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.

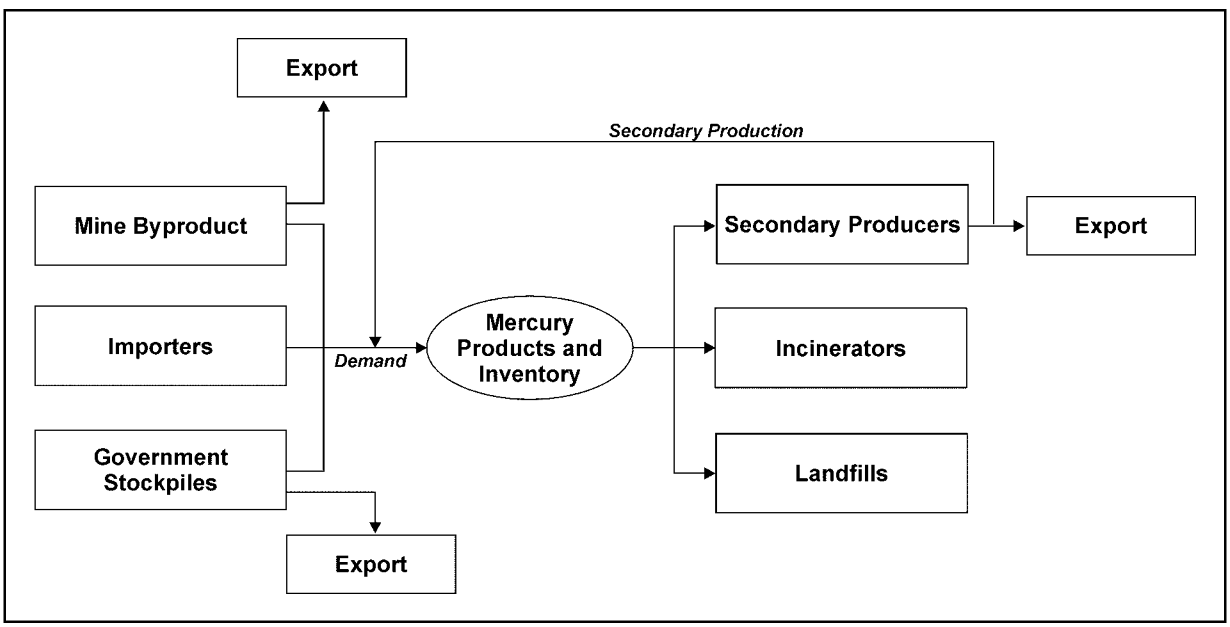


Figure D–1. Mercury Cycle in the United States

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.

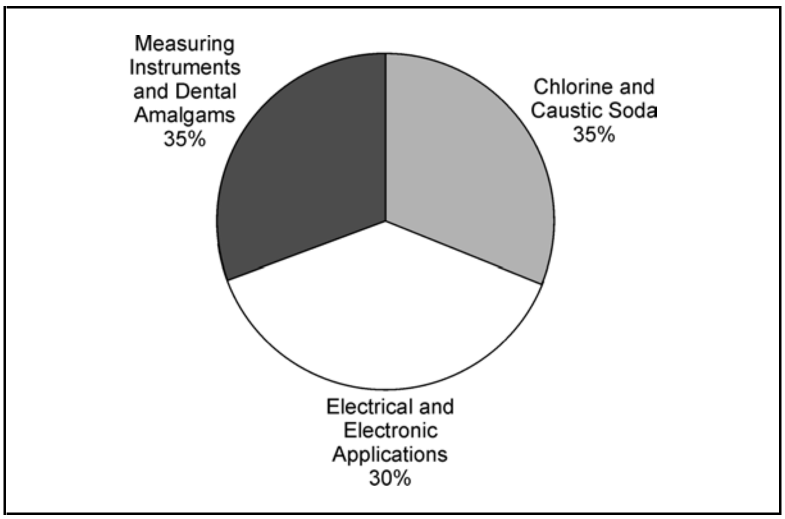


Figure D–2. Domestic Use of Mercury

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

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

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

Source: Sznopek and Goonan 2000; USGS 2001.

