Chapter 2

Chapter 2 - State and Federal Solid Waste Financial Assurance Programs

The purpose of this chapter is to document research into surrounding states' solid waste financial assurance programs and collect pertinent data. Chapter 2 also documents research into guidance documents produced by the United States Environmental Protection Agency (USEPA) for determining closure and post-closure cost estimates.

2.1 State Solid Waste Financial Assurance Programs

State agencies performing similar regulatory missions as the Oklahoma Department of Environmental Quality may have information and data beneficial to the goals of this project. Useful information includes:

- Identification of which landfill types are required to provide financial assurance;
- At what point in facility operations financial assurance is required;
- Regulatory language specifically identifying necessary tasks and services for closure and post-closure activities;
- Guidance documents illustrating the necessary tasks and services for closure and post-closure activities and associated unit costs;
- Regulatory language addressing the source and use of unit costs;
- When, why, and how closure and post-closure cost estimates must be adjusted; and
- Acknowledgment of regional variations.

2.1.1 State Regulatory Agencies

Research and data collection scope definition was necessary to accomplish two goals (1) create sufficient probability of acquiring information and (2) be completed in a reasonable amount of time to maintain project schedule at reasonable expense. Contacting all 50 states would result in the greatest probability of finding information, but the data from the most distant states may not be as relevant as adjacent states. All states within a USEPA's regional area for states contiguous to Oklahoma was the selection criteria and produced a target group consisting of states in USEPA's Region VI, VII, and VIII. One additional, Minnesota, which is in Region V, was added because the state regulatory agency is directly involved with closing 106 landfills with the Minnesota Closed Landfill Program. Table 2.1 lists the target contact states and associated regulatory agency.

TABLE 2.1 List of Identified State Regulatory Agencies

	REGION/STATE	REGULATORY AGENCY
	Region VI	
1	Arkansas	Department of Pollution Control and Ecology
2	Louisiana	Department of Environmental Quality
3	New Mexico	Environment Department
4	Oklahoma	Department of Environmental Quality
5	Texas	Natural Resource Conservation Commission
	Region VII	
6	Iowa	Department of Natural Resources
7	Kansas	Department of Health and Environment
8	Missouri	Department of Natural Resources
9	Nebraska	Department of Environmental Quality
	Region VIII	
10	Colorado	Department of Public Health and Environment
11	Montana	Department of Environmental Quality
12	North Dakota	Department of Health
13	South Dakota	Department of Environmental and Natural Resources
14	Utah	Department of Environmental Quality
15	Wyoming	Department of Environmental Quality
	Region V	
16	Minnesota	Pollution Control Agency

2.1.2 Landfill Financial Assurance Program Survey

A survey form was developed using the information identified in Section 2.1. The survey was distributed to contacts at each agency identified in Table 2.1. Multiple surveys were sent to regulatory agencies if the solid and hazardous waste programs were administered separately. The states that received two surveys were Arkansas, Iowa, Missouri, and Nebraska. A copy of the survey is presented in Table 2.2 and the form letter and complete mailing list are in Attachment 2.

TABLE 2.2. State Regulatory Agency Survey

LANDFILL FINANCIAL ASSURANCE PROGRAM SURVEY

Please answer each question thoroughly and attach supporting documentation where requested.

Region/State: _____

Agency: _____

Person Completing Survey: _____

Telephone Number: _____

Address: _____

E-mail Address _____

Municipal Solid Waste Landfill = MSWLF
Nonhazardous Industrial Solid Waste Landfill = NHISWLF
Construction & Demolition Landfill = C&D landfill

1. Do the regulations require the following landfills provide financial assurance for completing final closure and post-closure activities?

		Final Closure		Post-Closure	
a.	MSWLF:	☐Yes	☐No	☐Yes	☐No
b.	NHISWLF:	☐Yes	☐No	☐Yes	☐No
c.	C&D Landfills:	☐Yes	☐No	☐Yes	☐No

2. When is a facility required to provide financial assurance? (i.e. before receiving final permit, before receiving waste, or some other trigger mechanism)

3. Do the regulations specifically state what tasks and services must be performed for final closure? ☐Yes ☐No
   If "YES", Please provide regulatory citation for each landfill type
   If "NO", Please explain how owner/operators and state agree on list of tasks and services (attach applicable guidance document(s), if available)

4. Do the regulations specifically state what tasks and services must be performed for post-closure? ☐Yes ☐No
   If "YES", Please provide regulatory citation for each landfill type
   If "NO", Please explain how owner/operators and state agree on list of tasks and services (attach applicable guidance document(s), if available)

5. Does the State use a guidance document for determining unit costs? ☐Yes ☐No
   If "YES", Please attach a copy of the guidance document.

6. Do the regulations specifically state unit costs for individual closure and post-closure tasks and services? ☐Yes ☐No
   If "YES", Please provide regulatory citation for each landfill type _____
   If "NO", Does the State use unit prices published by other state or federal agencies? ☐Yes ☐No
   If "YES", please provide a list of acceptable state and federal agencies that publish unit prices_____
   If "NO", Explain how owner/operators determine unit costs acceptable to the regulatory agency _____

7. Do the regulations require periodic (i.e. annual) adjustments to the financial assurance amount? ☐Yes ☐No
   If "YES", Please explain when financial assurance must be adjusted and how to perform adjustment(s) _____

8. Does the State acknowledge regional variations in unit costs? ☐Yes ☐No
   If "YES", Please explain how regions are identified and how specific unit costs are derived for each region (attach supporting documentation)

9. Please provide a copy of the regulations containing the citations identified above or provide an internet address where they are available for downloading. _____

10. Would you like a copy of the survey results? ☐Yes ☐No

2.1.3 Summary of State Regulatory Agency Survey Responses

The regulatory agencies governing landfill activities in 16 states were contacted to gather information on closure and post-closure tasks and services and associated unit costs. In addition to the actual survey mailed to each agency, respondents were given the opportunity to complete the survey at Cardinal Engineering's webpage. Of the 20 surveys sent to 16 states, 12 were completed and returned, three were electronically submitted, and four of the four separate hazardous waste regulatory groups responded by stating information would be provided by the solid waste group. The replies represent a response rate of 95%. Submitted surveys and attached reference materials are contained in Attachment 3 and sorted by state. Attachment 4 lists information on how to contact each respondent. Table 2.3 summarizes the survey data from the 15 states and Section 2.1.4 discusses the individual state response.

