

IOWA DNR WORKSHOP #1 HANDOUT SUBTITLE D ECONOMICS

Introduction

The Iowa Department of Natural Resources (IDNR) is currently in the process of updating its solid waste administrative code to comply with the minimum standards set in the Resource Conservation and Recovery Act (RCRA), Subtitle D regulations by October 1, 2007. The IDNR, in cooperation with the Iowa Chapter of the Solid Waste Association of North America (Iowa Society of Solid Waste Operations), is sponsoring two workshops on May 17 and June 1, 2005 to assist the state's existing landfills with this transition. Landfills that do not currently comply with Subtitle D regulations must either demonstrate that their existing landfill is Subtitle D compliant, develop new disposal capacity with adequate liner systems, or close by the October 1, 2007 compliance date. Shaw Environmental, Inc. (Shaw) was retained to conduct the workshops and provide attendees with information on the expected cost of the permitting, operating, and constructing a Subtitle D compliant landfill.

Currently, only 27 of the state's 59 operating municipal solid waste landfills are equipped with either composite or alternative liners that comply with Subtitle D regulations. The 32 landfills that the IDNR consider non-compliant generally fall into one of two categories: 1) landfills with engineered 4' recompacted clay liners that have not been modeled at the point-of compliance; and 2) unlined landfills (in-situ liners). Engineered clay liners may meet Subtitle D alternative liner rules if modeled to show performance equivalency with composite liner systems. In-situ lined landfills will not be permitted under the new rules and must develop new disposal capacity with an adequate liner system by October 1, 2007.

Shaw created a cost model for incremental permitting, operational, and construction expenses related to complying with Subtitle D for the two groups of non-compliant landfills.

Typical landfill waste acceptance rates, Iowa design configurations, and standard means construction rates were used to develop the model. The model focuses on incremental costs (costs on a per ton of waste accepted at the facility) to illustrate the potential impact on tipping fees related to complying with the new rules.

Cost Model Assumptions

Clay Lined Landfills that Have not Been Performance Modeled

It is anticipated that landfills that currently operate with a documented 4' recompacted clay liner may meet Subtitle D criteria for these disposal areas through performance modeling at the point of compliance. The point of compliance is a point located 150 meters from the waste boundary in the downstream location. Modeling the in-place liner must show that the contaminant concentration values listed in federal regulations under 40 CFR 258, Subpart D, Table 1, will not be exceeded in the uppermost aquifer at the designated monitoring points of compliance. It is assumed that Multimed software will be used to conduct the modeling analysis.



As most of the Iowa landfills with 4' recompacted clay liners were constructed in accordance with Iowa Administrative Code 567-113 (Municipal Solid Waste Landfills), it is assumed that hydrogeological investigations at these sites are sufficient to complete point-of-compliance performance modeling without additional investigation. Thus, the main compliance cost for these landfills addressed in the cost model is performance modeling. It is possible that clay lined landfills may need to install a FML final cover system for modeling to meet minimum Federal standards. The cost model provides anticipated construction costs for FML final cover systems.

Unlined (In-Situ) Landfills

Unlined landfills are not permitted under Subtitle D rules. The cost estimate assumes that these facilities will become Subtitle D compliant through developing new disposal capacity (permitting, operating, and constructing) on existing property that meets Subtitle D requirements. The model only considers incremental costs associated with permitting, operating, and constructing Subtitle D compliant cells. It is assumed that facility development (with the exception of installing a leachate holding tank), overhead costs, and daily operations will not change as a result of the new rules. It is also assumed that a leachate holding tank will be installed and a full hydrogeologic investigation is conducted due to new rule requirements.

General Landfill Assumptions

The cost model was designed to represent the average landfill that will seek compliance with the new rules. Average waste acceptance rates were reviewed for the targeted landfills. General construction parameters were developed through discussions with local engineers, and state officials. The information below summarizes general assumptions used in the cost model:

- Total landfill footprint = 7.5 acres.
- Total landfill capacity = 429,590 cy, inclusive of daily and intermediate cover. This corresponds to approximately 246,480 tons of capacity for waste, assuming a 15 percent daily/intermediate cover and a compacted waste density of 1,350 pounds per cubic yard.
- Daily waste acceptance of 29 tons per day. This corresponds with the current average waste acceptance for unlined facilities.
- Projected operating life of the landfill is 30 years.
- Cell construction size will be 0.65 acres, representing the smallest practical construction size. New cells will be constructed approximately every 2.6 years based on the assumed waste acceptance rate.
- Total cell capacity = 21,360 tons of waste, calculated by dividing the total landfill capacity by the relative cell area.
- Currently unlined facilities will install a 150,000 gallon leachate holding tank.
- Leachate is generated at a rate of 400 gallons per acre per day (per Bonaparte and Othman, Geotechnical News, March 1995).
- Landfills that construct composite liners must build composite final cover



- systems. Landfills that construct alternative liners may build either composite or alternative final cover systems.
- 15 % contingency costs.

