Appendix D
Cost Analysis

D.1 INTRODUCTION

This appendix examines the costs for each of the alternatives evaluated for managing the Defense National Stockpile Center (DNSC) mercury stockpile over the next 40 years, and includes recent data on world and U.S. mercury markets, and historical information related to past mercury sales from the stockpile. Mercury has been sold from the government's stockpile as far back as 1971; however, demand for it has dropped significantly in the United States since that time. As a result, much of the detailed data on the U.S. mercury market that was previously collected by the U.S. Geological Survey is no longer available adding uncertainty to U.S. market projections.

D.2 MERCURY USAGE IN THE UNITED STATES

The U.S. market for mercury is composed of several parts, as illustrated in Figure D–1. It consists of suppliers, users, and disposers, and because recycling is a major source of supply in the United States, secondary producers. Mercury flows from the suppliers (including secondary producers) into a variety of products, inventories held by users and traders, or out of the country as exports. After mercury products reach the end of their useful lives, the mercury flows into incinerators, landfills, or, in the case of recycling, secondary producers. In addition to the secondary producers, other sources of mercury supply in the United States include traders, government stockpiles, and as a byproduct of mining operations. Since 1991, mines in the United States have only produced mercury as a byproduct of other production, as in the case of gold mining.

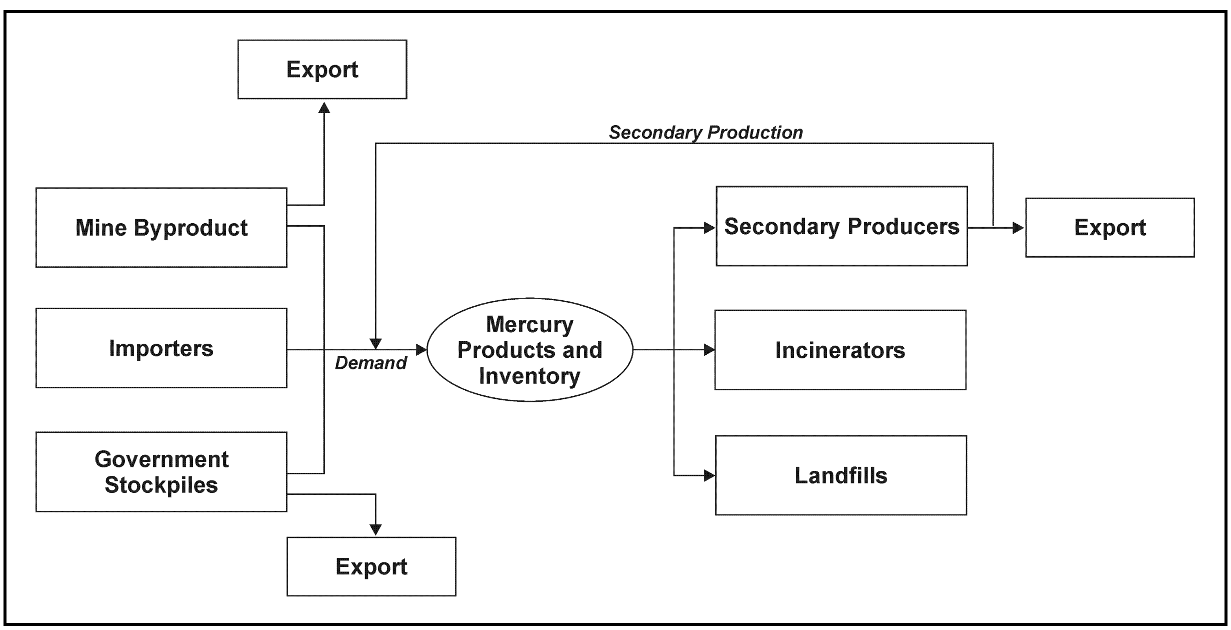


Figure D–1. Mercury Cycle in the United States

The domestic demand for mercury continues to come from a range of uses. For data reporting purposes, the U.S. Geological Survey groups these uses into three major categories: measuring instruments and dental amalgams, electrical and electronic applications, and chlorine and caustic soda. Examples of individual products that still use mercury are listed below:

- batteries
- fluorescent lamps
- switches
- dental amalgams
- measuring devices
- chlorine and caustic soda production

In 1997, the reported consumption of mercury was 381 tons (346 metric tons) (USGS 2001). As illustrated in Figure D–2, 35 percent of the mercury used domestically was in the production of chlorine and caustic soda, which has historically been the largest use for mercury, but is slowly being replaced by new processes that do not require it. Another 30 percent is estimated to be used in electrical and electronic applications, and the remainder is used in measuring instruments and dental amalgams.

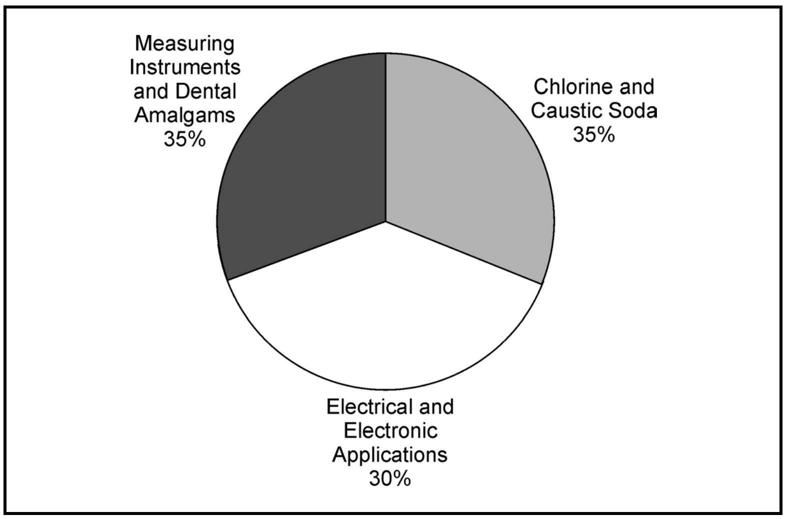


Figure D–2. Domestic Use of Mercury

Industries that use mercury also maintain inventories of the metal that continually fluctuate based on projected supply and demand. Approximately 7,496 tons (6,800 metric tons) of mercury was estimated to be in products and inventories within the United States in 1996 (Sznopek and Goonan 2000). Old or discarded products bearing mercury eventually arrive at an incinerator, landfill, or secondary producer. Secondary producers recover the mercury and sell it back to industry or export it. In 1997, approximately 429 tons (389 metric tons) of mercury were recovered by secondary producers (the three largest secondary producers were Bethlehem Apparatus Co. Inc., D.R. Goldsmith Chemical and Metal Corp., and Mercury Waste Solutions, Inc.). Secondary producers in the United States recovered more mercury in 1997 than was demanded. "Recycling of old scrap represented essentially all of the domestic mercury production in 2000" (USGS 2001).

