

**SUPPORT DOCUMENT FOR
THE CERCLA 104 PRIORITY LIST
OF HAZARDOUS SUBSTANCES
THAT WILL BE THE SUBJECT OF
TOXICOLOGICAL PROFILES**



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**IN COOPERATION WITH THE
U.S. ENVIRONMENTAL PROTECTION AGENCY**

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1. Introduction

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), as amended by the Superfund Amendments and Reauthorization Act (SARA), establishes certain requirements for ATSDR and EPA with regard to hazardous substances which are most commonly found at facilities on the CERCLA National Priorities List (NPL). Section 104(i)(2) of CERCLA, as amended (42 U.S.C. 9604(i)(2)), required that the two agencies prepare a list, in order of priority, of at least 100 hazardous substances that are most commonly found at facilities on the NPL and which, in their sole discretion, are determined to pose the most significant potential threat to human health (see 52 FR 12866, April 17, 1987). CERCLA also required the agencies to revise the priority list to include 100 or more additional hazardous substances (see 53 FR 41280, October 20, 1988), and to include at least 25 additional hazardous substances in each of the three successive years following the 1988 revision (see 54 FR 43619, October 26, 1989; 55 FR 42067, October 17, 1990; 56 FR 52166, October 17, 1991). CERCLA also requires that ATSDR and EPA shall not less often than once every year thereafter revise the list to include additional hazardous substances which are determined to pose the most significant potential threat to human health. Each substance on the CERCLA priority list of hazardous substances is a candidate to become the subject of a toxicological profile prepared by ATSDR and the subsequent identification of priority data needs.

The first priority list of 100 substances was published in the Federal Register on April 17, 1987 (52 FR 12866), with a summary of the procedure used by ATSDR and EPA to compile the list. In that notice, the agencies solicited public comment on the approach adopted for evaluating and ranking hazardous substances found at NPL sites and announced the intention to refine the listing process in response to these comments, as well as continued efforts by the agencies to improve the listing process.

A second priority list of 100 additional substances was published on October 20, 1988 (53 FR 41280), and the revised procedure used to prepare the second priority list was summarized. For the most part, the same procedure was used to generate the third and fourth lists of 25 substances each (54 FR 43619, October 26, 1989, and 55 FR 42067, October 17, 1990).

A notice providing the revised priority list of 275 hazardous substances was published in the Federal Register on October 17, 1991 (56 FR 52166). This list was based on the most comprehensive information currently available for substances found at NPL sites. An additional 56 substances whose total score did not differ considerably from substances near the lower end of the revised priority list was also provided in the interest of the public.

The 1992 priority list of hazardous substances was published on October 28, 1992 (57 FR 48801). In this year's listing activity, new candidate substances (substances which have been found at three or more NPL sites) were assigned a toxicity/environmental score (TES) using the EPA Reportable Quantity methodology, and were added to the pool of substances previously considered for the annual list. All substances were then evaluated together for consideration on the priority list.

The approach used to generate the revised priority list last year was summarized in the "Revised Priority List of Hazardous Substances" (56 FR 52166, October 17, 1991). Using the same approach, and the same algorithm this year, over 600 candidate substances have been ranked to create the current list of 275 substances.

Since publication of the first priority list in 1987, more comprehensive sources of information for the frequency of occurrence of substances at NPL sites and the potential for human exposure at these sites have become available. ATSDR has developed an Agency-wide database containing information from public health assessments, site files, health consultations, toxicological profiles and health studies, etc. This database (called HazDat) became available

for Agency use in early 1991. The HazDat system is the scientific and administrative database developed by ATSDR as a repository for information on hazardous substances found at NPL and non-NPL waste sites or emergency events and on the potential health effects of hazardous substances on human populations. The additional information used in this year's listing activity was entered into ATSDR's HAZDAT database since publication of last year's "Revised Priority List of Hazardous Substances". As with other site-specific information used in the listing activity, this information has been collected from ATSDR Public Health Assessments and from site file data packages used in the development of Public Health Assessments. The new information includes more recent NPL frequency of occurrence data, additional concentration data, and more information on exposure or potential exposure to substances present at NPL sites.

