United States
Environmental Protection
Agency

Municipal Environmental Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S2-82-035 Mar. 1983

EPA

Project Summary

Costs of Remedial Response Actions at Uncontrolled Hazardous Waste Sites

Howard L. Rishel, Terence M. Boston, Curtis J. Schmidt, and Oscar W. Albrecht

This study updates previously estimated costs for remedial response actions at uncontrolled and abandoned hazardous waste disposal sites. Costs for 35 remedial action operations were estimated for the United States and for the Newark, New Jersey, area. These estimates were based on mid-1980 price levels.

Cost components for capital and operating expenses were estimated for independent unit operations, and total and life cycle average costs were computed. An example is included to show the user how to estimate costs for complete remedial response activities.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Past disposal of hazardous wastes is one of the very serious problems facing the Nation today. Wastes at uncontrolled and abandoned disposal sites contain toxic, reactive, ignitable, corrosive, and persistent hazardous substances that pose significant risks to public health and the environment.

To deal with potential risks, Congress passed in 1980 the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), frequently referred to as the "Superfund." The Act calls for a broad response and liability mechanism for dealing with toxic substances pollution and requires the U.S. Environmental Protection Agency (EPA) to identify the hazardous substances and reportable quantities of such substances that may escape to the environment. The Act further provides for government response to actual and threatened releases, determination of the liability of polluters, and a joint government-industry response fund to cover costs for cleanup and restoration.

To assist those involved in estimating the costs of remedial response actions (e.g., containment, cleanup, and restoration), EPA sponsored this study to review and update engineering designs and related costs. The tasks included identification of appropriate designs from the available literature and revision of the associated capital and operating costs to reflect recent prices. Individual costs were estimated for unit operations (specific types of remedial actions), and these were then combined for estimating the costs of complete remedial action responses at uncontrolled or abandoned landfills or impoundment sites. The full report includes the following:

- Conceptualized descriptions of the uncontrolled landfill and surface impoundment disposal sites;
- Generalized discussions of the 35 unit operations (21 for landfills and

Table 1. *Average U.S. Low and High Costs of Unit Operations for Medium-Sized Landfill Sites*

Unit Operations	Unit	Average U.S. Cost $ Per Unit*				Total Units Used**
		Initial Capital		Life Cycle Costs		
		Low	High	Low	High	
1. Contour grading and surface water diversion	Site area, ha	15,300	17,900	16,300	19,900	5.4 ha site area
2. Bituminous concrete surface sealing	Site area, ha	67,300	92,700	67,300	92,700	5.4 ha site area
3. Revegetation	Site area, ha	3,450	16,500	14,300	18,100	5.4 ha site area
4. Bentonite slurry trench	Wall face area, m^2	54.5	96.1	61.2	103	10,800 m^2 wall face area
5. Grout curtain	Wall face area, m^2	600	1,209	937	1,880	10,800 m^2 wall face area
6. Sheet piling cutoff wall	Wall face area, m^2	73	108	73	108	10,800 m^2 wall face area
7. Grout bottom sealing	Site area, ha	5,282,000	10,209,000	5,296,000	10,224,000	5.4 ha site area
8. Drains	Pipe length, m	72.7	106	357	416	260 m pipe length
9. Well point system	Intercept face area, m^2	62.5	105	107	153	2,000 m^2 intercept face area
10. Deep well system	Intercept face area, m^2	11.6	18.3	28.6	37.2	4,800 m^2 intercept face area
11. Injection	Intercept face area, m^2	77	90	1,760	1,785	550 m^2 intercept face area
12. Leachate recirculation by subgrade irrigation	Site area, ha	5,270	8,360	19,700	24,000	5.4 ha site area
13. Chemical fixation	Site area, ha	69,100	130,000	82,500	145,000	5.4 ha site area
14. Chemical injection	Landfill volume, m^3	1.67	3.28	2.16	3.81	150,000 m^3 landfill volume
15. Excavation and reburial	Landfill volume, m^3	116	120	116	120	596,000 m^3 landfill volume
16. Ponding	Site area, ha	647	1,028	647	1,028	5.4 ha site area
17. Trench construction	Trench length, m	12.2	14.34	15.11	20.32	930 m trench length
18. Perimeter gravel trench vents	Trench length, m	99.2	144	100	146	935 m trench length
19. Treatment of contaminated ground water	Contaminated water, L/d	1.52	2.57	2.52	4.38	440,740 L/d contaminated water
20. Gas migration control - passive	Site perimeter, m	161	241	168	256	935 m site perimeter
21. Gas migration control - active	Site perimeter, m	113	173	167	279	935 m site perimeter

* *Mid-1980 dollars, 10-year life cycle, O & M costs are discounted at 11.4% to present value, capital costs are not amortized.*
** *For 5.4 ha site.*

14 for surface impoundments), and the methodology for cost estimation;
- Detailed cost information for each of the 35 unit operations and their components;
- Cost estimation examples for complete remedial/response scenarios;
- Evaluation of scale economies and regional variation of costs; and
- Unit costs for all capital and O&M components.