A total of 541 tons (491 metric tons) of mercury was estimated to be available to the U.S. market in 1997 from secondary production, net imports,[1] and a small amount as a byproduct from mining activities in California, Nevada, and Utah as shown in Table D–1. No mercury was released from government stockpiles; however, consumer inventories declined 267 tons (243 metric tons). Of the estimated 807 tons (734 metric tons) available to the market, 381 tons (346 metric tons) were used to manufacture products, while the remaining amount, 427 tons (388 metric tons) was ostensibly added to inventories as shown in Table D–1 (Sznopek and Goonan 2000, USGS 2001).

Table D–1. Estimated United States Market

1997 Estimated U.S. Market	Mercury (metric tons)
Secondary Production	389
Net Imports	30
Mine Production (calculated)[a]	72
Apparent Supply	491
Consumption (reported)	346
Estimated increase in Trader Inventories (calculated)	388[b]
Decrease in Consumer Inventories (calculated)	243

Source: Sznopek and Goonan 2000; USGS 2001.

[a] Mine Production + Apparent Supply – Secondary Production – Net Imports – Stockpile Releases.

[b] Trader Inventories = Apparent Supply + Decrease in Consumer Inventories – Reported Consumption.

D.3 U.S. MERCURY MARKET HISTORY

Mercury supply and demand have been steadily declining since 1971, when the U.S. Environmental Protection Agency (EPA) designated it a hazardous pollutant under the Clean Air Act. Since then, there has been a range of legislation restricting mercury use and disposal that includes:

- Federal Insecticide, Fungicide, Rodenticide Act; cancelled many pesticides containing mercury.
- Federal water Pollution Control Act; mercury designated as a toxic pollutant (1973); prohibited dumping in ocean (Sznopek and Goonan 2000).
- Legislation restricting the sale and disposal of batteries containing mercury (1994, 1996, and 1998).
- Legislation restricting the use of mercury in paint (1972, 1990, and 1991) (EPA 1999).

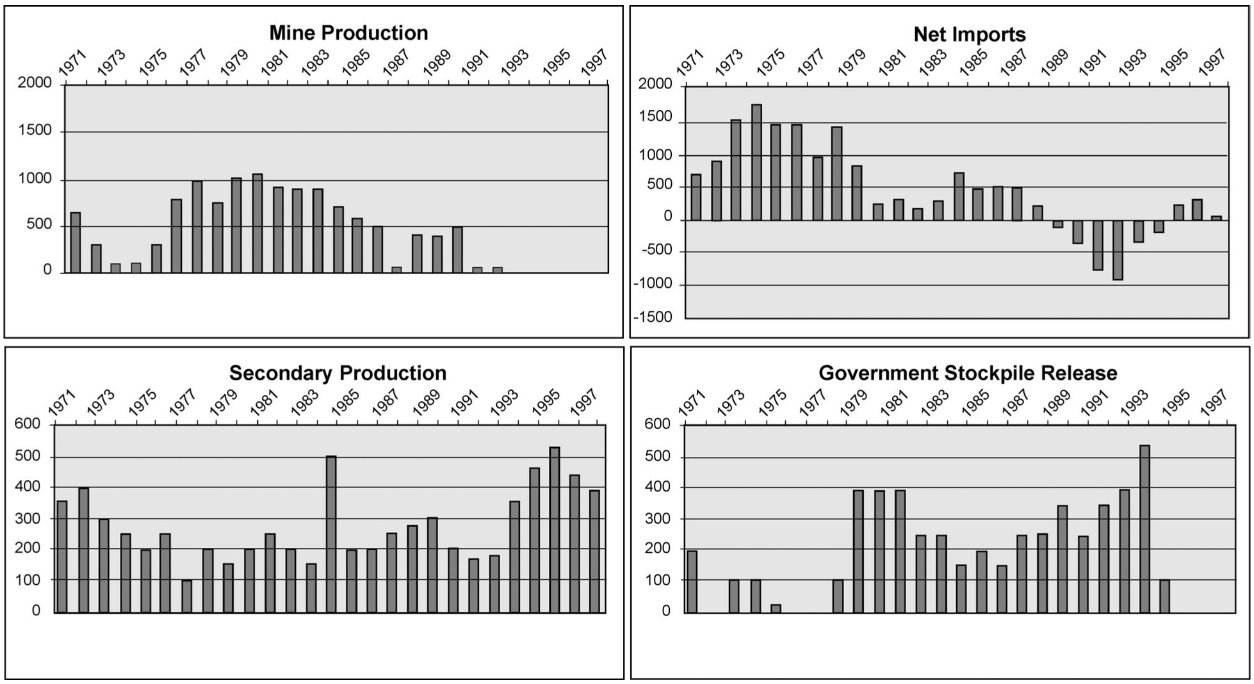
As a result of this legislation, the demand and supply of mercury in the United States has varied significantly. To characterize the changes in supply, the four sources of supply from 1971 to 1997 are discussed (see Figure D–3).

- **Mine production** declined from 1971 to 1974, and then peaked at approximately 1,213 tons (1100 metric tons) in 1980. By 1991, mine production had declined to less than 110 tons/yr

[1] Net imports = imports – exports.

(100 metric tons/yr) and has stayed below that level. Mercury is now only being produced in the United States as a byproduct of other mining activities.

- **Secondary production,** as a percentage of overall supply, increased significantly in 1984 and continued to grow throughout the 1990s to the point where it is now estimated to exceed domestic demand and represents a significant proportion of supply. "Recycling of old scrap represented essentially all of the domestic mercury production in 2000" (USGS 2001).



Source: Sznopek and Goonan 2000.