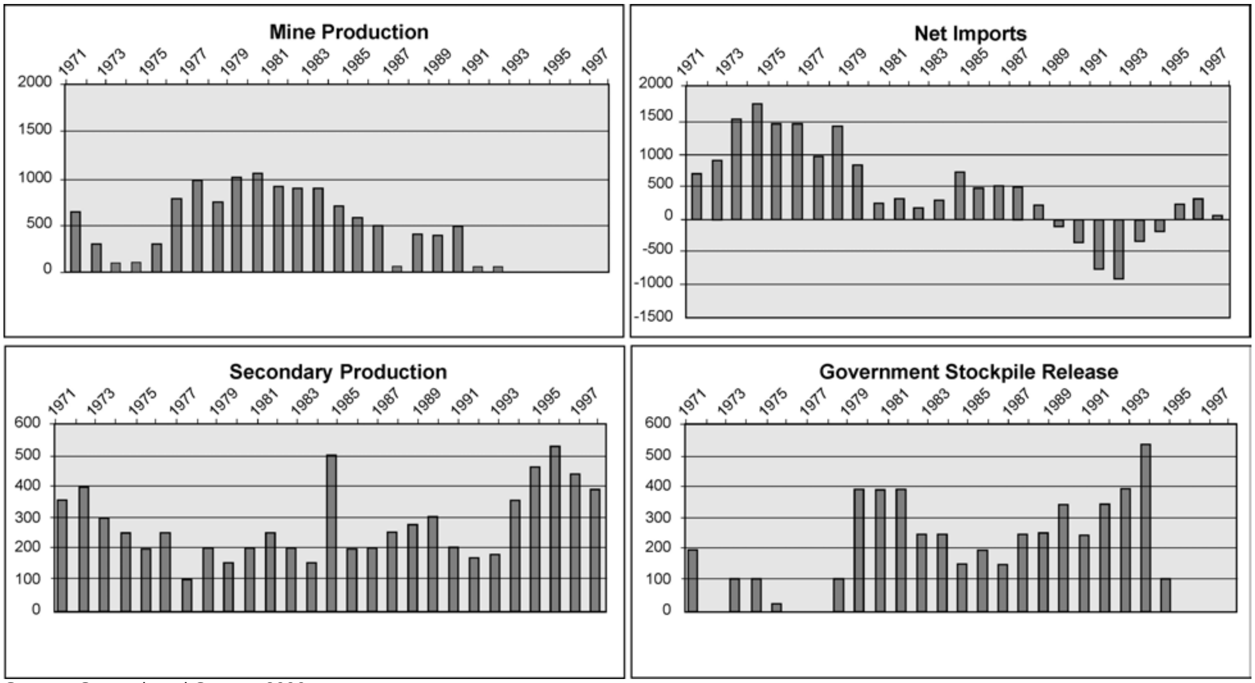
D.3 U.S. MERCURY MARKET HISTORY

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).

[1] Net imports = imports – exports.



Source: Sznopek and Goonan 2000.

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

- **Mine production** declined from 1971 to 1974, and then peaked at approximately 1,213 tons (1,100 metric tons) in 1980. By 1991, mine production had declined to less than 110 tons/yr (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).
- **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 metric tons). The years 1991 and 1992 saw a significant reduction in inventories (approximately 783 tons [710 metric tons] and 960 tons [870 metric tons], respectively).