1.1 1992 Listing Activity Workgroup

The workgroup for the 1991 and 1992 listing activities was comprised of members of the Divisions and Offices of ATSDR, as well as representatives from the U.S. Environmental Protection Agency (Office of Water, Office of Pollution Prevention and and Toxic Substances, and Office of Emergency and Remedial Response) and the Centers for Disease Control (National Center for Environmental Health). In the Summer of 1991, workgroup members met and discussed potential sources of information for the revised priority list and identified practical sources of information for the 1991 listing activity. The workgroup also formulated the strategies for development of preliminary reports to assess the extent of data available in various databases, developed the scoring scheme for the subcomponents of the algorithm, and determined the weight assigned to subcomponents in calculating the total score in the ranking algorithm. The workgroup also reviewed the Toxicity/Environmental Scores developed for substances lacking RQs. After the 1991 list was developed, the workgroup members reviewed the list prior to the release to the public in October 1991. In the Spring of 1992, the workgroup reconvened and discussed public comment received on the 1991 Priority List. At that time it was decided (based on favorable public comment) that the algorithm used for the 1991 list would again be used for the development of the 1992 Priority List of Hazardous Substances. Workgroup members then met again in the Summer of 1992 to discuss the toxicity scores assigned to new candidate substances for the 1992 list. At that time the workgroup discussed new HazDat data entered into the system since the 1991 priority list, and were briefed on the efforts underway in the Division of Toxicology to use this new information in the 1992 activity. In early Fall 1992, the algorithm was then run against the updated HazDat data and the 1992 Priority List of Hazardous substances was generated.

1.2 Sources of Information Considered for the 1991 and 1992 Priority Lists

The priority lists of hazardous substances developed before 1991 were based on the most comprehensive and relevant information available when the lists were developed. Previous sources of information used in listing activities prior to 1991 are described in Table 1.

In order to provide a list of hazardous substances that was based on the most relevant and up-to-date data on the presence of substances at NPL hazardous waste sites, sources of information used in previous listing activities were re-evaluated for potential usefulness in development of the 1991 revised priority list of hazardous substances. New sources of data were also evaluated in development of the revised list. The sources of information considered by the workgroup are described in Tables 2, 3, and 4.

Table 1. Sources of Information for Previous Listing Activities (pre-1991)

Type of Information	Source	Limitations
Frequency of Occurrence at NPL Sites	Contract Laboratory Program (CLP) Statistical Database	Limited to target analytes. Frequency of occurrence tends to vary significantly only for the most frequently detected substances.
	Hazard Ranking System (HRS) Database	Only 15 substances of concern per site are listed.
	Special Analytical Service (SAS) Database	Only those substances with 5 or more requests are included.
Toxicity	EPA Reportable Quantity (RQ) Methodology	Not established for all substances.
Potential for Human Exposure	CLP Statistical Database	Limited concentration data.
	NPL Technical Database	Indirect information; frequency used as correlate of exposure potential.
	National Human Adipose Tissue Survey (NHATS)	Indirect information; applies to general population.
	Dept. of Transportation Hazardous Materials Information System (DOT/HMIS)	Indirect information on releases on U.S. highways.
	Acute Hazardous Events (AHE) Database	Indirect information; industrial spill/accident information for U.S..
	National Response Center (NRC) Database	Indirect information; contains non-NPL information on releases greater than RQ.
	Removal Tracking System (RTS)	Indirect information; only includes substances that triggered clean-up activities.
	NEXIS Newswire Reports	Indirect information; applies to general population.