TABLE 2.3 Summary of State Regulatory Agency Survey Responses

Number of States Recieving Survey Questionare			16
Number of States Responding to Survey			15
Number of States Requiring Financial Assurance for Final Closure	MSWLF	NHISWLF	C&D Landfill
Before receiving permit	4	4	3
Before receiving waste	11	9	9
Not required or other trigger method	0	2	3
Number of States Requiring Financial Assurance for Post-Closure	MSWLF	NHISWLF	C&D Landfill
Before receiving permit	4	4	3
Before receiving waste	11	7	7
Not required or other trigger method	0	4	5
Number of States Using Guidance Documents with Unit Costs			4
Number of States Using Guidance Documents without Unit Costs			1
Number of States Not Using Guidance Documents			10
Number of States Using Statutory or Regulatory Defined Unit Costs			1
Number of States Requiring Annual Adjustments to Financial Assurance			
Increase/Decrease in Closure Costs			10
Increase/Decrease in Post-Closure Costs			10
Inflation (based on GDP)			5

Inflation (based on GNP)	2
Inflation (based on CPI)	0
Inflation (method not specified)	7
Acknowledging Regional Variation	
Using Site Specific Unit Costs	9
Not Acknowledged	6
Number of States Requesting Copy of Results	12

2.1.4 State Regulatory Agency Survey Data

2.1.4.1 Arkansas

The Arkansas Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving the final permit.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☐ Yes	☒ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide detailed closure and post-closure plans for state review and approval. Arkansas does not use a guidance document for determining a landfill's financial assurance amount. Nor does Arkansas use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating the facility's financial assurance are typically developed by professional engineers. The Solid Waste Division maintains a unit cost database for comparison with submitted costs.

State required annual adjustments must account for inflation. Regulations do not prescibe an accounting method for calculating the inflation rate. Arkansas DEQ does acknowledge some slight variations in costs based on soil availability and mobilizations costs across the state. Applicable state regulations can be found on the Internet at http://www.adeq.state.ar.us.

2.1.4.2 Louisiana

The Louisiana Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving the final permit.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide detailed closure and post-closure plans for state review and approval. Louisiana does not use a guidance document for determining a landfill's financial assurance amount. Nor does Louisiana use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating the facility's financial assurance are negotiated with the Louisiana DEQ.

State required annual adjustments must account for inflation. Inflation is adjusted annually using an inflation factor derived from the Implicit Price Deflator for the Gross Domestic Product (GDP). Louisiana DEQ does not acknowledge in-state regional variations in unit costs. Applicable state regulations can be found on the Internet at http://www.deq.state.la.us.

2.1.4.3 New Mexico

The New Mexico Environment Department's regulations require the following landfills provide financial assurance before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. New Mexico does not use a guidance document for determining a landfill's financial assurance amount. Nor does New Mexico use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating the facility's financial assurance are determined by the owner/operator and must have documentation justifying a unit cost if it is significantly lower than those for other facilities.

State required annual adjustments must account for increases or decreases in cost estimates due to operational changes and inflation. Regulations do not prescribe an accounting method for calculating the rate of inflation. New Mexico does not acknowledge in-state regional variations in unit costs. Applicable state regulations can be found at http://www.nmenv.state.nm.us.

2.1.4.4 Oklahoma

The Oklahoma Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. Oklahoma does use a guidance document for determining a landfill's financial assurance amount (See Attachment 3). Oklahoma does not use regulatorily defined unit costs. Unit costs used in calculating the facility's financial assurance were determined using cost estimates provided by companies that perform similar work and/or state agency that records unit cost for similar task. Owner/operators can also provide reference sources to justify using a unit cost different than the one provided in the guidance document. Table 2.4 contains the current unit costs listed in Oklahoma's guidance document.

TABLE 2.4 Oklahoma Closure and Post-Closure Unit Cost Data

TASK/SERVICE (unit)	UNIT COST	RESOURCE
FINAL CLOSURE		
Control Grading (acre)	$500.00	Departmental estimate
Recompacted clay cover (CY)	$3.00	Departmental estimate and ODOT data
Top soil (CY)	$6.00	Departmental estimate and ODOT data
Vegetation (acre)	$500.00	Departmental estimate
Remove temporary buildings (lump sum)	$3,500.00	Departmental estimate
Remove equipment (lump sum)	$2,000.00	Departmental estimate
Surface drainage ditches (LF)	$3.50	Departmental estimate
Replace defective groundwater monitoring well (well)	$2,500.00	Departmental estimate and information from drilling company(s)
Plug defective groundwater monitoring well and final plugging (well)	$1,000.00	Departmental estimate and information from drilling company(s)
Final closure topographic map (each)	$4,000.00	Departmental estimate
Administrative closure costs (lump sum)	20%	Departmental estimate
Contingency closure costs	10%	Departmental estimate

POST-CLOSURE		
Routine inspections (each)	$500.00	Departmental estimate
Maintenance of on-site improvements (lump sum)	$2,000.00	Departmental estimate
Maintaining vegetation (acre)	$250.00	Departmental estimate
Gas sampling (probe)	$35.00	Departmental estimate
Groundwater monitoring well sampling and analysis (well)†	$1,000.00	Departmental estimate and information from certified laboratories
Surface water sampling and analysis (sample point)‡	$100.00	Departmental estimate and information from certified laboratories
Leachate System Maintenance (LF)	$0.25	Departmental estimate
Leachate Management (gallon)	$0.15	Departmental estimate and information from POTWs
Post-closure administrative cost (lump sum)	10%	Departmental estimate
Post-closure contingency cost (lump sum)	10%	Departmental estimate

† Analysis includes: pH, COD, specific conductance, chloride, sulfate, calcium, magnesium, nitrates, sodium, carbonates, potassium, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc, and 47 volatile organics in USEPA Report SW-846 Test Method 8260.
‡ Analysis includes: pH, chemical oxygen demand (COD), conductivity, dissolved oxygen (DO), and turbidity.

Annual adjustments must account for increases or decreases in cost estimates due to operational changes and inflation. Regulations do not prescribe an accounting method for calculating the inflation rate. Accounting for regional variations is accomplished through the use of bids or other actual cost estimates for that specific site. Applicable state regulations can be found on the Internet at http://www.deq.state.ok.us.

2.1.4.5 Texas

The Texas Natural Resource Conservation Commission's (TNRCC's) regulations require the following landfills provide financial assurance 60 days before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. TNRCC does not use a guidance document for determining a landfill's financial assurance amount. Nor does TNRCC use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating financial assurance are

determined by the owner/operator and must be signed and sealed by a Texas registered professional engineer.

Annual adjustments must account for increases or decreases in cost estimates due to operational changes and inflation. Inflation is adjusted annually using an inflation factor derived from the Implicit Price Deflator for the Gross National Product (GNP). Texas does not acknowledge in-state regional variations in unit costs. Applicable state regulations can be found on the Internet at http://www.tnrcc.state.tx.us.