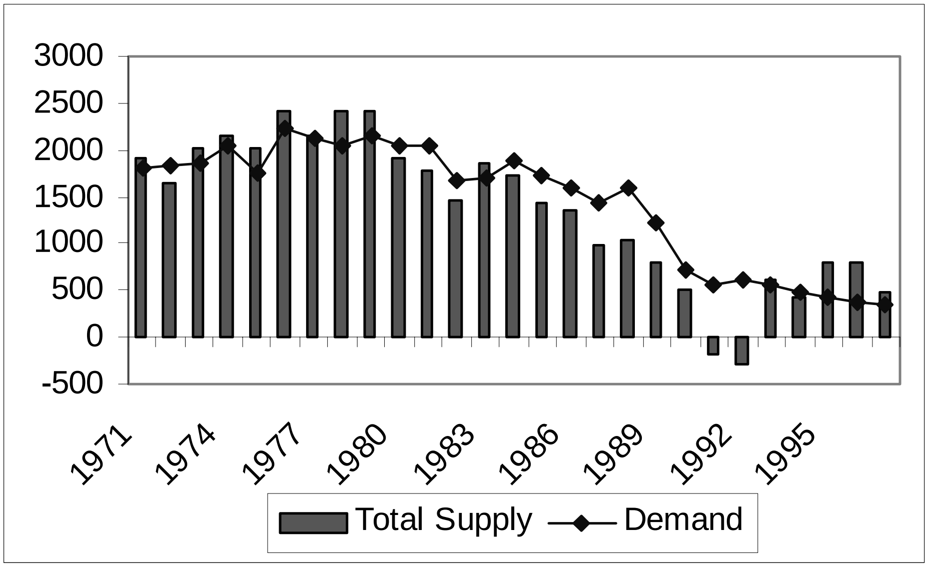


Figure D–4. Demand Mirrors Supply

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 (34-kg) flask when excess supply was low, while in 1976 it fell to $121 per 76-lb (34-kg) 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.

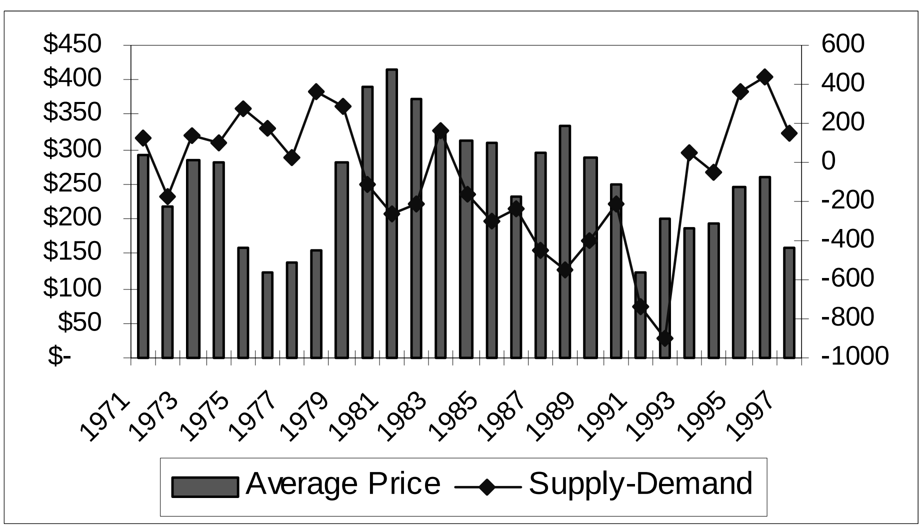
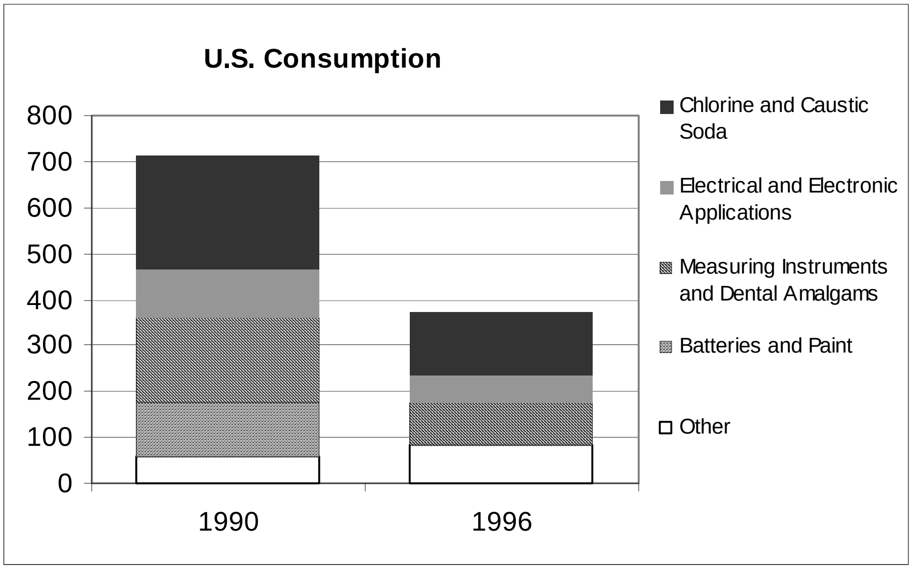