Figure D–3. Sources of Mercury, 1971 through 1997

- **Net imports** are somewhat more difficult to understand. When they are positive, it means that more mercury is being imported into the United States from other countries than is being exported. When they are negative, more mercury is being exported than imported. With that in mind, from 1971 to 1988 and 1995 to 1998, more mercury was imported into the United States for consumption than exported, so there was a positive net import. From 1989 to 1994, net imports were negative as more mercury was exported than imported.
- **Government stockpile releases** were low prior to 1979. After that year, they increased significantly, peaking in 1993 at 607 tons (550 metric tons). In 1994, stockpile releases were stopped while mercury management policies were reviewed.

Combined, the four graphs shown in Figure D–3 indicate the total U.S. mercury supply from 1971 to 1997. From 1971 to 1986, domestic mine production and net imports contributed a significant percentage of the total supply. During that period, the two sources were inversely correlated to each other (when domestic mine production goes up, net imports go down). In 1985, a substantial decline in total supply began due to the introduction of more restrictive-use legislation. Starting in 1991, secondary production became the main source of supply in the United States, outside of occasional stockpile releases.

The demand for mercury has roughly followed the same trend as supply. As shown in Figure D–4, from 1971 to 1984, supply usually surpassed demand, suggesting that industry inventories were increasing. However, from 1985 to 1992, demand was consistently higher than supply and inventories most likely decreased. For example, in 1990, the supply was 662 tons (600 metric tons) while demand was 772 tons (700 metric tons), so inventories were ostensibly reduced by 110 tons (100 t). The years 1991 and 1992 saw a significant reduction in inventories (approximately 783 tons [710 metric tons] and 960 tons [870 metric tons], respectively).

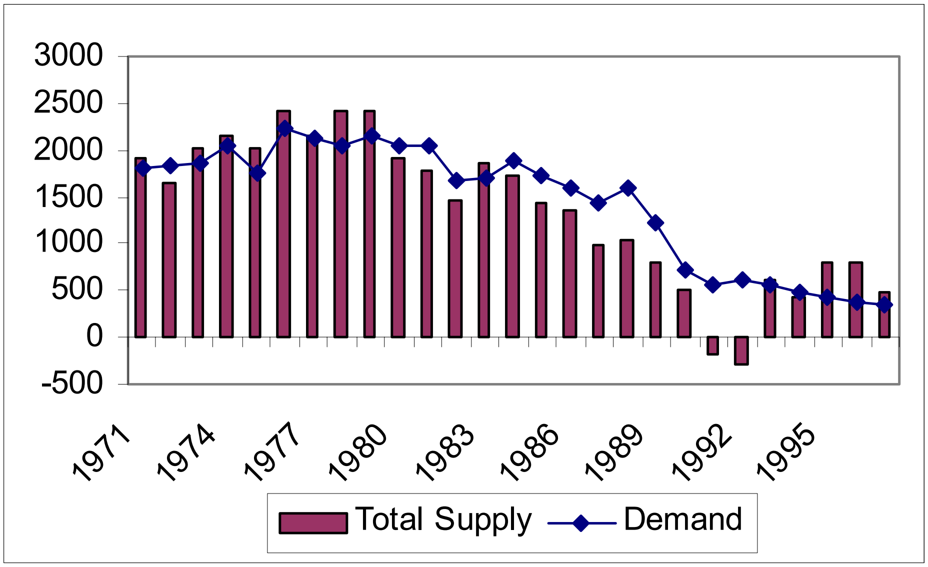


Figure D–4. Demand Mirrors Supply

The changes in supply and demand had a moderate effect on the price of mercury from 1971 to 1997. Figure D–5 illustrates the trend. In 1981, the price reached a peak of $414 per 76-lb flask when excess supply was low, while in 1976 it fell to $121 per 76-lb flask when supply was high. Excess supply is supply minus demand (in many years it was negative, indicating the demand for mercury was greater than the available supply). Prior to 1990, when supply surpassed demand, the price of mercury tended to drop. After 1990, legislation restricting mercury use seemed to affect this correlation, limiting the effect that excess supply had on price.

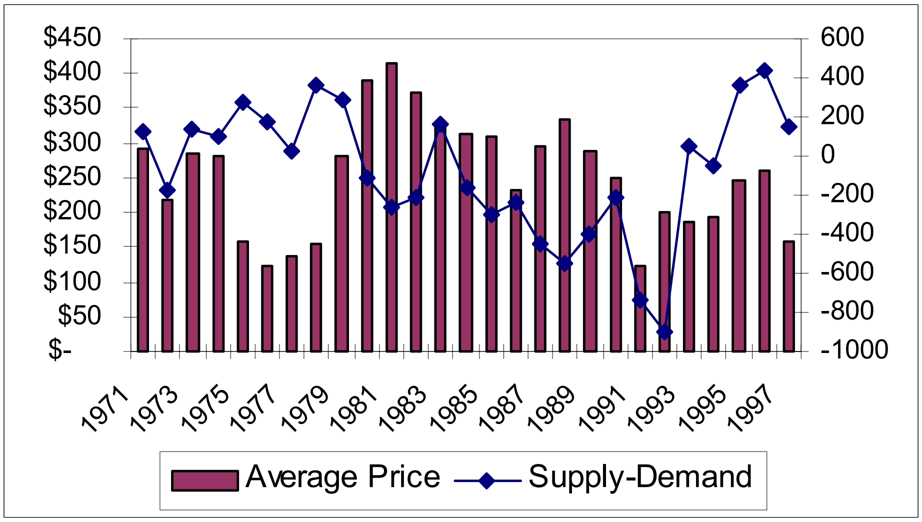
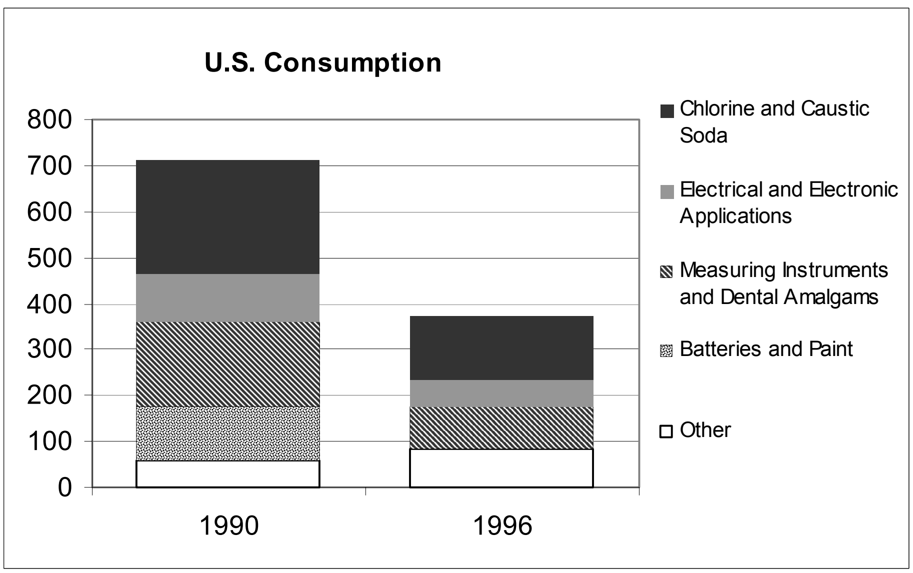