2.1.4.6 Iowa

The Iowa Department of Natural Resources' (DNR's) regulations require the following landfills provide financial assurance before the initial receipt of solid waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☐ Yes	☒ No	☐ Yes	☒ No
C&D Landfills:	☐ Yes	☒ No	☐ Yes	☒ No

Current regulations provide only general descriptions of closure and post-closure requirements. Owner/operators must develop tasks and services in accordance with the approved closure and post-closure plans. Iowa does not use a guidance document for determining financial assurance amount. Nor does Iowa use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating financial assurance are determined by the owner/operator and do not have to be approved by the Iowa DNR. Instead the Iowa DNR must be notified when the cost estimate has been placed in the facility files. Iowa requires annual adjustments for inflation and changes in the closure and post-closure plans. Regulations do not prescribe an accounting method for calculating the rate of inflation. In-state regional variations are not acknowledged in unit costs. Applicable state regulations can be found on the Internet at http://www.iac.legis.state.ia.us.

2.1.4.7 Kansas

The Kansas Department of Health and Environmental's regulations require the following landfills provide financial assurance before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☐ Yes	☒ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans with specific tasks and services for state review and approval. Kansas does use a guidance document for determining a landfill's financial assurance amount (See Attachment 3). However, the guidance document does not use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating the facility's financial assurance are determined using R.S. Means Cost Guides, state-wide averages of previously submitted third-party estimates, and actual contractor supplied bids. R.S. Means estimates are multiplied by a factor of 0.85 to adjust national averages to locations in Kansas. Not all tasks and services have assigned unit costs and owner/operators must determine applicable unit costs if one is not provided. Owner/operators can also provide reference sources to justify using a unit cost different than the one provided in the guidance document. Table 2.5 contains the current unit costs listed in Kansas' guidance document.

TABLE 2.5 Kansas Closure and Post-Closure Unit Cost Data

TASK/SERVICE(unit)	UNIT COST	RESOURCE
FINAL CLOSURE		
Final Grading (acre)	$53.75	R.S. Means
Soil-compacted, off-site (CY)	$5.63	State-wide average + R.S. Means
Soil-compacted, on-site (CY)	$2.20	State-wide average + R.S. Means
Drainage material, sand (CY)	$11.00	State-wide average
Drainage material, geogrid (sq. yd.)	$4.18	State-wide average
Geomembrane (sq. yd.)	$3.90	State-wide average
Vegetative soil, off-site and cover repair (CY)	$5.20	State-wide average + R.S. Means
Vegetative soil, on-site and cover repair (CY)	$1.77	State-wide average
Seeding and mulching (acre)	$1,500.00	State-wide average
Terraces (l.f.)	$0.55	U.S. Natural Resources Conservation Service
Grass ditching/channels (LF)	$9.00	R.S. Means
Riprap ditching/channels (LF)	$13.00	R.S. Means
Gas Vents (LF)	not specified	not applicable
Passive Gas System or Active Gas System	not specified	not applicable
Professional Services (Lump Sum)	not specified	not applicable
Administration and Contingency	10%	not applicable
POST-CLOSURE		
Cover Repair 5% of Landfill - Soil off-site (CY)	$5.20	State-wide average + R.S. Means

Cover Repair 5% of Landfill - Soil on-site (CY)	$1.77	State-wide average
Reseeding 5% of Landfill (acre)	$1,500.00	State-wide average
Operation and Maintenance of Leachage Collection System (year)	not specified	not applicable
Leachate Hauling (trip)	not specified	not applicable
Leachate Treatment (gallon)	not specified	not applicable
Leachate Management and Treatment On-site (lump sum)	not specified	not applicable
Leachate Sampling (trip)	not specified	not applicable
Leachate Analysis (event)	not specified	not applicable
Landfill Gas Monitoring (event)	not specified	not applicable
Reinstallation of Gas Vents (LF)	not specified	not applicable
Operation and Maintenance of Gas Extration System (Million CU FT)	not specified	not applicable
Groundwater sampling personnel labor (hr)	$35.00	Medium hourly rate for ten (10) KDHE leaking underground storage tanks contractors who perform work in the state
Groundwater sampling event mobilization (mile)	$0.40	Medium hourly rate for ten (10) KDHE leaking underground storage tanks contractors who perform work in the state
Groundwater monitoring analytical costs† (2/year)	blank - industrial landfills $165.00 - small arid MSWLF $220.00 - MSWLF	State-wide average + 10%
Groundwater monitoring well maintenance (well/year)	$13.00	Cost includes replacement of well pads and padlocks. Price is prorated over 30 years
Groundwater monitoring well replacement (sum of total well footage)	$0.20	Cost includes replacing 30% of the groundwater wells during the 30-year post-closure period at an installation rate of $20/ft
Inspections and Recordkeeping (lump sum)	not specified	not applicable
Remedial System Operations (lump sum)	not specified	not applicable
Administration and Contingency	10%	KDHE prescribed

NOTE: CY = cubic yard
sq. yd. = square yard
LF = linear feet

† Small Arid MSWLF analysis includes: benzene, 1,2-dichloroethane, 1,1-Dichloroethene, ethylbenzene, styrene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, vinyl chloride, total xylenes, cadmium, and chromium.
MSWLF analysis includes: Alkalinity, Calcium, Chemical Oxygen Demand (COD), Chloride, Nitrogen (Ammonia), Pottasiu (dissolved), Sodium (dissolved), Sulfate, Total Dissolved Solids (TDS), Acetone, Benzene, Bromodichloromethane, Bromomethane, Bromoform, 2-Butanone, Carbon Disulfide, Carbon tetrachloride, Chlorobenzene, Chlorethane, 2-Chloroethylinyl ehter, Chloroform, Chloromethane, Dibromochloromethane, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,1-Dichloroethene, trans-1,2-Dichloroethene, 1,2-Dichloropropane, cis-1,3-Dichloropropene, Trans-1,3-Dichloropropene, Ethylbenzene, 2-Hexanone, 4-Methyle-2-pentanone, Methylene chloride, Styrene, Tetrachlorethene, Toluene, Total Xylenes, 1,1,2,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethene, Vinyl acetate, Vinyl chloride, MCL promulgated.

State required annual adjustments must account for increases or decreases in cost estimates resulting from operational changes. Inflation is adjusted annually using an inflation factor derived from the Implicit Price Deflator for the Gross Domestic Product. Accounting for regional

variations is accomplished on a case-by-case basis if a facility believes the standard unit cost is significantly different from the local cost. Applicable state regulations can be found on the Internet at http://www.kdhe.state.ks.us.