Findings

The updated cost estimates are useful for preliminary comparisons of costs for alternative unit operations that perform the same function. The unit operation costs can be combined to estimate total costs of complete remedial response actions. The user is cautioned however, that the approach is only a first approximation of total costs, as many components are affected by site-specific considerations. Considerable additional research in evaluating technical cost differences is needed. As more remedial response activities at uncontrolled and abandoned sites are undertaken, the cost estimates should be modified to reflect more nearly the actual conditions. Average cost estimates for medium-sized sites are presented in Tables 1 and 2 for landfills and surface impoundments, respectively.

Conclusions and Recommendations

Little is known about the actual costs involved in cleanup at uncontrolled and abandoned hazardous waste disposal sites. The literature on remedial response activities refers mostly to a national and industrywide approach. Cost information, where available, is highly aggregated. Critical components of cost are frequently omitted. This study attempts to overcome some of these deficiencies.

The primary product of this study is a cost estimating methodology that can be consistently applied to each of the identified unit operations. The resulting cost estimates can be used to compare costs for alternative remedial response actions that perform the same function (e.g., prevent infiltration) and to compute combined cost estimates for operations that constitute a complete remedial response scenario. The user is cautioned, however, that a simple comparison of these costs does not address the many technical differences in the capabilities or efficiencies of alternative operations under site-specific conditions. The site profiles used for this study were conceptualizations of general environmental settings; thus they

Table 2. Average U.S. Low and High Costs of Unit Operations for Medium-Sized Surface Impoundment Sites

Unit Operations	Unit	Average U.S. Cost $ Per Unit* Initial Capital Low	Initial Capital High	Life Cycle Costs Low	Life Cycle Costs High	Total Units Used**
22. Pond closure and contour grading of surface	Site area, ha	26,900	35,100	35,900	53,500	0.47 ha site area
23. Bituminous concrete surface	Site area, ha	48,500	70,700	48,500	70,700	0.47 ha site area
24. Revegetation	Site area, ha	2,540	3,820	3,970	5,450	0.47 ha site area
25. Slurry trench cutoff wall	Wall face area, m^2	60.1	106	60.1	106	4,165 m^2 wall face area
26. Grout curtain	Wall face area, m^2	326	631	343	649	4,104 m^2 wall face area
27. Sheet piling cutoff wall	Wall face area, m^2	76.8	115	94.6	135	4,100 m^2 wall face area
28. Grout bottom seal	Site area, ha	868,000	1,621,000	1,024,000	1,792,000	0.47 ha site area
29. Toe and underdrains	Pipe Length, m	316	609	1,550	1,960	60 m pipe length
30. Well point system	Intercept face area, m^2	62.3	117	321	398	300 m^2 intercept face area
31. Deep well system	Intercept face area, m^2	33.2	60.3	114.4	149	950 m^2 intercept face area
32. Well injection system	Intercept face area, m^2	31.3	55.5	109	141	950 m^2 intercept face area
33. Leachate treatment	Contaminated water, L/d	1.16	1.96	4.49	8.14	51,870 L/d contaminated water
34. Berm reconstruction	Replaced berm, m^3	2.98	3.80	4.00	5.85	410 m^3 berm
35. Excavation and disposal at secure landfill	Impoundment volume, m^3	260	268	260	268	5,000 impoundment volume

* *Mid-1980 dollars, 10-year life cycle, O & M costs are discounted at 11.4% to present value, capital costs are not amortized.*
** *For 0.47 ha impoundment.*

do not necessarily represent actual site conditions.

Complete remedial response action for uncontrolled or abandoned hazardous waste disposal sites typically consists of at least several unit operations. Scale economies may exist when multiple unit operations requiring similar component inputs are performed, but the extent of these economies is unknown and needs to be researched. Furthermore, additional research is needed on short- and long-term remedial response actions to address the net benefits as well as the costs to society.

The full report was submitted in fulfillment of Contract No. 68-01-4885 by SCS Engineers under the sponsorship of the U.S. Environmental Protection Agency.

Howard L. Rishel, Terence M. Boston, and Curtis J. Schmidt are with SCS Engineers, Long Beach, CA 90807; the EPA author ***Oscar W. Albrecht*** *(also the EPA Project Officer, see below for contact) was with the Municipal Environmental Research Laboratory, Cincinnati, OH 45268.*

The complete report, entitled "Costs of Remedial Response Actions at Uncontrolled Hazardous Waste Sites," (Order No. PB 83-164 830; Cost: $16.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

For information contact ***Donald E. Sanning*** *at:*
Municipal Environmental Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

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