Figure D–5. Price Relates Inversely to Supply

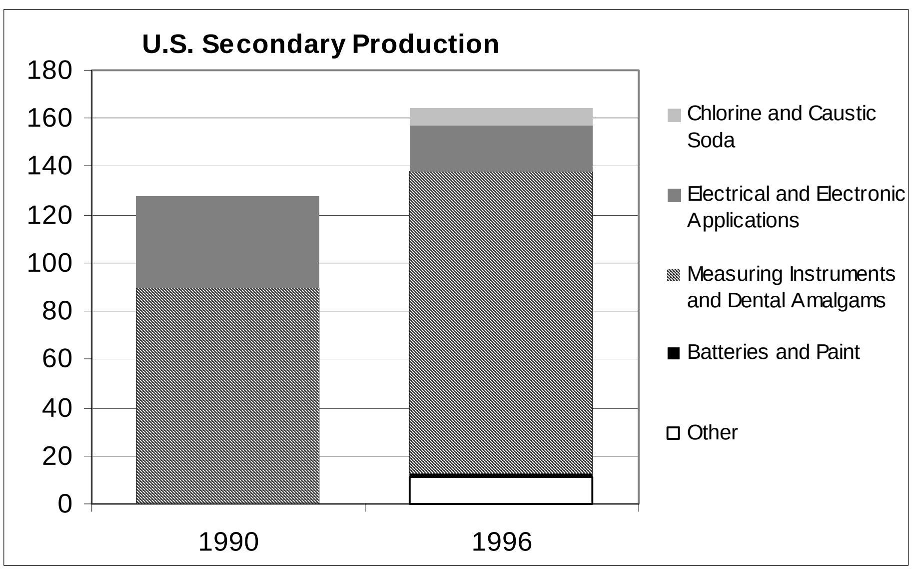
Information on the U.S. industries that demand mercury is sparse, although statistics for 1990 and 1996 are available. Figure D–6 presents an industry cross section for both years. From 1990 to 1996, U.S. demand decreased by almost 50 percent, from 784 tons (711 metric tons) to 410 tons (372 metric tons), 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. The cost of each alternative is estimated according to total real costs. 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. Overpacks are assumed not to fail over the 40-yr 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 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. Assumptions are listed below:

- Continuation of overpacked storage at current mercury storage depots
- Storage for 40 years
- Overpacks will not fail
- Overpack drums are opened during the last year of storage, and some flasks are found to have leaked

Table D–2. No Action Costs ($)

Costs	New Haven Depot	Somerville Depot	Warren Depot	Y–12	
Years 1 to 39	3,041,936	15,792,856	3,231,624	2,745,600	
Year 40	92,236	458,153	97,213	87,324	
Subtotal	3,134,171	16,251,010	3,328,837	2,832,924	
Total for No Action Alternative					25,546,942

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

Table D–2 shows that the total value of the No Action Alternative is estimated at $25,546,942. 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 ($53.82 per square meter) (U.S. Department of Energy's Y–12 National Security Complex [Y–12] is the highest unit cost at $16.00 per square foot [$172.22 per square meter], 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 utilities, and rent.

Utility costs are determined by estimating the fraction of space occupied by mercury containers and applying it to an estimated utility cost for an entire depot. This estimated utility cost was developed using monthly utility costs at the New Haven and Warren depots as the base and then adjusting the utility costs by differences in the average cost per kilowatt hour for commercial electricity users in each of the states where the depots are located (EIA 2001). Using this method, utility costs for the Somerville Depot are estimated to be higher than those for the New Haven or Warren depots due to a larger amount of space being used to store mercury and higher expected energy costs. For example, at the New Haven Depot, mercury containers occupy approximately 3.9 percent of 1.1 million ft^2 (0.1 million m^2) of warehouse space, which equates to $1,966 of the $50,284 estimated to be spent on the depot's utility costs.