**Table 2. Sources of Information Considered for
Frequency of Occurrence at NPL Sites**

Source of Information	Advantages	Disadvantages
Contract Laboratory Program (CLP) Statistical Database	Follows CLP protocol for QA of analytical results. Provides quantitative water and soil data.	Statistical sampling of 141 NPL sites. Database frozen in 1986.
CLP Analytical Results Database (CARD)	Follows CLP protocol for QA of analytical results. Provides quantitative water and soil data.	Compilation of CLP sampling after 1986. Contains multiple entries for substances at sites; difficult to obtain site-specific information.
View (pre-1990 ATSDR database)	Data for 1177 NPL sites. Not limited to CLP data — also includes air, soil gas, biota, etc.	- Frozen in February 1990.
Special Analytical Services (SAS)	Identifies detection of non-routine substances for which 5 or more requests for analysis had been made.	Not quantitative results. Text-type database that requires manual search for information.
National Governor's Association Report on Closed and Restricted Sites	Report covers both CLP and non-CLP substances. Alternative source of data other than EPA.	Not designed to convey substance-specific information. Designation of NPL sites requires verification.
HazDat (ATSDR Agency-wide Database)	Designed to convey substance-specific information from documented sources. Data for > 1268 NPL sites. Includes data for non-CLP substances. Contains exposure data where available. Includes media in addition to water and soil. Ready access to information.	Not all data are quantified. Not able to correct for background of naturally-occurring substances. Not all exposure data are substance-specific.

Table 3. Sources of Information Considered for Toxicity Assessment

Source of Information	Advantages	Disadvantages
RQ Scoring Scheme	Based on different types of effects; considers potency, severity, and route-specific toxicity. Chronic toxicity RQ based on most sensitive endpoint.	RQs not available for all candidate substances.
Sax Ranking Scheme	Evaluation is based on both acute and chronic toxicity. Considers severity of effect in determination of the toxicity score.	No specific quantitative criteria are used to define the levels of severity No consideration for potency. No differentiation between acute and chronic effect in toxicity classification.
Modified Hazardous Air Pollutant Prioritization System (MHAPPS)	Scoring based on data from the Registry of Toxic Effects of Chemical Substances (RTECS) and the National Toxicology Program (NTP) testing program schedule.	Limited in terms of the toxic effects considered in scoring chemicals. No consideration for potency. Developed for screening air pollutants and would require modification for ranking NPL hazardous substances.
USEPA Office of Toxic Substances Scoring System	Scores a broad range of toxic effects. Considers both potency and severity. Evaluation of a chemical is made in the absence of data based on structure-activity relationships.	Involves subjective evaluation of scores; leads to qualitative rather than quantitative ranking of chemicals. Component toxicity scores are not combined into a single comprehensive score. Low score may indicate that no data were available.
Food Safety and Inspection Service Compound Evaluation	Types and severity of effects are well defined. High quality, critically reviewed toxicity data are used.	Toxicity characterization under this approach would be resource-intensive (cost and work effort).
OHEA Procedure for Ranking Chemicals of Concern	Flexible and simple to use. Relies upon easily obtained data.	Two-tiered toxicity classification (i.e., high, low) severely restricts evaluation to one based on gross criteria (e.g., carcinogen vs. noncarcinogen).
Chemical Ranking Scheme for Priority Pollutants	Provides a conceptual framework for the toxicity ranking of chemicals.	Limited in its treatment of chronic toxicity. No consideration of potency. Assessment based primarily on considerations of oral and dermal exposures to chemicals in water.