Figure D–5. Price Relates Inversely to Supply

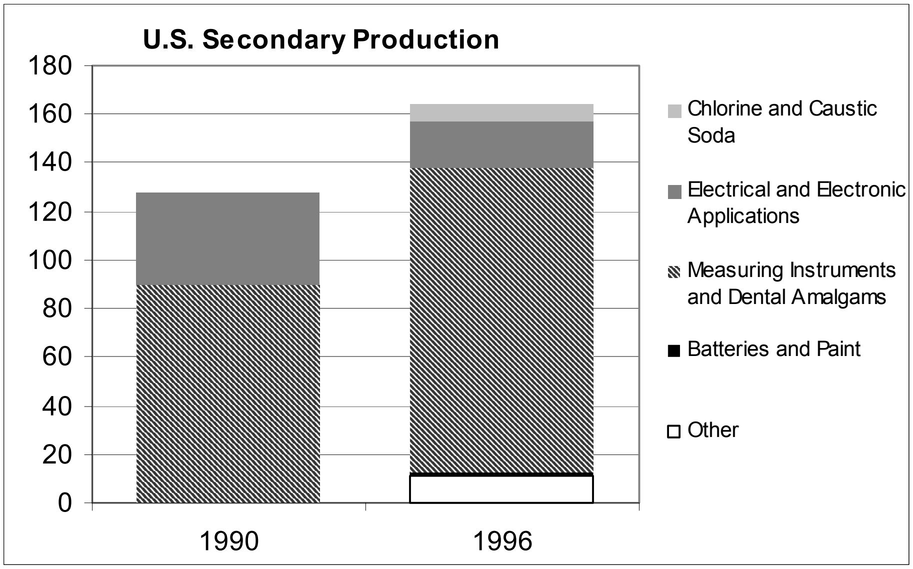
Information on the U.S. industries that demand mercury is sparse, although statistics for 1990 and 1996 are available. Figure D–6 presents an industry cross section for both years. From 1990 to 1996, U.S. demand decreased by almost 50 percent, from 784 tons (711 metric tons) to 410 tons (372 metric tons), while mercury use in batteries and paint was eliminated. Chlorine and caustic soda production continued to be the largest consumer of mercury, accounting for 37 percent (150 tons [136 metric tons]).



Source: Sznopek and Goonan 2000.

Figure D–6. Industry Cross-Section

Secondary production in 1996 increased over that in 1990 as shown in Figure D–7. This indicated that U.S. industries were recovering more mercury from spent material, with measuring instruments and dental amalgams accounting for the largest *known* proportion (138 tons [125 metric tons] in 1996). Including 311 tons (282 metric tons) from *unknown* sources, secondary production in 1996 totaled 492 tons (446 metric tons).



Source: Sznopek and Goonan 2000.

Figure D–7. Secondary Production

D.4 MANAGEMENT ALTERNATIVES

The alternatives for managing the stockpile of mercury include taking no action, consolidating at one of six sites, and selling the entire stockpile at one of two rates. For comparison, the cost of each alternative is estimated according to total real costs and net present value. Real costs, as opposed to nominal costs, do not escalate according to inflation, eliminating the need to estimate future inflation rates. In each table that presents cost data, the totals may not add due to rounding.

D.4.1 Alternative 1—No Action

For the No Action alternative, mercury would continue to be stored at the four current locations. Replacing roofs is the only upgrade required for the storage buildings. Overpacks are assumed not to fail over the forty-year storage period, however, a small percentage of flasks are assumed to fail and must be replaced during the last year of storage. As a result, costs for labor, utilities and rent, in real terms, are the same for years 1 through 39, as shown in Table D–2. The cost in year 40 is higher due to the examination and replacement of leaking flasks and warehouse roofs. Assumptions are listed below:

- Continuation of overpacked storage at current mercury storage depots.
- Storage for 40 years.
- No major upgrades to buildings required during storage period.
- Assumes overpacks will not fail.
- Assumes that overpack drums are opened during the last year of storage. Some flasks are found to have leaked and must be reflasked.
- Roofs are replaced during the last year of storage.

Table D–2. No Action Summary Costs ($)

No Action Summary Costs	New Haven Depot	Somerville Depot	Warren Depot	Y–12
Real cost, years 1 to 39	89,538	482,087	95,006	72,666
Real cost, year 40	190,175	695,295	189,357	98,390
Total real costs, years 1 to 39	3,491,983	18,801,393	3,705,233	2,833,974
Real cost, year 40	190,175	695,295	189,357	98,390
Subtotal real costs	3,682,159	19,496,689	3,894,589	2,932,364
Total Present Value	30,005,801			

Key: %, percent; Y–12, U.S. Department of Energy's Y–12 National Security Complex.