Table D–3. Detailed No Action Costs 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
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($)												
Annual utility[a]	50,284	0.039	1,966	63,424	0.078	4,945	57,389	0.029	1,662	0.00	0.326	0
Annual rent	1.76	43,200	76,032	5.00	80,000	400,000	2.03	40,000	81,200	16.00	4,400	70,400
Total			**77,998**			**404,945**			**82,862**			**70,400**

a Y–12 utilities included in rent.
Key: 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	Cost	Unit Cost	Quantity	Cost	Unit Cost	Quantity	Cost	Unit Cost	Quantity	Cost
Estimated overpacking costs (labor)												
Cost of new seamless 76-lb flask	40.00	120	4,800	40.00	564	22,552	40.00	121	4,852	40.00	151	6,024
Estimated waste disposal costs												
Hazardous waste (per pound to retort and dispose)	3.18	1,800	5,724	3.18	8,457	26,894	3.18	1,819	5,786	3.18	2,259	7,183
Nonhazardous waste (per cubic yard)	6.00	2.22	13	6.00	10.44	63	6.00	2.25	13	6.00	2.79	17
Estimated transportation costs												
Materials[a] (per truckload)	550	2.00	1,100	550	2.00	1,100	550	2.00	1,100	550	2.00	1,100
Hazardous wastes[b] (per truckload)	1,300	2.00	2,600	1,300	2.00	2,600	1,300	2.00	2,600	1,300	2.00	2,600
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)												
Annual utility[c]	50,284	0.039	1,967	63,424	0.078	4,945	57,389	0.029	1,662	0.00	0.326	0.00
Annual rent	1.76	43,200	76,032	5.00	80,000	400,000	2.03	40,000	81,200	16.00	4,400	70,400
Total			**92,236**			**458,153**			**97,213**			**87,324**

a New overpacks, flasks, pallets, etc.
b Old flasks, other hazardous waste, etc.
c Y–12 utilities included in rent.
Key: Y–12, U.S. Department of Energy's Y–12 National Security Complex.

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 ft^2 (4,013 m^2), while the Somerville and Warren warehouse sections are 40,000 ft^2 (3,716 m^2). However, the Somerville Depot uses two warehouse sections to store mercury. The mercury at Y–12 is stored in 4,400 ft^2 (409 m^2) of space.

Rental cost is estimated by applying the estimated cost per square foot to the area occupied by mercury containers. Mercury occupies 43,200 ft^2 (4,013 m^2) at the New Haven Depot, costing approximately $76,032 for rental space at a rental cost of $1.76 per square foot ($18.94 per square meter).

Costs are higher during the last year of storage than other years due to additional expenses incurred to replace leaking flasks, dispose of wastes, and transport materials, 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 (18,144 kg), the number of trips required to dispose of wastes and materials is unaffected by the relatively small waste disposal quantities estimated for each site.

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
- Existing storage buildings will be used; no new construction or land disturbance
- Overpacks will not fail
- Overpack drums are opened during the last year of storage and some flasks are found to have leaked

Considerations for facility costs are based on a budgetary formulation strategy for a generic facility. Facilities to support continued storage would have to be leased, either commercially or through an intra-government agreement. Total storage requirement would be 200,000 ft^2 (18,581 m^2). The average annual cost for storage is estimated to be $3.50 per square foot ($37.67 per square meter) throughout the contiguous United States. Therefore, the estimated annual mercury storage cost would be $700,000.

Basic facility requirements subject to negotiation include, but are not limited to:

- Fully enclosed, secure, weather resistant warehouse structure
- Floor load capacity of 3,000 lbs/ft^2 (14,648 kg/m^2)
- Minimum ceiling height of 16 ft (4.9 m)
- Power operated overhead equipment access doors
- Personnel access doors
- Electrical power sufficient to provide lighting and operate the equipment doors and ancillary equipment
- Fire resistance (by means of a suppression system or non-flammable construction)
- Leak resistant floor sealant

- Three-inch-high curbing at all doors and ramping to accommodate material handing equipment

Cost assumptions include:

- A facility located within the contiguous United States
- Property will be either commercially or government-owned
- Lease rate includes all related property maintenance costs
- Lease rate includes all related utility costs
- Lease rates provide consideration for recapitalization costs
- Lease rates provide consideration for profit