2.1.4.8 Missouri

The Missouri Department of Natural Resources' regulations require the following landfills provide financial assurance. Closure estimates are due during permit review and post-closure estimates are required before any waste is deposited for MSWLF only.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☐ Yes	☒ No
C&D Landfills:	☒ Yes	☐ No	☐ Yes	☒ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans with specific tasks and services for state review and approval. Missouri does not use a guidance document for determining a landfill's financial assurance amount. Unit costs used in calculating the facility's financial assurance are determined on a site specific basis and reviewed by the Missouri DNR. Missouri does not use regulatorily defined unit costs or unit costs published by other state or federal agencies. Annual adjustments must account for increases or decreases in cost estimates resulting from operational changes. Inflation is adjusted annually using an inflation factor derived from the Implicit Price Deflator for the Gross Domestic Product. In-state regional variations are not acknowledged in unit costs. Applicable state regulations can be found on the Internet at http://www.dnr.state.mo.us.

2.1.4.9 Nebraska

The Nebraska Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving final permit.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Nebraska uses a guidance document with ranges of unit costs for determining the financial assurance amount. The guidance document describes the necessary individual tasks and services (See Attachment 3). However, the guidance document does not use regulatorily defined unit costs or unit costs from other state or federal agencies. Unit costs used in calculating the facility's financial assurance were determined using cost estimating references such as R.S. Means, United States Environmental Protection Agency documents, actual construction costs for closing landfills, the state-wide Solid Waste Management Plan, and cost estimates from owner/operators. Facilities must still submit site specific unit costs with documentation showing breakdown of labor, equipment, materials, etc. However, if the unit cost is within the guidance document range no additional documentation is necessary before agency approval. If the unit cost is outside the guidance document range then additional information is required before agency approval. Table 2.6 lists the current unit costs listed in Nebraska's guidance document.

TABLE 2.6 Nebraska Closure and Post-Closure Unit Cost Data

TASK/SERVICE (unit)	UNIT COST RANGE	RESOURCE
FINAL CLOSURE		Unit costs were calculated using cost estimating references like R.S. Means (labor, equipment, and materials), United States Environmental Protection Agency (USEPA) documents, actual construction costs for closing landfills, the state-wide Solid Waste Management Plan, and cost estimates from owner/operators.
Infiltration layer (CY)	$2.16 - $4.66	
Erosion layer (CY)	$1.23 -$2.00	
Flexible membrane liner (sq. ft.)	$0.30 - $0.80	
Filter fabric (sq. ft.)	$0.28 - $0.56	
Venting layer (CY)	$13.50	
Drainage layer (CY)	$13.50	
Final grading (acre)	$1,700 - $2,000	
Surface water control structures (LF)	$8.50 - $25.00	
Seeding, mulching, fertilizer (acre)	$915 - $1,982	
Gas venting system (acre)	$500	
Engineering - closure	15%	
Legal and administration - closure	5%	
Other direct costs - closure	1%	
Contingency - closure	10%	

TABLE 2.6 Nebraska Closure and Post-Closure Unit Cost Data (continued)

TASK/SERVICE (unit)	UNIT COST RANGE	RESOURCE
POST-CLOSURE		
Groundwater monitoring sampling (event)	$500 - $1,200	Unit costs were calculated using cost estimating references like R.S. Means (labor, equipment, and materials), United States Environmental Protection Agency (USEPA) documents, actual construction costs for closing landfills, the state-wide Solid Waste Management Plan, and cost estimates from owner/operators.
Groundwater monitoring analytical (well/year)†	$1,056 - $1,288	
Groundwater monitoring data assessment (event)	$500	
Groundwater monitoring well replacement (well)	$2,500	
Leachate management - sampling & analysis (year)	$900	
Leachate management - maintenance & inspections (year)	$1,000	
Leachate management - pumping, removal, & disposal (gallon - mile)	$0.12/gallon & $2.50/mile	
Leachate management - pump replacement (each/10years)	$2,000	
Gas monitoring - sampling & analysis (quarter)	$150 - $240	
Gas monitoring - maintenance & inspections (year)	$500 - $1,500	
Gas monitoring - replacement & repair (year)	$500	
Site inspection (year)	$300 - $1,200	
Final cover repair (CY)	$2.00 - $4.00	
Seeding repair (acre)	$1,000 - $1,500	
Mowing (acre)	$25.00	
Rodent, weed, & tree control (acre)	$75.00	
Surface water control (year)	$300	
Fence repair (year)	$500 - $1,000	
Gate and sign replacement (year)	$120	
Post-closure recordkeeping and administration (year)	$1,200 - $1,600	
Contingency - post-closure	10%	
Other direct costs - post-closure	1%	

† Analysis includes: pH, COD, specific conductance, chloride, sulfate, calcium, magnesium, nitrates, sodium, carbonates, potassium, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc, and 47 volatile organics in USEPA Report SW-846 Test Method 8260.

State required annual adjustments must account for inflation. Inflation is adjusted annually using an inflation factor derived from the Implicit Price Deflator for the Gross Domestic Product. Accounting for regional variations is accomplished through the use of bids or other actual cost estimates for that specific site. Applicable state regulations can be found on the Internet at http://www.deq.state.ne.us.

2.1.4.10 Colorado

The Colorado Department of Health and Environment's regulations require the following landfills provide financial assurance 60 days before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. Colorado does not use a guidance document for determining a landfill's financial assurance amount. Nor does Colorado use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating financial assurance are determined by values published in R.S. Means, or a facility may provide documentation from contractors and suppliers for site specific unit costs.

State required annual adjustments must account for inflation. Inflation is adjusted annually using an inflation factor derived from the Implicit Price Deflator for the Gross Domestic Product. Accounting for regional variations is accomplished through the use of bids or other actual cost estimates for that specific site. Applicable state regulations can be found on the Internet at http://www.cdphe.state.co.us.

2.1.4.11 Montana

The Montana Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☐ Yes	☒ No	☐ Yes	☒ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. Montana does not use a guidance document for determining a landfill's financial assurance amount. Nor does Montana use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating the facility's financial assurance are determined on a site specific basis, where costs are compared to previous work completed at the site and nearby sites or experience with other areas of Montana. State required annual adjustments mirror annual adjustments specified in 40 CFR 258 that require annual adjustments for inflation and changes in closure and post-closure plans. Regulations do not

prescribe an accounting method for calculating the rate of inflation. Accounting for regional variations is accomplished through the use of site specific closure and post-closure tasks and services and unit costs.