Construction details were developed through discussions with Iowa solid waste engineers and are presented in the PowerPoint presentation prepared for the May 17, 2005 workshop. Costs were gathered from geosynthetics installers, 2005 construction means costs, and previous Shaw experience.

Cost Model Results

Incremental Costs for Existing In-Situ Liner Facilities

To develop the cost model, costs were broken down into three general categories: 1) Allocated Permitting Costs; 2) Additional Operating Costs; and 3) Cell Construction Costs. Allocated Permitting Costs consist of completing a hydrogeological investigation of the site property and installing a leachate storage tank. The Allocated Permitting Costs are assumed to be spread out over the 30 year site life. The cost to perform these activities was divided by the total site waste tonnage to demonstrate the potential influence on tipping fees. Additional Operating Costs include semi-annual sampling of leachate and leachate treatment and system operation. Additional Cell Construction Costs reflect the cost difference between constructing in-situ liners and alternative/composite liners. The total cost to build an in-situ liner was subtracted from the cost to construct composite and alternative Subtitle D liners to determine the additional construction costs. Both the operating and construction costs were then divided by the total waste placed in the 0.65 acre cell to determine the potential effect on tipping fees.

Table 1 summarizes the incremental costs that owners of unlined (in-situ) landfills may expect for developing a Subtitle D waste disposal area.

TABLE 1: INCREMENTAL COSTS FOR EXISTING IN-SITU LINER FACILITIES (0.65 ACRE CELL SIZE)						
CATEGORY	Composite Liner		Alternate Liner - 4'		Alternate Liner - 5'	
	Low	High	Low	High	Low	High
ALLOCATED PERMITTING COSTS	\$22,428.00	\$37,380.00	\$22,428.00	\$37,380.00	\$22,428.00	\$37,380.00
ADDITIONAL OPERATING COSTS	\$15,249.00	\$17,388.00	\$15,249.00	\$17,388.00	\$15,249.00	\$17,388.00
CELL CONSTRUCTION COSTS	\$143,222.50	\$159,570.03	\$138,043.36	\$159,531.16	\$148,149.56	\$173,727.68
TOTAL:	\$180,899.50	\$214,338.03	\$175,720.36	\$214,299.16	\$185,826.56	\$228,495.68



TABLE 1: INCREMENTAL COSTS FOR EXISTING IN-SITU LINER FACILITIES (0.65 ACRE CELL SIZE)						
	Composite Liner		Alternate Liner - 4'		Alternate Liner - 5'	
	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton
PER TON COSTS						
ALLOCATED PERMITTING COSTS	\$1.05	\$1.75	\$1.05	\$1.75	\$1.05	\$1.75
ADDITIONAL OPERATING COSTS	\$0.71	\$0.81	\$0.71	\$0.81	\$0.71	\$0.81
CELL CONSTRUCTION COSTS	\$6.71	\$7.47	\$6.46	\$7.47	\$6.94	\$8.13
TOTAL:	\$8.47	\$10.03	\$8.23	\$10.03	\$8.70	\$10.70

Cost Summary of Possible Construction Configurations (0.65 Acre Cell Size)

Various assemblages of liner and final cover configurations are possible for Subtitle D cell development. Landfills with composite liner systems must construct composite final cover systems. However, alternative liners may be paired with either composite or alternative final cover systems. Table 2 presents the low and high cost estimates for each of these options. The costs summarize the detailed information found in Tables 5A/5B (Cell Construction Costs) and 6A/6B (Final Cover Construction Costs). Liners configurations include composite and alternative designs. Alternative designs for 4' and 5' of recompacted clay are considered. Final cover configurations include composite and alternative designs.