Table D–2 shows that the total present value of the No Action Alternative is estimated at $30,005,801. The Somerville Depot is more costly to operate than the other depots because it contains the largest stockpile of mercury, requires more rental space, and the rent is the second highest at $5.00 per square foot (U.S. Department of Energy's Y–12 National Security Complex [Y–12] is the highest unit cost at $16.00 per square foot, but occupies less area). Tables D–3 and D–4 show the itemized costs that make up the totals for each depot. For each year, costs are incurred for labor, utilities, and rent. Labor is determined by estimating full-time equivalent staff (FTE) required for security and inspections and applying them to a standard of 1,744 hours per FTE.[2] The New Haven and Warren depots are estimated to require approximately 0.239 FTE each, or 8 hours per week; for example, while the Somerville Depot is estimated to require more than 1 FTE. Using Bureau of Labor and Statistics Data, the labor rate for each site is adjusted according to relative differences in average compensation for each region, using the New Haven Depot as the base. For example, Somerville Depot's average salary and benefits are 1.4 times that of the New Haven Depot's average compensation, which is estimated at $50,000 for the storage depot workers. Thus, compensation at the Somerville Depot would correspond to $70,435 per year.

Utility costs are determined by estimating the fraction of space occupied by mercury containers and applying it to an estimated average utility cost for an entire depot ($40,390/year). This average was developed using monthly utility costs at New Haven, Warren, and Somerville, which ranged from $900 to $6,200 per month. At the New Haven Depot, mercury containers occupy approximately 3.9 percent of 1.1 million square feet of warehouse space, which equates to $1,579 of the $40,390 spent on the depot's utility costs. Unlike the other sites, the utility cost for Y–12 is included in the estimate for rent. In addition, the warehouses at each depot differ slightly in their dimensions. The New Haven Depot warehouse sections are 43,200 square feet, while the Somerville and Warren warehouse sections are 40,000 square feet. However, the Somerville Depot uses two warehouse sections to store mercury. The mercury at Y–12 is stored in 4,400 square feet of space.

Rental cost is estimated by applying the cost per square foot to the area occupied by mercury containers. Mercury occupies 43,200 square feet at the New Haven Depot, costing approximately $76,032 for rental space.

[2] 1,744 hrs per FTE = (365 days/yr – 104 weekend days – 10 Federal holidays – 20 annual leave days – 13 sick days) × 8 hrs/day.

Table D–3. Detailed No Action Costs[a, b] for Years 1 to 39

	New Haven			Somerville			Warren			Y–12		
	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost
Annual labor (determined by multiplying FTE by estimated annual salary and benefits)	50,000.00	0.24	11,926.61	70,435.27	1.12	78,937.90	52,410.12	0.24	12,636.16	49,263.26	0.046	2,266.11
Annual utility	40,390.00	0.039	1,579.00	40,390.00	0.078	3,149.00	40,390.00	0.029	1,170.00	0.00	0.326	0.00
Miscellaneous costs, annual rent (space rental rate)	1.76	43,200.00	76,032.00	5.00	80,000.00	400,000.00	2.03	40,000.00	81,200.00	16.00	4,400.00	70,400.00
Total			89,538.00			482,087.00			95,006.00			72,666.11

[a] Estimated costs for continued storage not including overpacking, waste disposal, and transportation.
[b] Estimated costs $/yr.
Key: FTE, full-time equivalent; Y–12, U.S. Department of Energy's Y–12 National Security Complex.

Table D–4. Detailed No Action Costs for the Last Year of Storage

	New Haven			Somerville			Warren			Y–12		
	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost
Estimated overpacking costs (labor)												
Cost of new seamless 76-lb flask	40.00	120.00	4,800.00	40.00	563.81	22,552.24	40.00	121.29	4,851.71	40.00	150.59	6,023.70
Estimated waste disposal costs												
Hazardous waste (per pound to retort and dispose)	3.18	1,800.00	5,724.00	3.18	8,457.09	26,893.55	3.18	1,819.39	5,785.66	3.18	2,258.89	7,183.26
Nonhazardous waste (per cubic yard)	6.00	2.22	13.33	6.00	10.44	62.65	6.00	2.25	13.48	6.00	2.79	16.73
Estimated transportation costs												
Materials[a] (per truckload)	550.00	2.00	1,100.00	550.00	2.00	1,100.00	550.00	2.00	1,100.00	550.00	2.00	1,100.00
Hazardous wastes[b] (per truckload)	1,300.00	2.00	2,600.00	1,300.00	2.00	2,600.00	1,300.00	2.00	2,600.00	1,300.00	2.00	2,600.00
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)												
Annual labor[c]	50,000.00	0.24	11,926.61	70,435.27	1.12	78,937.90	52,410.12	0.24	12,636.16	49,263.26	0.046	2,266.11
Annual utility	40,389.79	0.04	1,579.43	40,389.79	0.08	3,149.00	57,389.14	0.03	1,662.15	0.00	0.33	0.00
Miscellaneous[d], annual rent	1.76	43,200.00	76,032.00	5.00	80,000.00	400,000.00	2.03	40,000.00	81,200.00	16.00	4,400.00	70,400.00
Estimated cost for replacing warehouse roof			86,400.00			160,000.00			80,000.00			8,800.00
Total			**190,175.29**			**695,295.58**			**189,357.16**			**98,389.80**

[a] New overpacks, flasks, pallets, etc.
[b] Old flasks, other hazardous waste, etc.
[c] Determined by multiplying FTEs by estimated annual salary.
[d] Space rental rate.
Key: FTE, full-time equivalent; Y–12, U.S. Department of Energy's Y–12 National Security Complex.

Costs are higher during the last year of storage than other years due to additional expenses incurred to replace leaking flasks, dispose of wastes, transport materials, and replace warehouse roofs, as shown in Table D–4. For each site, only four truck trips are assumed to be needed the last year of storage, two for materials and two for hazardous wastes. Because the trucks have a large capacity, 40,000 lbs, the number of trips required to dispose of wastes and materials is unaffected by the relatively small waste disposal quantities estimated for each site. The costs to replace warehouse roofs were estimated using available information from roofing contractors (Improve Net 2002; Roofing People 2002).

D.4.2 Consolidated Storage Alternatives

There are six candidate locations for consolidated storage: the New Haven, Somerville, and Warren depots, the Hawthorne Army Depot, PEZ Lake Development, and the Utah Industrial Depot. For each alternative, several assumptions are made, and are listed below.