Variances:

- To offset acquisition and installation by the property owner, costs for special applications such as the floor sealant, curbing, and ancillary systems may be amortized over the early portion of the lease.
- Geographic location of potential facilities will impact costs. Costs at Government-owned storage facilities in rural locations may be as much as 33 percent below the estimate. Costs for commercially owned storage facilities in urban and suburban locations may be as much as 20 percent above the estimate. Costs for all other potential accommodations would fall between those estimates.
- There are other items necessary to provide a full-service facility that are not considered in this basic facility estimate. These items include, but are not necessarily limited to, utilities and security.
- Actual facility costs in the event that the Consolidated Storage Alternative is chosen would be established based on best value to the Government during a procurement process.

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. In addition, the labor required for consolidation varies because the total quantity of mercury transported depends on the site chosen. For example, if the New Haven Depot was chosen as the consolidation site, 112,511 flasks would be transported; if the Somerville Depot was chosen, only 52,782 flasks would be transported. If one of the new candidate sites was chosen, all 128,662 flasks would have to be transported.

Transportation to the consolidation site under each Consolidated Storage Alternative has been estimated using either trucks or rail to transport the mercury. The number of truck trips required is estimated based on each truck carrying up to 14 pallets of mercury. The number of rail trips is estimated assuming each rail car can carry up to 28 pallets of mercury. In the case of the mercury stored at Y–12, the site does not have a rail line accessible to the mercury storage facility. Therefore, the mercury would need to be loaded onto trucks and transported to the nearest railhead (a distance of approximately 5 mi [8 km]) where it would need to be loaded onto the railcars. The result is additional labor and transportation costs for the materials being shipped from Y–12 to any of the candidate consolidation sites. Similarly, the Somerville Depot rail head is in need of repairs. It is estimated that these repairs will cost approximately $80,000 so the estimated transportation costs by rail include a one-time cost for rail repairs at Somerville (Lynch 2003). These costs would be incurred under any of the consolidation alternatives if rail transportation is chosen because material would either have to be shipped from Somerville or received there by rail.

Transportation estimates were calculated using average quotations from commercial haulers from one site to another in the case of trucks (Military Traffic Management Command 2003) and an average cost per gross ton-mile for rail shipments by Class I railroads (Association of American Railroads 2003). The costs to transport the mercury to the consolidation site then vary based on the number of pallets of mercury that need to be transported and the distances from the current storage sites to the consolidation site.

The second period of costs only includes utilities and rent while the third period includes costs for inspection, and reflasking. Summarized costs for the six sites are listed in Tables D–5 and D–6, which indicates that consolidation cost estimates for all sites are within 1 percent of each other, which is not a significant difference in cost over the 40-year year storage period. The detailed costs for each of the sites are listed in Tables D–7 through D–12. 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.

Table D–5. Consolidation Costs (Transportation by Truck)[a] ($)

Costs	New Haven Depot	Somerville Depot	Warren Depot	Hawthorne Army Depot	PEZ Lake Development	Utah Industrial Depot
Year 1	1,379,352	1,322,956	1,360,427	1,885,605	1,407,491	1,875,681
Years 2–39	26,945,932	27,069,778	26,915,809	26,651,300	27,139,714	26,855,146
Year 40	796,751	800,010	795,958	788,997	801,850	794,362
Total	29,122,035	29,192,744	29,072,194	29,325,903	29,349,056	29,525,189

[a] Includes transportation and management costs that include rent, utilities, etc.

Table D–6. Consolidation Costs (Transportation by Rail)[a] ($)

Costs	New Haven Depot	Somerville Depot	Warren Depot	Hawthorne Army Depot	PEZ Lake Development	Utah Industrial Depot
Year 1	1,415,516	1,371,908	1,398,380	1,698,593	1,411,330	1,642,758
Years 2–39	26,945,932	27,069,778	26,915,809	26,651,300	27,139,714	26,855,146
Year 40	796,751	800,010	795,958	788,997	801,850	794,362
Total	29,158,199	29,241,696	29,110,147	29,138,890	29,352,895	29,292,266

[a] Includes transportation and management costs that include rent, utilities, etc.