2.1.4.12 North Dakota

No response was submitted.

2.1.4.13 South Dakota

The South Dakota Department of Environment and Natural Resources' (DENR's) regulations require the following landfills provide financial assurance as a condition of the permit, but not necessarily before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☐ Yes	☒ No	☐ Yes	☒ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. South Dakota does not use a guidance document for determining a landfill's financial assurance amount. Nor does South Dakota use regulatorily defined unit costs or unit costs published by other state or federal agencies. Unit costs used in calculating financial assurance are determined by the owner/operator or engineering consultant. The necessity of adjustments are determined by the facility owners. Annual reviews are required with South Dakota DENR oversight. Accounting for regional variations is accomplished through the use of site specific closure and post-closure unit costs. Applicable state regulations can be found on the Internet at http://www.state.sd.us/denr.

2.1.4.14 Utah

The Utah Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving waste.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans for state review and approval. Utah does use a guidance document for determining a landfill's financial assurance amount (See Attachment 3). The guidance document identifies all the closure and

post-closure tasks and services, as shown in Tables 2.7 and 2.8, respectively. However, the guidance document does not provide unit costs nor does it use regulatorily defined unit costs or unit costs published by other state or federal agencies.

TABLE 2.7 Utah Closure Tasks and Services

Item	Unit Measure	Cost/Unit	No. Units	Total Cost
1.0 Engineering				
1.1 Topographic Survey				
1.2 Boundary Survey				
1.3 Site Evaluation				
1.4 Development of Plans				
1.5 Contract Administration, Bidding, and Award				
1.6 Administrative Costs for Certification of Final Cover and Closure Notice				
1.7 Project Management; Construction Observation and Testing				
1.8 Monitor Well Consultant Cost				
1.9 Other Environmental Permit Costs				
2.0 Construction				
2.1 Final Cover System				
2.1.1 Completion of Sidewall Liner				
2.1.1a Soil Placement				
2.1.1b Soil Processing				
2.1.1c Soil Amendment				
2.1.1d Soil Purchase				
2.1.1e Soil Transportation				
2.1.2 Drainage Layer on Sidewall				
2.1.2a Geotextile Filter Fabric				
2.1.2b Geonet/Geotextile Composite				
2.1.2c Geomembrane Sidewall Liner				
2.2 Completing of Top Cover				
2.2.1 Infiltration Layer				
2.2.1a Soil Placement				
2.2.1b Soil Processing				
2.2.1c Soil Amendment				
2.2.1d Soil Purchase				

Item	Unit Measure	Cost/Unit	No. Units	Total Cost
2.2.1e Soil Transportation				
2.2.2 Flexible Membrane Cover				
2.2.2a Drainage Layer on Top				
2.2.2b Sand Layer				
2.2.2c Geotextile Filter Fabric				
2.2.3 Drainage Layer				
2.2.3a Geonet/Geotextile				
2.2.3b Collection Pipe				
2.2.3c Soil Cover				
2.2.3d Geonet/Geotextile Composite				
2.3 Erosion Layer Placement				
2.4 Revegetation				
2.4.1 Seeding				
2.4.2 Fertilizer				
2.4.3 Mulch				
2.5 Site Grading and Drainage				
2.6 Site Fencing and Security				
2.7 Leachate Collection System Completion				
2.8 Completion of Gas Monitoring System				
3.0 Gas Collection System				
3.1 System Design				
3.2 Equipment and Installation				
4.0 Monitor Well Installation Cost				
4.1 Monitoring Well Installation				
4.2 Piezometer and Monitoring Well Plugging				
10% Contingency				
Contract Performance Bond				
Legal Fees (0% to 25%)				

TABLE 2.8 Utah Post-Closure Tasks and Services

Item	Unit Measure	Cost/Unit	No. Units	Total Cost
1.0 Engineering Costs				
1.1 Post-Closure Plan				

Item	Unit Measure	Cost/Unit	No. Units	Total Cost
1.2 Site Inspection and Recordkeeping (annual)				
1.3 Correctional Plans and Specifications (annual)				
1.4 Site Monitoring (semiannual)				
1.4.1 Ground Water Monitoring				
1.4.1a Ground Water Sample Collection				
1.4.1b Ground Water Sample Analysis				
1.4.1c Ground Water Sample Analysis Review and Reporting				
1.4.2 Landfill Gas Monitoring				
1.4.2a Gas Monitoring Data Collection				
1.4.2b Gas Monitoring Data Review and Reporting				
2.0 Maintenance Costs				
2.1 Cover Maintenance Costs				
2.1.1 Soil Replacement				
2.1.2 Vegetation Reseeding				
2.2 Equipment Maintenance				
2.2.1 Ground Water Well Maintenance and Replacement				
2.2.2 Gas Collection System Operation				
2.2.3 Gas Collection System Maintenance and Repair				
2.2.4 Leachate Collection System Operation				
2.2.5 Leachate Collection System Repair and Maintenance				
3.0 Leachate Disposal				
4.0 Site Maintenance				
4.1 Repair of Surface Water Diversion Structures				
4.2 Repair of Fences and Gates				
4.3 Other Site Maintenance				
10% Contingency				

Unit costs used in calculating the facility's financial assurance are determined on a site specific basis, where costs are obtained from third-party bid or other available cost data. State required annual adjustments must account for increases or decreases in cost estimates but does not define accounting method to adjust for inflation. Design changes could change total closure and post-closure costs and are addressed with the modification request. Accounting for regional variations is accomplished through the use of bids or other actual cost estimates for that specific site. Applicable state regulations can be found on the Internet at http://www.deq.state.ut.us.

2.1.4.15 Wyoming

The Wyoming Department of Environmental Quality's regulations require the following landfills provide financial assurance before receiving final permit.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☒ Yes	☐ No	☒ Yes	☐ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans with task and services for state review and approval. Wyoming does not use a guidance document for determining a landfill's financial assurance amount. Wyoming does use regulatorily defined unit costs for a number of tasks and accepts unit costs published by R.S. Means (See Attachment 3). Owner/operators can submit third-party contractor bids for DEQ review and approval. Published data must be updated every four years and third-party bids must be updated every year. Table 2.9 presents current regulatory unit costs listed in Chapter 7, Section 9 of the Solid Waste Rules.