- Staging and transportation take 1 year; storage for an additional 39 years.
- Y−12 mercury will be overpacked before storage at the consolidated storage site at $20.06 per flask.
- Existing storage buildings will be used; no new construction or land disturbance; no major modifications or upgrades.
- Storage space would have sealed floors and sprinkler systems.
- Overpacks will not fail.
- Overpack drums are opened during the last year of storage. Some flasks are found to have leaked and must be reflasked.
- Roofs are replaced during the last year of storage.

Costs for each Consolidated Storage Alternative are broken-down into three periods: year 1, years 2 through 39, and year 40. The first period includes costs for transporting the mercury to the consolidation site and overpacking the Y–12 mercury. The unit cost for overpacking the Y–12 mercury is $20.06. In addition, the labor required for consolidation varies by storage depot because the quantity of mercury transported depends on the site chosen. For example, if the New Haven Depot were chosen, 112,511 flasks would be transported; if the Somerville Depot were chosen, only 52,782 flasks would be transported.

The second period of costs only includes labor, utilities, and rent, while the third period includes costs for inspection, reflasking and replacing the warehouse roof. Summarized costs for the six sites are listed in Table D–5, which indicates that consolidation at the New Haven Depot is the least expensive, while consolidation at the Hawthorne Army Depot is the most expensive. The disparity in cost is due to rent and utility cost; rent at the Hawthorne Army Depot, PEZ Lake Development, and the Utah Industrial Depot is estimated at $7.89 per square foot; while the Hawthorne Army Depot has the added cost of fuel for generating electricity (900 gallons per year at $1.50 per gallon). The detailed costs for each of the sites are listed in Tables D–5 through D–11[3] (Lynch 2002; Schmid 2001).

[3] All costs are from Lynch 2002 except the "transportation costs to consolidate," which are from Schmid 2001.

Table D–5. Consolidation Summary Costs ($)

Costs	New Haven Depot	Somerville Depot	Warren Depot	Hawthorne Army Depot	PEZ Lake Development	Utah Industrial Depot
Real cost, year 1	1,371,687	1,840,239	1,400,137	2,461,337	2,465,251	2,465,251
Real costs, years 2–39	483,042	1,141,678	511,412	1,521,129	1,525,043	1,525,043
Real cost, year 40	1,002,662	1,629,298	999,032	1,968,777	1,972,691	1,972,691
Real cost, year 1	1,371,687	1,840,239	1,400,137	2,461,337	2,465,251	2,465,251
Total real costs, years 2–39	18,355,586	43,383,767	19,433,660	57,802,911	57,951,647	57,951,647
Real cost, year 40	1,002,662	1,629,298	999,032	1,968,777	1,972,691	1,972,691
Total Present Value	20,729,935	46,853,304	21,832,829	62,233,025	62,389,589	62,389,589

Key: %, percent.

A competitive procurement process may be used to obtain storage space at one of the three new consolidated storage sites or at another unspecified location. Therefore, the rental rates that DNSC would be charged at the new sites are not known at this time. The $7.89 per square foot rate is the standard rental rate the U.S. Army charges other agencies for warehouse space. Because actual rates are unknown, the $7.89 per square foot rate was used as a surrogate for the rental rates at all new sites.

D.4.2.1 Alternative 2A—Consolidated Storage at the New Haven Depot

Table D–6. Detailed Costs for Consolidation at the New Haven Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**
Estimated overpacking costs									
Cost per flask for overpacking	20.06	20,276	406,737	3.94	-	-	3.94	-	-
Cost of new 30-gal overpack	35.00	3,380	118,300	35.00	-	-	35.00	-	-
Cost of new seamless 76-lb flask	40.00	-	-	40.00	-	-	40.00	956	38,228
Estimated waste disposal costs									
Hazardous waste (per pound to retort and dispose)	3.18	-	-	3.18	-	-	3.18	14,335	45,586
Nonhazardous waste (per cubic yard)	6.00	-	-	6.00	-	-	6.00	17.70	106
Estimated transportation costs									
Materials[a] (per truckload)	550	-	-	550	-	-	550	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2.00	2,600
Labor costs for consolidation[c] (by truck)	50,000	0.31	15,360	50,000	-	-	50,000	-	-
Transportation costs to consolidate (by truck)	NA	NA	348,248	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual labor costs[c]	50,000	1.900	94,985	50,000	1.900	94,985	50,000	1.900	94,985
Annual utility costs	40,390	0.196	7,897	40,390	0.196	7,897	40,390	0.196	7,897
Miscellaneous, annual rent[d]	1.76	216,000	380,160	1.76	216,000	380,160	1.76	216,000	380,160
Estimated cost for replacing warehouse roof									432,000
Total			**1,371,687**			**483,042**			**1,002,662**

[a] New overpacks, flasks, pallets, etc.
[b] Old flasks, other hazardous waste, etc.
[c] Determined by multiplying FTEs by estimated annual salary.
[d] Space rental rate.
Key: FTE, Full-time equivalent; NA, not applicable.

D.4.2.2 Alternative 2B—Consolidated Storage at the Somerville Depot

Table D–7. Detailed Costs for Consolidation at the Somerville Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**
Estimated overpacking costs									
Cost per flask for overpacking	20.06	20,276	406,737	7.26	0.00	0	7.26	0.00	0.00
Cost of new 30-gal overpack	35.00	3,380.00	118,300.00	35.00	0.00	0	35.00	0.00	0.00
Cost of new seamless 76-lb flask	40.00	0.00	0.00	40.00	0.00	0	40.00	955.69	38,228
Estimated waste disposal costs									
Hazardous waste (per pound to retort and dispose)	3.18	0.00	0.00	3.18	0.00	0	3.18	14,335.37	45,586
Nonhazardous waste (per cubic yard)	6.00	0.00	0.00	6.00	0.00	0	6.00	17.70	106
Estimated transportation costs									
Materials[a] (per truckload)	550.00	0.00	0.00	550.00	0.00	0	550.00	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300.00	0.00	0.00	1,300.00	0.00	0	1,300.00	2.00	2,600
Labor costs for consolidation[c] (by truck)	70,435.27	0.14	10,151	0.00	0.00	0	0.00	0.00	0
Transportation costs to consolidate (by truck)	NA	NA	163,373	0.00	0.00	0	0.00	0.00	0
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual labor[c]	70,435.27	1.90	133,805	70,435.27	1.90	133,805	70,435.27	1.90	133,805
Annual utility	40,390	0.19	7,873	40,390	0.19	7,873	40,390	0.19	7,873
Miscellaneous, annual rent[d]	5.00	200,000.00	1,000,000	5.00	200,000.00	1,000,000	5.00	200,000.00	1,000,000
Estimated cost for replacing warehouse roof									400,000
Total			**1,840,239**			**1,141,678**			**1,629,298**

[a] New overpacks, flasks, pallets, etc.