**Table 4. Sources of Information Considered to Assess
Potential for Human Exposure**

Source of Information	Advantages	Disadvantages
National Human Adipose Tissue Survey	Reflects direct biomarker of exposure.	Limited in number of substances analyzed. Source of exposure unknown; not necessarily NPL site-related.
Contract Laboratory Program (CLP/CARD) Databases	Provides some indication of contamination at sites.	No direct exposure link. Data for <50% of candidate substances.
VIEW (ATSDR pre-1990 database)	Provides some indication of contamination at sites. 1177 NPL sites in database.	No direct exposure link. Data frozen in February 1990.
DOT/HMIS Acute Hazardous Events Database; National Response Center Database; NEXIS Newswire Reports	Indicates release in accidents.	Text-type databases not readily searched. Substance considered if evacuation, injury, or death reported; not necessarily related to the chemical exposure. Data for general population; not necessarily NPL site-related.
Removal Tracking System (RTS)	Indication of removal of substances that pose acute hazard. CERCLA-related.	Text-type database. Site deterioration or external factors may influence prompt removal.
Toxics Release Inventory (TRI)	Provides comprehensive release data for substances produced/used in large quantities.	Not necessarily NPL site related. Methods of quantification differ. Data quality varies.
Emergency Event Surveillance System	Includes ATSDR emergency response information.	Not ready in time for 1991 activity. Merged into HazDat in late 1991.
NPL Technical Database (1991 version)	Provides population estimates for 1-mile and 3-mile radius around NPL sites.	No information on de-listed or non-finalized NPL sites. Public comment advised that pop. data not to be used to assess human exposure potential.
FERDS (EPA Office of Drinking Water Database)	Information on more than 50 chemicals in drinking water supplies (state-reported). Good analytical quality assurance.	Limited number of substances; indirect measure of exposure (not necessarily NPL site-related).
EPA "Air Toxics" Database	Provides information on presence of substances in air.	Exposure not necessarily NPL site-related.
HazDat	Provides direct human exposure data; some substance-specific exposure data. Provides limited demographic information. Discriminates between on-site and off-site exposure information.	Exposure data for each site not fully characterized -- insufficient data exist to assess human exposure potential for every NPL site.

The sources of information described in Table 5 were regarded by the workgroup as those sources which represented the most comprehensive, reliable, and readily accessible data for the development of the 1991 revised Priority List of hazardous substances. These information sources were retained for use in the development of the 1992 Priority List of Hazardous Substances as well.

Table 5. Sources of Information Used in Development of the 1991 and 1992 Priority Lists

Type of Information	Source	Advantages
Frequency of Occurrence at NPL Sites	HazDat site file and public health assessment information	Substances not limited to CLP target analytes
Toxicity	Reportable Quantity (RQ)	Well established method for toxicity scoring.
	Toxicity/ Environmental Score (TES)	Provides consistency by basing toxicity scores for substances lacking RQs on the RQ methodology.
Potential for Human Exposure	HazDat concentration data	Data not limited to CLP target analytes. Ability to specify media to be included.
	HazDat exposure status of populations data	Provides evidence of human exposure based on information in ATSDR health assessments.

Before the 1991 revised Priority List was published, a notice announcing the intention of ATSDR and EPA to revise the priority list of hazardous substances was published on June 27, 1991 (56 FR 29485). Sources for NPL frequency, toxicity, and potential for human exposure information were provided in the June 27, 1991 notice. Comments received by the agencies solicited by this notice were considered in the re-evaluation of the 250 previously listed substances and in the identification of additional substances as mandated by CERCLA.

2. Methodology for Selecting Substances for the Priority List

2.1 Criteria for Inclusion on the Priority List

Substances considered for the priority list of hazardous substances came from the universe of substances present at NPL sites, as indicated in HazDat from either health assessment or site file information. Currently, there are over 2,000 substances with unique Chemical Abstracts Service (CAS) numbers in HazDat. Because this pool of substances was so large, only those substances found at three or more NPL sites were considered for the priority list; over 700 substances were found at three or more sites.

The list of candidate substances was reviewed to identify petroleum-related substances, as covered under CERCLA Section 101(14). These substances were assigned TES values of zero and total point scores of -1 to place them at the bottom of the list of candidate substances (see Appendix J).