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

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

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**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	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	-	-	550	-	-	550	2	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2	2,600
Labor costs for consolidation[c] (by truck)	NA	0.31	15,462		-	-		-	-
Transportation costs to consolidate (by truck)	482	269	129,751	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual utility costs	50,284	0.181	9,103	50,284	0.181	9,103	50,284	0.181	9,103
Annual rent[d]	3.50	200,000	700,000	3.50	200,000	700,000	3.50	200,000	700,000
Total with truck transportation			**1,379,352**			**709,103**			**796,751**
Labor costs for consolidation by rail	NA	0.37	17,870						
Transportation costs to consolidate (by rail)	0.023	3,413,324	83,506						
One-time rail improvements at Somerville	NA	NA	80,000						
Total with rail transportation			**1,415,516**						

a New overpacks, flasks, pallets, etc.

b Old flasks, other hazardous waste, etc.

c Determined by multiplying full-time equivalents by estimated annual salary.

d Space rental rate.

Key: NA, not applicable.

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

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

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**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	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	-	-	550	-	-	550	2	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2	2,600
Labor costs for consolidation[c] (by truck)	NA	0.15	7,292	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	616	127	78,265	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual utility	63,424	0.195	12,363	63,424	0.195	12,363	63,424	0.195	12,363
Annual rent[d]	3.50	200,000	700,000	3.50	200,000	700,000	3.50	200,000	700,000
Total with truck transportation			**1,322,956**			**712,363**			**800,010**
Labor costs for consolidation by rail	NA	0.21	9,700						
Transportation costs to consolidate (by rail)	0.023	1,730,826	44,809						
One-time rail improvements at Somerville	NA	NA	80,000						
Total with rail transportation			**1,371,908**						

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

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

[c] Determined by multiplying full-time equivalents by estimated annual salary.

[d] Space rental rate.

Key: NA, not applicable.

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

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

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**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	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	-	-	550	-	-	550	2	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2	2,600
Labor costs for consolidation[c] (by truck)	NA	0.31	15,462	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	415	269	111,618	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)				-		-	-	-	-
Annual utility	57,389	0.145	8,311	57,389	0.145	8,311	57,389	0.145	8,311
Annual rent[d]	3.50	200,000	700,000	3.50	200,000	700,000	3.50	200,000	700.000
Total with truck transportation			**1,360,427**			**708,311**			**795,958**
Labor costs for consolidation by rail	NA	0.37	17,870						
Transportation costs to consolidate (by rail)	0.023	2,702,764	67,164						
One-time rail improvements at Somerville	NA	NA	80,000						
Total with rail transportation			**1,398,380**						

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

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

[c] Determined by multiplying full-time equivalents by estimated annual salary.

[d] Space rental rate.

Key: NA, not applicable.

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

Table D–10. Detailed Costs for Consolidation at the Hawthorne Army Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**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	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	-	-	550	-	-	550	2	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2	2,600
Labor costs for consolidation[c] (by truck)	NA	0.35	17,030	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	2,085	308	642,188	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual utility	1,350	1.000	1,350	1,350	1.000	1,350	1,350	1.000	1,350
Annual rent[d]	3.50	200,000	700,000	3.50	200,000	700,000	3.50	200,000	700,000
Total with truck transportation			**1,885,605**			**701,350**			**788,997**
Labor costs for consolidation by rail	NA	0.42	19,439						
Transportation costs to consolidate (by rail)	0.023	15,989,898	372,768						
One-time rail improvements at Somerville	NA	NA	80,000						
Total with rail transportation			**1,698,593**						

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

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

Table D–11. Detailed Costs for Consolidation at PEZ Lake Development

	Year 1			Years 2–39			Year 39		
	Unit Cost	**Quantity**	**Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**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	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	-	-	550	-	-	550	2	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2	2,600
Labor costs for consolidation[c] (by truck)	NA	0.35	17,917	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	488	308	150,334	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual utility	14,203	1.000	14,203	14,203	1.000	14,203	14,203	1.000	14,203
Annual rent[d]	3.50	200,000	700,000	3.50	200,000	700,000	3.50	200,000	700,000
Total with truck transportation			**1,407,491**			**714,203**			**801,850**
Labor costs for consolidation by rail	NA	0.42	20,325						
Transportation costs to consolidate by rail	0.023	2,902,830	71,765						
One-time rail improvements at Somerville	NA	NA	80,000						
Total with rail transportation			**1,411,330**						

[a] New overpacks, flasks, pallets, etc.
[b] Old flasks, other hazardous waste, etc.
[c] Determined by multiplying full-time equivalents by estimated annual salary.
[d] Space rental rate.