TABLE 2.9 Wyoming Closure and Post-Closure Unit Cost Data

TASK/SERVICE (unit)	UNIT COST	RESOURCE
FINAL CLOSURE		
Final cover, seeding, fertilizer, and mulching (acres)	$10,200	Chapter 7, Section 9(d)(I)(A)
Building demolition, removal, and disposal (sq. ft.)	$6.00	Chapter 7, Section 9(d)(I)(B)
Install new groundwater monitoring well (well)	$2,400	Chapter 7, Section 9(d)(I)(C)
Install new methane gas probe (probe)	$1,300	Chapter 7, Section 9(d)(I)(C)
Disposal of stored solid waste (CY)	$10.00	Chapter 7, Section 9(d)(I)(D)
Perimeter fencing (LF)	$13.00	Chapter 7, Section 9(d)(I)(E)
Final facility survey (lump sum)	$3,600	Chapter 7, Section 9(d)(I)(F)
Surface water diversion structures (LF)	$1.00	Chapter 7, Section 9(d)(I)(G)
Closure contingency	15%	Chapter 7, Section 9(d)(I)(H)
POST-CLOSURE		
Annual post-closure inspections (lump sum)	$733.33	Chapter 7, Section 9(d)(ii)(A)
Annual groundwater monitoring well sampling & analysis - Type I (well)†	$400	Chapter 7, Section 9(d)(ii)(B)(I)

Annual groundwater monitoring well sampling & analysis - Type II (well)††	$150	Chapter 7, Section 9(d)(ii)(B)(II)
Perimeter fence maintenance and replacement (LF)	$12.00	Chapter 7, Section 9(d)(ii)(C)
Remove and dispose perimeter fence (LF)	$2.00	Chapter 7, Section 9(d)(ii)(D)
Annual Methane gas monitoring (probe)	$240	Chapter 7, Section 9(d)(ii)(E)
Maintain surface water diversion structures (LF)	$1.00	Chapter 7, Section 9(d)(ii)(F)
Post-closure contingency	15%	Chapter 7, Section 9(d)(ii)(G)

† Type I analysis includes: pH, COD, specific conductance, chloride, sulfate, calcium, magnesium, nitrates, sodium, carbonates, potassium, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc, and 47 volatile organics in USEPA Report SW-846 Test Method 8260.
††Type II analysis includes: total dissolved solids, chlorides, ammonia as nitrogen, iron, hardness, total organic carbon, water temperature, specific conductance, pH.

For the purpose of estimating closure and post-closure costs for facilities electing to participate in Wyoming's state guarantee trust account, the cost factors listed in Table 2.9 are expressed in 1993 dollars. Any closure and post-closure cost estimate resulting from the use of these cost factors must be adjusted to account for inflation. The inflation factor shall be derived from the most recent implicit price deflator for Gross National Product published by the US Department of Commerce. Inflation is adjusted when closure and post-closure costs are adjusted, either annually or every four years. Wyoming does not acknowledge in-state regional variations. Applicable state regulations can be found on the Internet at http://deq.state.wy.us.

2.1.4.16 Minnesota

The Minnesota Pollution Control Agency's (MPCA's) regulations require the following landfills provide financial assurance before receiving final permit or permit re-issuance.

	Final Closure		Post-Closure	
MSWLF:	☒ Yes	☐ No	☒ Yes	☐ No
NHISWLF:	☒ Yes	☐ No	☒ Yes	☐ No
C&D Landfills:	☐ Yes	☒ No	☐ Yes	☒ No

Current regulations provide only general descriptions of tasks and services to include in closure and post-closure plans. Owner/operators must provide closure and post-closure plans with tasks and services for state review and approval. Minnesota does not use a guidance document for determining a landfill's financial assurance amount. Nor does Minnesota use regulatorily defined unit costs or unit costs published by other state or federal agencies. Owner/operators can submit third-party contractor cost estimates or the facility can use data maintained as part of the Closed Landfill Program. Attachment 3 contains project costs sheets for several landfills the MPCA is managing.

The Closed Landfill Program was created by the 1994 Landfill Cleanup Act. The program is an alternative to Superfund for closed landfills and the first of its kind in the nation. Under the program MPCA is authorized to initiate cleanup actions, complete closures, take over long-term operation and maintenance and reimburse eligible parties for past clean-up costs at the 106 qualified closed state-permitted landfills. Funding for the program has or will come from the following five sources.

- Solid Waste Assessment fees;
- Up to $90 million in state general obligation bonds;
- Funds transferred from the financial assurance accounts of closed landfills;
- A one-time transfer of funds from the Metropolitan Landfill Contingency Action Trust Fund; and
- Future settlements from landfill-related insurance policies.

At the end of the 1998 fiscal year, the program had 27 construction projects underway or completed and another 30 construction designs underway or completed. A copy of the 1998 annual report is contained in Attachment 3.

State required annual adjustments must account for increases or decreases in cost estimates but does not define an accounting method to adjust for inflation. Accounting for regional variations is accomplished through the use of bids or other actual cost estimates for that specific area of the state. Applicable state regulations can be found on the Internet at http://www.pca.state.mn.us.

2.2 United States Environmental Protection Agency Research

The United States Environmental Protection Agency's document database maintained at its webpage was researched for reports and guidance documents pertaining to financial assurance and closure and post-closure cost estimates. Research applicability screening identified the following described in Table 2.10.

TABLE 2.10 USEPA Reference Documents

	USEPA Reference Document
1	Guidance Manual: Cost Estimates for Closure and Post-Closure Plans (Subparts G and H) Volume II - Land Disposal Facilities, November 1986
2	Guidance Manual: Cost Estimates for Closure and Post-Closure Plans (Subparts G and H) Volume III - Unit Costs, November 1986
3	Guidance Manual: Cost Estimates for Closure and Post-Closure Plans (Subparts G and H) Volume IV - Documentation, November 1986
4	RCRA Guidance Manual for Subpart G Closure and Post-Closure Care Standards and Subpart H Cost Estimating Requirements, January 1987
5	Requirements for Hazardous Waste Landfill Design, Construction, and Closure, August 1989

6	Solid Waste Disposal Facility Criteria - Technical Manual, November 1993
7	Design, Operation, and Closure of Municipal Solid Waste Landfills, September 1994

2.2.1 Guidance Manual: Cost Estimates for Closure and Post-Closure Plans

Subpart H of 40 CFR Part 264 and Part 265 of the RCRA Subtitle C regulations requires owner/operators of all hazardous waste treatment, storage, and disposal facilities (TSDFs) to prepare an estimate of the cost for closing the facility in accordance with regulations. In addition to the closure cost estimates, TSDF owner/operators are to prepare estimates of the cost of post-closure care for those facilities. The cost estimates are based on closure and post-closure plans required by Subpart G of 40 CFR Part 264 and Part 265. Financial assurance must be established for closure and post-closure, the amount of which is based on these cost estimates. Reviewers of closure and post-closure cost estimates need to be able to determine whether the cost estimates are reasonable in order to assess the adequacy of the closure and post-closure financial assurance. This involves consideration both of the closure and post-closure plans and of the unit costs and calculations used to develop the cost estimates.