2.2 Determination of the Frequency of Occurrence Criterion of the Ranking Methodology

2.2.1 Overview

ATSDR and EPA selected ATSDR's HazDat database as the source of data for the frequency of occurrence of substances at NPL hazardous waste sites or facilities. The sources of HazDat site-specific information include ATSDR public health assessments, health consultations, and other site-specific documents submitted to ATSDR by EPA, state agencies, and other parties. HazDat has information on approximately 1,300 sites that have been proposed for, listed on, or delisted from the NPL. Furthermore, the HazDat database contains information on substances that have been identified at sites but are currently not included in EPA's Contract Laboratory Program (CLP) databases. HazDat contains information on substances found in groundwater, surface water, leachate, soil, sludge, sediment, air, soil gas, biota, human tissues, and waste materials or containers. The number of NPL sites at which a substance was identified in any medium in health assessment or site-file documents was used to indicate the frequency of occurrence. Contaminants in HazDat identified in the ATSDR site files are substances that have been positively identified at the site as a result of chemical analyses (concentrations above the limits of detection), inventories, or other documentation collected during the ATSDR health assessment process. Substances identified in documents as Tentatively Identified Compounds (TICs) are not included in ATSDR's HazDat system and therefore were not considered in the determination of frequency of occurrence for the priority list. Presence in one or more environmental medium per NPL site constituted one occurrence.

2.2.2 Frequency of Occurrence Scoring

The frequency of occurrence component of the algorithm was assigned a maximum score of 600 points. The substance that was found in highest frequency was given 600 points; points were spread evenly between the maximum and minimum frequency (3 NPL sites; 2.11 points assigned).

2.3 Determination of the Toxicity Component of the Ranking Methodology

2.3.1 Overview

For several reasons, ATSDR and EPA have continued to use the Reportable Quantity (RQ) approach as the toxicity hazard scoring system. It provides the most complete characterization of toxicity of all hazard scoring systems reviewed by the two agencies; other schemes were more limited in either the consideration of different types of toxic effects, severity of effects, or potency. In addition, toxicity data used in the RQ approach are derived from primary peer-reviewed literature, and RQs have already been established for the majority of substances frequently detected at hazardous waste sites. Moreover, the determination of RQ health effect values utilizes weight-of-evidence considerations in the evaluation of data.

The reportable quantity ranking scheme was developed by EPA to set RQs for hazardous substances as required by CERCLA. Under CERCLA section 103(a), any person in charge of a vessel or an offshore or onshore facility from which a hazardous substance has been released in a quantity that equals or exceeds its RQ must immediately notify the National Response Center and state and local response authorities of the release. RQs are developed for individual chemicals and for waste streams that have already been designated under CERCLA section 101(14) as hazardous substances.

Each CERCLA hazardous substance is assigned to one of five tiered RQ categories (1, 10, 100, 1,000, and 5,000 pounds) based on acute toxicity, chronic toxicity, carcinogenicity, aquatic toxicity, and ignitability and reactivity. RQs are determined for each criterion separately; the

lowest of these is selected as the RQ for the substance, subject to adjustment for potential hydrolysis, photolysis, or biodegradation in the environment. The RQ scoring scheme is described in several Federal Register notices (50 FR 13456, April 4, 1985; 51 FR 34534, September 29, 1986; 52 FR 8140, March 16, 1987; 54 FR 35988, August 30, 1989).

The RQ methodology was applied for those candidate substances without final CERCLA RQs to establish a Toxicity/Environmental Score (TES). These scores were developed for use only in the ranking methodology and do not represent regulatory amounts. TESs were assigned for over 350 substances. Substances that received a TES greater than 5,000 (using the RQ methodology) were dropped to the bottom of the candidate list and received a rank and total score of #525 and zero points, respectively. A breakdown of the toxicity/environmental scores developed for candidate substances is provided in Appendix B. An overview of the toxicity scoring methodology is provided in Appendix C.

2.3.2 Sources of Information Used to Determine the Toxicity/Environmental Score (TES)

Several sources of toxicity, reactivity/ignitability, and environmental fate information were used to determine the TESs for substances lacking RQs. The following sources were used:

National Library of Medicine Online Databases:

Hazardous Substances Data Bank (HSDB)

Registry of Toxic Effects of Chemical Substances (RTECS)

Chemical Carcinogenesis Research Information System (CCRIS)

Toxline (When no other online databases provided data.)