TABLE 2: COST SUMMARY OF POSSIBLE CONSTRUCTION CONFIGURATIONS (0.65 ACRE CELL SIZE)								
LINER CONFIGURATION			FINAL COVER CONFIGURATION		TOTAL CONSTRUCTION COST		PER TON CONSTRUCTION COST	
COMPOSITE	4' ALTERNATIVE	5' ALTERNATIVE	COMPOSITE	ALTERNATIVE	LOW	HIGH	LOW	HIGH
X			X		\$260,897.80	\$313,608.80	\$12.21	\$14.68
	X		X		\$255,718.66	\$313,569.12	\$11.97	\$14.68
	X			X	\$232,583.06	\$291,355.48	\$10.89	\$13.64
		X	X		\$265,824.86	\$327,765.64	\$12.44	\$15.34
		X		X	\$242,689.26	\$305,552.00	\$11.36	\$14.30



Allocated Permitting and Operation Costs

Table 3 presents the allocated permitting and regulatory costs for both unlined and clay liner facilities. The costs for unlined facilities generally consist of installing a leachate tank and performing a hydrogeological investigation. The cost item for the clay lined facilities is performance modeling of previous liners. The total costs were assumed to be absorbed over the 30 year site life. The allocated costs are presented both as the total amount and the total amount divided by the total tons of waste accepted during the facility life.

Table 4 shows the incremental operating costs that unlined and clay liner facilities may incur. As shown, only unlined landfills will have an increase in costs, which result from sampling and treating leachate.

TABLE 3: ALLOCATED PERMITTING AND REGULATORY COSTS								
CATEGORY	Units Needed		Unit Cost		Engineered Liners		In-Situ Liners	
	Number	Unit	Low	High	Unit Cost	Total Cost	Unit Cost	Total Cost
Install 150,000 gal Leachate Vault	1	LS	\$150,000.00	\$250,000.00	-	-	\$150,000.00	\$250,000.00
Hydrogeological Investigation	1	LS	\$75,000.00	\$125,000.00	-	-	\$75,000.00	\$125,000.00
Performance Modeling of Previous Liners	1	LS	\$15,000.00	\$20,000.00	\$15,000.00	\$20,000.00	-	-
			SUBTOTAL:		\$15,000.00	\$20,000.00	\$225,000.00	\$375,000.00
			15 % CONTINGENCY:		\$2,250.00	\$3,000.00	\$33,750.00	\$56,250.00
			TOTAL:		\$17,250.00	\$23,000.00	\$258,750.00	\$431,250.00
			COST PER TON:		\$0.07	\$0.09	\$1.05	\$1.75



TABLE 4: INCREMENTAL OPERATING COSTS								
LEACHATE	Units Needed		Unit Cost		Engineered Liners		In-Situ	
	Number	Unit	Low	High	Low	High	Low	High
Sample Collection (One sample twice per year)	2	Each	\$125.00	\$375.00	-	-	\$250.00	\$750.00
Laboratory Analysis (One sample twice per year)	2	Each	\$115.00	\$135.00	-	-	\$230.00	\$270.00
Recordkeeping	16	Hrs	\$80.00	\$100.00	-	-	\$1,280.00	\$1,600.00
Leachate Treatment - Operational Period (0.65 acres)	95,000.00	Gal	\$0.10	\$0.10	-	-	\$9,500.00	\$9,500.00
Leachate Operations	1	LS	\$2,000.00	\$3,000.00	-	-	\$2,000.00	\$3,000.00
SUBTOTAL:					\$0.00	\$0.00	\$13,260.00	\$15,120.00
15 % CONTINGENCY:					\$0.00	\$0.00	\$1,989.00	\$2,268.00
TOTAL:					\$0.00	\$0.00	\$15,249.00	\$17,388.00

Cell Construction Costs for a 0.65 Acre Cell

Cost estimates for constructing a 0.65 acre cell with composite and alternative liners are presented in Tables 5A and 5B. Construction details were developed through discussions with Iowa solid waste engineers and are presented in the PowerPoint presentation prepared for the May 17, 2005 workshop. Costs were gathered from geosynthetics installers, 2005 construction means costs, and previous Shaw experience.

Table 5B provides a detailed cost estimate to construct a 0.65 acre landfill liner. Construction of different Subtitle D liners is presented, including a composite liner (2' of compacted clay and a flexible membrane liner) and alternative liners (4' and 5' of recompacted clay). The table also presents the cost to develop an unlined (in-situ) waste disposal area for purposes of cost comparison.

Table 5A summarizes the results of Table 5B in general construction categories and presents the incremental cost to construct each liner configuration as compared with the unlined waste disposal areas. Table 5A additionally divides the total and incremental construction costs by the total waste (in tons) that will be placed in the cell to indicate how Subtitle D cell



construction may impact current tipping fees.