Although there are many construction and operational differences between Subtitle C and Subtitle D facilities, the obligation to develop closure and post-closure plans and provide defendable unit costs exists for both facility types. The corresponding federal regulations are 40 CFR Part 258 Subpart F - Closure and Post-Closure Care and Subpart G - Financial Assurance Criteria. Based on the similarities between the respective regulations, the methods and procedures of determining unit costs developed for some Subtitle C facilities provide a framework to evaluate methods and procedures of determining unit cost for solid waste landfills. Volume I of the guidance document addressed treatment and storage facilities and therefore was not reviewed. Volume II that addressed land disposal facilities, Volume III that covered unit costs, and Volume IV that provided documentation for unit costs developed in Volume III were reviewed. A summary of findings for each volume is presented in the following subsections respectively.

2.2.1.1 Volume II - Land Disposal Facilities

The purpose of this volume is to provide a framework for developing the closure and post-closure cost estimates for land disposal technologies. Volume II is divided into six major chapters addressing closure cost estimating for waste piles, surface impoundments, land treatment facilities, and landfills, post-closure cost estimating, and summary worksheets. For purpose of this project, Chapters 5 and 6 were reviewed for pertinent information, procedures, and methods for identifying and determining closure and post-closure unit costs.

Chapter 5 addresses landfills and identifies tasks and services necessary to complete final closure. The calculation worksheets are very detailed. Chapter 6 addresses post-closure cost estimates and is also very detailed. Both sets of worksheets are included in Attachment 5 for review. The worksheets contain unit costs for some tasks and services. Discussion on unit costs is covered in Volume III.

Since the guidance document was published in November 1986, the unit costs have to be updated before being applied to an Oklahoma facility. The guidance document shows how to complete a detailed breakdown of tasks and services to include in calculating closure costs. Defining such detail creates a complicated procedure for calculating closure costs, with many items subject to different interpretation and disagreement. The goal of this project is to develop a procedure that is easy to implement and comply with, therefore a less complicated and subjective approach to calculating closure and post-closure costs will be developed.

2.2.1.2 Volume III - Unit Costs

Volume III is the companion to the Volume II closure and post-closure calculation sheets. Volume III contains information and guidance on unit cost ranges, typical unit costs, and how the unit costs are applied to different facilities in calculating closure and post-closure cost estimates. The unit costs were developed from cost information obtained through cost-estimating manuals, USEPA reports, technical publications, contractor's bid estimates, equipment vendor specifications and contracts, and site surveys. All reported costs are in 1986 dollars and represent third-party costs. The cost estimating procedure used in Volume III consists of the following steps:

- Identify tasks and subtasks to be performed;
- Determine appropriate labor categories;
- Estimate hours to complete each task and subtask for each labor category;
- Determine appropriate equipment necessary to complete each task and subtask;
- Estimate operating time to complete each task and subtask;
- Select a unit cost for each item identified in Steps 1 through 5; and
- Calculate cost for each task and subtask.

Chapters 2 through 9 provide extensive detail in determining tasks, subtasks, and associated assumptions. For example, the cost for moving a cubic yard of soil is calculated after deciding the cost associated with the type of equipment, engine horsepower, size of bucket, distance to move material, specific soil classification, and mobilization/demobilization. This method presents many different possible scenarios for calculating one unit cost item. Using this method would create difficulties in calculating consistent and defendable unit costs for the different landfills located across Oklahoma. The method would be very time consuming for both the owner/operator and reviewing authority. Furthermore, the method would require extensive explanation and supporting documentation for each assumption. Although the guidance document is detailed in describing the tasks and subtasks, the result is an impracticable and time-consuming procedure for calculating a specific unit cost. Rather, the guidance document is useful as a reference for aggregating similar activities into one unit cost.

Another useful item in Volume III is the discussion on additional project costs that are percentages of the total project cost. The discussion in Chapter 10 is helpful in identifying appropriate values for additional cost percentages for closure and post-closure cost estimates. The reported value or range is presented in Table 2.11.

TABLE 2.11 Closure and Post-Closure Indirect Costs

Indirect Cost Category		Additional Cost Ranges
1	Engineering and supervision	5% - 15%
2	Contractor's fee	15% - 50%
3	Contingency fee	10% - 30%
	Landfill Closure Contingency	25%
	Landfill Post-Closure Contingency	15%

2.2.1.3 Volume IV - Documentation

Volume IV contains the documentation for the unit costs presented in Volume III. The purpose of
Volume IV is to present information on the source(s) used for each unit cost, provide examples of any computations performed in developing a unit cost, and describe any assumptions made in developing the unit costs. The discussion and calculations presented in Chapters 2 through 10 are very thorough and the interested reader is directed to the specific document for questions and inquiries. A concise summary of reference resources reported in Volume IV and used in Volume III are presented in Table 2.12.

TABLE 2.12 USEPA Unit Cost Primary Reference Resources

Unit Cost Category		Primary Reference Resources
1	Laboratory analysis (soil and water)	USEPA Contract Laboratories
2	Inspection and Maintenance	R.S. Means, Minnesota Department of Transportation, and vendors
3	Inventory and Residual Management	R.S. Means, Department of Energy, City of St. Paul Water Department, USEPA Reports, and vendors
4	Equipment and Facility Decontamination	R.S. Means and vendors
5	Protective clothing and safety equipment	Lab Safety Supply Company
6	Demolition and Excavation	R.S. Means and consultants
7	Final Cover and Revegetation	R.S. Means, vendors, Engineering News Record (ENR)
8	Labor Categories and Rates	R.S. Means, consultants, and attorney
9	Closure and Post-closure Indirect Costs	R.S. Means, National Construction Estimator, USEPA Reports, and cost engineering texts

2.2.2 RCRA Guidance Manual for Subpart G Closure and Post-Closure Care Standards and Subpart H Cost Estimating Requirements

The purpose of this guidance manual is to assist the USEPA and state regulatory agencies in implementing the closure and post-closure care and cost estimate regulations and to help owners and operators prepare plans and costs estimates. The manual addresses four broad topics:

- Clarifies the intent and scope of regulations;
- Provides examples of information to include in closure and post-closure plans and cost estimate;
- Discusses site-specific factors that may affect closure and post-closure; and
- Provides closure and post-closure plan checklists.