Key: NA, not applicable.

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

Table D–12. Detailed Costs for Consolidation at the Utah Industrial Depot

	Year 1			Years 2–39			Year 40		
	Unit Cost	**Quantity**	**Cost**	**Unit Cost**	**Quantity**	**Annual Cost**	**Unit Cost**	**Quantity**	**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	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	-	-	550	-	-	550	2	1,100
Hazardous wastes[b] (per truckload)	1,300	-	-	1,300	-	-	1,300	2	2,600
Labor costs for consolidation[c] (by truck)	NA	0.35	17,030	-	-	-	-	-	-
Transportation costs to consolidate (by truck)	2,035	308	626,899	-	-	-	-	-	-
Estimated costs for continued storage not including overpacking, waste disposal, and transportation ($/yr)									
Annual utility	6,714	1.000	6,714	6,714	1.000	6,714	6,714	1.000	6,714
Annual rent[d]	3.50	200,000	700,000	3.50	200,000	700,000	3.50	200,000	700,000
Total with truck transportation			**1,875,681**			**706,714**			**794,362**
Labor costs for consolidation by rail	NA	0.42	19,439						
Transportation costs to consolidate (by rail)	0.023	13,546,463	311,569						
One-time rail improvements at Somerville	NA	NA	80,000						
Total with rail transportation			**1,642,758**						

[a] New overpacks, flasks, pallets, etc.
[b] Old flasks, other hazardous waste, etc.
[c] Determined by multiplying full-time equivalents by estimated annual salary.
[d] Space rental rate.
Key: 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–13 lists the estimated cost for the two alternatives. The maximum and minimum average price paid for DNSC sales since 1992, is $88 and $58. Recent public articles[2] on mercury prices indicate 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–13. 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 ($)	195	58	195	58
Total cost ($)	(11,674,243)	6,135,757	(25,089,090)	(7,462,396)
Years to deplete stockpile	26	26	1	1

Note: Values in parentheses () are revenues.

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 estimated selling price ($58/flask) for the mercury sold at the maximum acceptable rate (i.e., 5,000 flasks per year) results in an estimated cost of $6.1million over the life of the sales program, while the maximum estimated selling price ($195/flask) would actually generate a profit of $11.7 million.

Table D–14 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–14 indicate that the Somerville Depot incurs the highest storage cost, because it takes so long to deplete that stockpile.

2 AMM.com 2001; Metal Pages 2002; Platts 2002.

Table D–14. Storage Costs Until Mercury is Sold ($)

Location	Cost
New Haven	1,013,979
Somerville	10,528,571
Warren	1,077,208
Y–12	1,056,000
Total	13,675,758

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). Revenue from this alternative is estimated to be between $7.5 million and $25.1 million.

D.5 CONCLUSION

As shown in Table D–15, 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 approximately $25 million in revenue. The most costly alternative is consolidated storage which would result in costs of approximately $29 million.

Table D–15. Summary Costs ($)

Alternatives	Cost
No Action	25,546,942
Consolidated Storage (lower of truck or rail transportation)	
New Haven Dept	29,122,035
Somerville Depot	29,192,744
Warren Depot	29,072,194
Hawthorne Army Depot	29,138,890
PEZ Lake Development	29,349,056
Utah Industrial Depot	29,292,266
Sales at the Maximum Allowable Market Rate	
Estimated minimum[a]	(11,674,243)
Estimated maximum[b]	6,135,757
Sales to Mining Company	
Estimated minimum[a]	(25,089,090)
Estimated maximum[b]	(7,462,396)

[a] Assuming $195 per flask.
[b] Assuming $58 per flask.

D.6 REFERENCES

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