TABLE 5A: SUMMARY OF CELL CONSTRUCTION COSTS FOR 0.65 ACRE CELL								
	Existing In-Situ Liner		Composite Liner		4' Alternative Liner		5' Alternative Liner	
	Low	High	Low	High	Low	High	Low	High
TOTAL CONSTRUCTION COSTS								
EXCAVATION AND SURGRADE	\$40,422.70	\$64,515.70	\$50,185.90	\$80,607.10	\$56,497.70	\$90,680.90	\$59,638.50	\$95,693.70
GROUNDWATER DIVERSION LAYER	\$0.00	\$0.00	\$17,621.20	\$17,661.50	\$16,422.60	\$16,435.60	\$16,422.60	\$16,435.60
LINER SYSTEM	\$0.00	\$0.00	\$26,846.70	\$30,232.50	\$22,697.40	\$29,469.00	\$28,344.60	\$36,801.00
LEACHATE COLLECTION SYSTEM	\$0.00	\$0.00	\$45,841.80	\$47,484.35	\$41,165.90	\$42,776.15	\$41,165.90	\$42,776.15
OTHER	\$0.00	\$0.00	\$13,773.40	\$16,326.80	\$12,926.80	\$12,926.80	\$12,926.80	\$12,926.80
CONSTRUCTION QUALITY ASSURANCE	\$0.00	\$0.00	\$9,750.00	\$9,750.00	\$9,750.00	\$9,750.00	\$9,750.00	\$9,750.00
LABORATORY TESTING	\$0.00	\$0.00	\$945.00	\$1,210.00	\$1,000.00	\$1,200.00	\$1,000.00	\$1,200.00
GAS WELL INSTALLATION	\$1,700.00	\$1,700.00	\$1,700.00	\$1,700.00	\$1,700.00	\$1,700.00	\$1,700.00	\$1,700.00



TABLE 5A: SUMMARY OF CELL CONSTRUCTION COSTS FOR 0.65 ACRE CELL

	Existing In-Situ Liner		Composite Liner	4' Alternative Liner		5' Alternative Liner		
TOTAL DIRECT:	\$42,122.70	\$66,215.70	\$166,664.00	\$204,972.25	\$162,160.40	\$204,938.45	\$170,948.40	\$217,283.25
15% CONTINGENCY:	\$6,318.40	\$9,932.36	\$24,999.60	\$30,745.84	\$24,324.06	\$30,740.77	\$25,642.26	\$32,592.49
TOTAL:	\$48,441.10	\$76,148.05	\$191,663.60	\$235,718.09	\$186,484.46	\$235,679.22	\$196,590.66	\$249,875.74
INCREMENTAL COST VS. EXISTING IN-SITU LINER:	\$0.00	\$0.00	\$143,222.50	\$159,570.03	\$138,043.35	\$159,531.16	\$148,149.56	\$173,727.68
PER TON CONSTRUCTION COSTS	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton	\$/ Ton
EXCAVATION AND SUBGRADE	\$1.89	\$3.02	\$2.35	\$3.77	\$2.65	\$4.25	\$2.79	\$4.48
GROUNDWATER DIVERSION LAYER	\$0.00	\$0.00	\$0.82	\$0.83	\$0.77	\$0.77	\$0.77	\$0.77
LINER SYSTEM	\$0.00	\$0.00	\$1.26	\$1.42	\$1.06	\$1.38	\$1.33	\$1.72
LEACHATE COLLECTION SYSTEM	\$0.00	\$0.00	\$2.15	\$2.22	\$1.93	\$2.00	\$1.93	\$2.00
MISCELLANEOUS	\$0.00	\$0.00	\$0.64	\$0.76	\$0.61	\$0.61	\$0.61	\$0.61
CONSTRUCTION QUALITY ASSURANCE	\$0.00	\$0.00	\$0.46	\$0.46	\$0.46	\$0.46	\$0.46	\$0.46
LABORATORY TESTING	\$0.00	\$0.00	\$0.04	\$0.06	\$0.05	\$0.06	\$0.05	\$0.06
GAS WELL INSTALLATION	\$0.08	\$0.08	\$0.08	\$0.08	\$0.08	\$0.08	\$0.08	\$0.08
TOTAL DIRECT:	\$1.97	\$3.10	\$7.80	\$9.60	\$7.59	\$9.59	\$8.00	\$10.17
15% CONTINGENCY:	\$0.30	\$0.46	\$1.17	\$1.44	\$1.14	\$1.44	\$1.20	\$1.53
TOTAL:	\$2.27	\$3.56	\$8.97	\$11.04	\$8.73	\$11.03	\$9.20	\$11.70
INCREMENTAL COST VS. EXISTING IN-SITU LINER:	\$0.00	\$0.00	\$6.71	\$7.47	\$6.46	\$7.47	\$6.94	\$8.13