After the introduction chapter, Chapters 2 and 3 list and explain the regulatory language for closure and post-closure. Due to space limitations, these discussions are not valuable in the context of this project. The last Chapter, Chapter 4, provides instructions for preparing cost estimates. Interesting conclusions presented include:

- Cost estimates should not include the cost of responding to highly unusual contingencies, unless such circumstances exist at the time of preparing or updating the closure and post-closure cost estimates;
- Cost estimates must be based on the owner/operator hiring a third-party to conduct the activities. Parent companies or subsidiaries of the owner/operator cannot be considered third-parties;
- Cost estimates cannot account for salvage value of equipment or material or sale of recyclable materials present at the site. These items shall have a zero value;
- Some examples of when cost estimates may increase:
    - The facility increases in size or capacity;
    - Change in regulatory requirements;
    - More extensive or frequent groundwater monitoring due to new data, groundwater usage change; and
    - Extension in the post-closure monitoring period.
- Some examples of when cost estimates may decrease:
    - Reduction in the size needing closure due to phased closure; and
    - Reduction in the post-closure monitoring period.
- A facility may account for inflation by completely redoing closure and post-closure costs using current year dollars or by calculating an adjustment factor using the Implicit Price Deflator for the Gross National Product that is published in the Survey of Current Business.
- Documentation for cost estimates should clearly delineate all the activities and subactivities consistent with those described in the closure and post-closure plans and include the fully loaded costs. Fully loaded costs account for labor, materials, equipment, and contingency. Five sources identified in the manual are: Guidance Manual: Cost Estimates for Closure and Post-Closure Plans (Subpart G and H), owner/operator experience, contractor estimate, cost estimating handbooks, and accounting worksheets and workups.

2.2.3 Requirements for Hazardous Waste Landfill Design, Construction, and Closure

This publication outlines in detail the provisions of the minimum technology guidance and regulations, and offers practical and detailed information on the construction of hazardous waste facilities. Although Chapter 5 discusses elements of closure systems for landfills and Chapter 9 presents an overview of long-term care considerations, the document does not provide valuable discussion or detail on calculating closure and post-closure cost estimates.

2.2.4 Solid Waste Disposal Facility Criteria - Technical Manual

This technical manual was developed by the USEPA to assist municipal solid waste landfill owner/operators in achieving compliance with 40 CFR Part 258. Chapter 6 specifically addresses 40 CFR Part 258 Subpart F - Closure and Post-Closure. Subsections address individual regulatory requirements, such as technical considerations for final cover design, including infiltration layer, erosion layer, drainage layer, gas vent layer, biotic layer, settlement and subsidence, and slope stability. Subsection 6.4 addresses the closure plan and includes a provision whereby the closure cost estimate must account for the portions of the landfill that have received waste but not final cover. Some steps identified in the subsection include:

- Determining the area to receive final cover;
- Developing the closure schedule;
- Preparing construction contract documents and securing a contractor;
- Hiring an independent registered professional engineer to observe closure activities and provide certification;
- Securing borrow material;
- Constructing the cover system;
- Obtaining signed certificate and placing it in operating record; and
- Recording notation in deed to land or other similar instrument.

Subsection 6.6 addresses post-closure care requirements, specifically identifying the operation and maintenance performance criteria that targets the final cover system, leachate collection system, groundwater monitoring system, and gas monitoring system.

Unit cost discussions are absent from the technical manual. However, the discussions on closure and post-closure expectations are useful in identifying closure and post-closure tasks. For example, in order to determine the area to receive final cover, a site inspection and topographic survey will have to be performed prior to commencing construction. Additionally post-closure performance activities can be categorized into three groups.

Inspections - necessary to determine site conditions and equipment performance;

Operations - collecting and analyzing samples, removing and disposing leachate, operating gas collection system, and performing necessary recordkeeping and reporting; and

Maintenance - correcting erosion and settlement of final cover, maintaining vegetative cover, maintaining drainage structures, maintaining monitoring equipment (monitoring wells, methane gas probes, and piezometers), and maintaining access control.

2.2.5 Design, Operation, and Closure of Municipal Solid Waste Landfills

The purpose of this publication, when published in 1994, was to provide people with state-of-the-art information on the proper design, construction, operation, and closure of municipal solid waste landfills. Chapter 7 deals with closure and post-closure while an earlier chapter addressed other design, construction, and operational topics. The information provided on closure activities is summarized in the following paragraphs.

Final cover should include an interim layer of soil, gas venting layer, low permeability layer, drainage layer, and erosion control layer. The USEPA document further recommends the installation of one passive gas vent per acre of cover. These are necessary to prevent the buildup of gas pressure beneath the final cover. Passive vents may not be necessary for landfills that do not install a composite cap or landfills that operate and maintain an active gas extraction system.

Post-closure requirements are summarized into the monitoring plan, maintenance plan, emergency plan and contacts, and description of the end-use plan for the site. Specific maintenance items discussed included: routine vegetation management (mowing and planting), subsidence repair, run-on/run-off control, inspection and repair of sedimentation basins and drainage channels, cleaning and maintaining the leachate collection system, and inspecting and maintaining methane gas probes, passive gas vents, and groundwater monitoring wells.

Chapter 8 addresses financial assurance and provides cost estimates for specific construction, operation, and maintenance tasks. The unit cost source(s) and some of the calculation assumptions were not disclosed. These tasks and cost estimates are summarized in Table 2.13.

TABLE 2.13 USEPA Estimating Final Cover and Post-Closure Care Costs

DESCRIPTION		UNIT COST
FINAL CLOSURE		
1	Infiltration Layer	
	Geomembrane	$0.20-$0.80/square foot
	Placing and compacting soil	$4-$6/CY
	Transporting soil to the site	$0.15-$0.25/ton/mile
2	Drainage Layer	
	6-inch sand layer	$12-$20/ton
	Bonded geonet	$0.55-$0.70/square foot

3	Erosion Control Layer	
	Soil	$8-$14/ton
	Fertilizing, seeding, and hydro mulching	$1,200-$1,800/acre
	Drainage swales	$1,100-$2,000/acre
4	Passive Gas Venting Layer	
	Venting wells	$3,000-$8,000/well
	Surface trench collectors	$2,000/each
POST-CLOSURE		
5	Long-term Maintenance of Final Cover	$1,500-$3,000/acre
6	Leachate Management	
	Maintenance and operation	$10,000-$25,000/year
	Leachate treatment	$0.15-$0.25/gallon
7	Groundwater Monitoring	
	Installation of replacement well	$50-$100/foot
	Annual sampling and analysis (40 CFR Part 258, Appendix I, Constituents)	$2,500-$3,200/well
8	Gas Monitoring System	
	Gas monitoring	$1,000-$1,600/year
	Methane gas probe repair	$1,000/year