[b] Old flasks, other hazardous waste, etc.

[c] Determined by multiplying FTEs by estimated annual salary.

[d] Space rental rate.

Key: FTE, full-time equivalent; NA, not applicable.

D.4.2.3 Alternative 2C—Consolidated Storage at the Warren Depot

Table D–8. Detailed Costs for Consolidation at the Warren Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**
Estimated overpacking costs									
Cost per flask for overpacking	20.06	20,276	406,737		-	-	5.60	-	-
Cost of new 30-gal overpack	35.00	3,380	118,300		-		35.00	-	-
Cost of new seamless 76-lb flask	40.00	-	-	40.00	-	-	40.00	955.69	38,228
Estimated waste disposal costs		-	-		-	-			
Hazardous waste (per pound to retort and dispose)	3.18	-	-	3.18	-	-	3.18	14,335.37	45,586
Nonhazardous waste (per cubic yard)	6.00	-	-	6.00	-	-	6.00	17.70	106
Estimated transportation costs		-	-			-			
Materials[a] (per truckload)	550.00	-	-	550.00	-	-	550.00	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300.00	-	-	1,300.00	-	-	1,300.00	2.00	2,600
Labor costs for consolidation[c] (by truck)	52,410.12	0.31	16,071	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	NA	NA	347,617	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)				-		-	-	-	-
Annual labor[c]	52,410.12	1.900	99,563	52,410.12	1.900	99,563	52,410	1.900	99,563
Annual utility	40,390	0.145	5,849	40,390	0.145	5,849	40,390	0.145	5,849
Miscellaneous, annual rent[d]	2.03	200,000.00	406,000	2.03	200,000	406,000	2.03	200,000	406,000
Estimated cost for replacing warehouse roof									400,000
Total			**1,400,137**			**511,412**			**999,032**

[a] New overpacks, flasks, pallets, etc.

[b] Old flasks, other hazardous waste, etc.

[c] Determined by multiplying FTEs by estimated annual salary.

[d] Space rental rate.

Key: FTE, full-time equivalent; NA, not applicable.

D.4.2.4 Alternative 2D—Consolidated Storage at the Hawthorne Army Depot

Table D–9. Detailed Costs for Consolidation at the Hawthorne Army Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**
Estimated overpacking costs									
Cost per flask for overpacking	20.06	20,276	406,737		-	-		-	-
Cost of new 30-gal overpack	35.00	3,380	118,300		-	-		-	-
Cost of new seamless 76-lb flask	40.00	-	-	40.00	-	-	40.00	956	38,240
Estimated waste disposal costs									
Hazardous waste (per pound to retort and dispose)	3.18	-	-	3.18	-	-	3.18	14,340	45,601
Nonhazardous waste (per cubic yard)	6.00	-	-	6.00	-	-	6.00	17.70	106.22
Estimated transportation costs									
Materials[a] (per truckload)	550	-	-	550	-	-	550.00	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300.00	2.00	2,600
Labor costs for consolidation[c] (by truck)	52,410	0.35	16,071	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	NA	NA	254,974	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual labor[c]	52,410	1.900	99,579	52,410	1.900	99,579	52,410	1.900	99,579
Annual utility	1.50	900	1,350	1.50	900	1,350	1.50	900	1,350
Miscellaneous, annual rent[d]	7.89	180,000	1,420,200	7.89	180,000	1,420,200	7.89	180,000	1,420,200
Estimated cost for replacing warehouse roof									360,000
Total			**2,461,337**			**1,521,129**			**1,968,777**

a New overpacks, flasks, pallets, etc.
b Old flasks, other hazardous waste, etc.
c Determined by multiplying FTEs by estimated annual salary.
d Space rental rate.

Key: FTE, full-time equivalent; NA, not applicable.

D.4.2.5 Alternative 2E—Consolidated Storage at PEZ Lake Development

Table D–10. Detailed Costs for Consolidation at PEZ Lake Development

	Year 1			Years 2–39			Year 39		
	Unit Cost	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**Annual Cost**
Estimated overpacking costs									
Cost per flask for overpacking	20.06	20,276	406,737		-	-		-	-
Cost of new 30-gal overpack	35.00	3,380	118,300		-	-		-	-
Cost of new seamless 76-lb flask	40.00	-	-	40.00	-	-	40.00	956	38,240
Estimated waste disposal costs									
Hazardous waste (per pound to retort and dispose)	3.18	-	-	3.18	-	-	3.18	14,338	45,596
Nonhazardous waste (per cubic yard)	6.00	-	-	6.00	-	-	6.00	17.70	106
Estimated transportation costs									
Materials[a] (per truckload)	550.00	-	-	550.00	-	-	550	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300.00	-	-	1,300.00	-	-	1,300	2.00	2,600
Labor costs for consolidation[c] (by truck)	52,410.12	0.35	16,071	0.00	-	-	-	-	-
Transportation costs to consolidate (by truck)	NA	NA	254,974	0.00	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual labor[c]	52,410	1.900	99,579	52,410	1.900	99,579	52,410	1.900	99,579
Annual utility	40,390	0.130	5,264	40,390	0.130	5,264	40,390	0.130	5,264
Miscellaneous, annual rent[d]	7.89	180,000	1,420,200	7.89	180,000	1,420,200	7.89	180,000	1,420,200
Estimated cost for replacing warehouse roof									360,000
Total			**2,465,251**			**1,525,043**			**1,972,691**

[a] New overpacks, flasks, pallets, etc.

[b] Old flasks, other hazardous waste, etc.

[c] Determined by multiplying FTEs by estimated annual salary.

[d] Space rental rate.

Key: FTE, full-time equivalent; NA, not applicable.

D.4.2.6 Alternative 2F—Consolidated Storage at the Utah Industrial Depot

Table D–11. Detailed Costs for Consolidation at the Utah Industrial Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost	Unit Cost	Quantity	Annual Cost
Estimated overpacking costs									
Cost per flask for overpacking	25.00	20,276	506,900	5.60	-	-	7.30	-	-
Cost of new 30-gal overpack	35.00	3,380	118,300	35.00	-	-	35.00	-	-
Cost of new seamless 76-lb flask	40.00	-	-	40.00	-	-	40.00	956	38,240
Estimated waste disposal costs									
Hazardous waste (per pound to retort and dispose)	3.18	-	-	3.18	-	-	3.18	14,340	45,601
Nonhazardous waste (per cubic yard)	6.00	-	-	6.00	-	-	6.00	17.70	106
Estimated transportation costs									
Materials[a] (per truckload)	550.00	-	-	550	-	-	550	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300.00	-	-	1,300	-	-	1,300	2.00	2,600
Labor costs for consolidation[c] (by truck)	52,410.12	0.35	16,071	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	NA	NA	254,974	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual labor[c]	52,410.12	1.900	99,579	52,410	1.900	99,579	52,410	1.900	99,579
Annual utility	40,390	0.130	5,264	40,390	0.130	5,264	40,390	0.130	5,264
Miscellaneous, annual rent[d]	7.89	180,000	1,420,200	7.89	180,000	1,420,200	7.89	180,000	1,420,200
Estimated cost for replacing warehouse roof									360,000
Total			**2,465,251**			**1,525,043**			**1,972,691**

[a] New overpacks, flasks, pallets, etc.
[b] Old flasks, other hazardous waste, etc.
[c] Determined by multiplying FTEs by estimated annual salary.
[d] Space rental rate.
Key: FTE, full-time equivalent; NA, not applicable.

D.4.3 Sales Alternatives

This section examines two strategies for selling the stockpile of mercury: selling at the maximum allowable market rate or selling the entire quantity in 1 year to an existing mercury mining company. The costs described here are those that DNSC would bear to manage the mercury. The costs do not include those paid by the purchaser to ship the mercury from the DNSC storage site to its' location.

Table D–12 lists the estimated cash flow and present value for the two alternatives. The maximum and minimum average price paid for DNSC sales since 1992, is $88 and $58. The most recent public articles[4] on mercury prices have indicated a range of prices for prime virgin mercury of between $140 and $195 per flask, and an unofficial conversation with a U.S. mercury broker indicated an approximate range of between $120 and $170 ($3.48 to $4.93 per kg) (D.F. Goldsmith Company 2002). For the purpose of comparing disposition alternatives, it is reasonable to assume, that future DNSC sales could fall within the range of $58 to $195 per flask. Historically, mercury sold by DNSC has been priced at a discount to the market price.

Table D–12. Summary Costs for the Sales Alternatives

	Maximum Allowable Market Rate		Sell to Mining Company	
Sales Summary	**Estimated Minimum**	**Estimated Maximum**	**Estimated Minimum**	**Estimated Maximum**
Flasks sold per year	5,000	5,000	128,662	128,662
Price per flask ($)	195	58	195	58
Total Present Value to the Government ($)	(10,552,927)	7,257,073	(25,089,090)	(7,462,396)
Years to deplete stockpile	26	26	1	1

D.4.3.1 Alternative 3A—Sale at the Maximum Allowable Market Rate

In this alternative, the sale of 5,000 flasks per year were determined to be the maximum allowable market rate, which would correspond to less than 10 percent of world consumption, according to estimates by the Bethlehem Apparatus Company (between 55,000 and 120,000 flasks per year) (Lawrence 2002). Mercury would be sold in equal quantities from each of the four current mercury storage locations, increasing from 1,250 flasks per location to 5,000 as they are depleted. The New Haven and Warren depots would be depleted first, then Y–12, and finally the Somerville Depot in year 26. While revenue would be generated from selling mercury, costs would also be incurred for continued storage before sales. As a result, the minimum estimate for selling mercury at the maximum acceptable rate shows a cost of $7.2 million, while the maximum estimate would actually generate a profit of $10.6 million. This was determined using the same costs from the No Action Alternative and including the affect of sales.

Table D–13 presents the costs incurred at each of the four sites as mercury is sold over 26 years. As the mercury stockpile is depleted, the total cost to store the mercury declines. After 13 years of selling 5,000 flasks annually, New Haven and Warren depot's stockpiles would be depleted. Two years later, Y–12 would be depleted, and finally, after 26 years, the Somerville Depot would be depleted. The costs in Table D–13 indicate that the Somerville Depot incurs the highest storage cost, because it takes so long to deplete that stockpile. Y–12 incurs the lowest cost, even though it takes an additional 2 years to deplete its stockpile because of the lower operating cost.

[4] AMM.com 2001; Metal Pages 2002; Platts 2002.

Table D–13. Storage Costs Until Mercury is Sold ($)

Location	Present Value
New Haven	1,091,996
Somerville	11,459,272
Warren	1,155,813
Y–12	1,089,992

D.4.3.2 Alternative 3B—Sale of Mercury Inventory to Mining Company

In this alternative, the entire stockpile is sold to an existing mercury mining company, replacing a portion of the normal production output of mining. World mining production is estimated to be less than 30,000 flasks per year (Lawrence 2002; Weiler 2002). Sales from this alternative are estimated to be between $7.5 million and $25.1 million.

D.5 CONCLUSION

As shown in Table D–14, simply based on cost, the least costly alternative is to sell the entire stockpile of mercury to a mining company at an estimated price of $195 per flask, which would result in $25.1 million in revenue. The most costly alternative is consolidating all of the mercury at the Hawthorne Army Depot, PEZ Lake Development, or the Utah Industrial Depot, where rent is the highest of the six candidate storage sites.

Table D–14. Summary Costs ($)

Alternatives	Present Value
No Action	30,005,801
Consolidated Storage	
New Haven Dept	20,729,935
Somerville Depot	46,853,304
Warren Depot	21,832,829
Hawthorne Army Depot	62,233,025
PEZ Lake Development	62,389,589
Utah Industrial Depot	62,389,589
Sales at the Maximum Allowable Market Rate	
Estimated minimum	(10,552,927)
Estimated maximum	7,257,073
Sales to Mining Company	
Estimated minimum	(25,089,090)
Estimated maximum	(7,462,396)

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