In addition, the following online sources were also used for the 1992 Listing Activity:

DIALOG Online Database Files:

Biosis Previews 1969-August 1992

SEDBASE current up to June 1992

EMBASE (EXCERPTA MEDICA) 1974-1992

International Pharmaceutical Abstracts 1970-July 1992

Life Sciences Collection 1978-June 1992

Martindale Online 1989

Occupational Safety and Health (NIOSH) 1973-June 1992

Drug Information Fulltext - December 1990

Agrochemicals Handbook June 1991

Chemical Safety Newbase 1981-July 1992

RTECS - Registry of Toxic Effects of Chemical Substances (May 1992)

Chemical Abstracts Search 1967-1992

American Medical Association Journals Online

The New England Journal of Medicine Online 1985-July 1992

Other Sources of Information:

Sax, I. 1984. *Dangerous properties of industrial materials*. 6th ed. New York: Van Nostrand Reinhold Company.

Sittig, M. 1985. *Handbook of toxic and hazardous chemicals and carcinogens*. 2nd ed. Park Ridge, NJ: Noyes Publications.

Windholz M, ed. 1983. *The Merck index*. 10th ed. Rahway, NJ: Merck and Company, Incorporated.

2.3.3 Assumptions Used in Determining the TES

2.3.3.1 Ignitability/Reactivity. Where no specific values were found to express potential for ignitability/reactivity, professional judgement was applied. For example, if a substance was classified as extremely flammable, but no flash point was given, a score of 10 was assigned for the ignitability/reactivity component. Similarly, if no information was found to indicate the substance was ignitable or reactive, the substance was assigned a score of >5,000 for this component of the TES.

2.3.3.2 Aquatic Toxicity. Specific aquatic toxicity data were lacking for many substances. In these cases, Sax (1984) was used to assess aquatic toxicity. The standard method of reporting aquatic toxicity in this text provides a range of toxicity without identifying the test species. Seventy-five percent of the maximum value was used for the aquatic toxicity component (for example, if the range was 100-1,000, the LC₅₀ value used was 750) for substances that lacked any other source of aquatic toxicity information.

2.3.3.3 Chronic Toxicity. Some substances lacked chronic toxicity data in the NLM online databases, but were mentioned in Sax or HSDB as having developmental or reproductive effects at a specified dose. For these substances, the developmental or reproductive effects were used to assess the chronic toxicity component because these effects are given the highest effect ranking (R_c in the RQ methodology) and potentially occur regardless of duration of exposure.

2.3.3.4 Carcinogenicity. Substances classified by EPA or the International Agency for Research on Cancer (IARC) in cancer classification groups A, B, or C, were assigned TES scores of 1, 10, or 100, respectively. Substances with limited evidence of carcinogenicity in animals, but not classified by IARC or EPA for carcinogenicity were assigned a score of 100. Substances with evidence of carcinogenicity in animals, but noted in the data source as "lacking sufficient evidence for carcinogenicity" by IARC were not evaluated for carcinogenicity (group D — insufficient evidence). Substances for which no information on carcinogenicity was located were not evaluated for carcinogenicity.

2.3.3.5 Radionuclides. The RQs for radionuclides are expressed in Curies, whereas other RQs are expressed in pounds. To provide comparative values and consistency in this activity, all radionuclides were assigned a TES of one, based on the potential carcinogenicity associated with exposure to various types of radiation.

2.3.3.6 Naturally Occurring Elements. TESs for several of the naturally-occurring elements were based on values for the ionized forms of the element rather than the "pure" element because the ionized forms are those most likely to be found in environmental media. Substances for which this approach was used are presented in Table 6.

The RQ for phosphorus was not adjusted because of concern in the workgroup that pure phosphorus might in fact be found at certain sites. ATSDR recognizes the uncertainty in assigning TESs to naturally occurring inorganic substances and intends to commit resources toward collecting data on speciation of inorganic substances at NPL hazardous waste sites.

2.3.3.7 Substances Lacking Data. For several substances, essentially no relevant information was located. In these cases, TESs were assigned based on the RQs for structurally-related substances (see Appendix B; TES=RQ column).

Table 6. Substances with TESs Based on Ionized Forms

CAS Number	Chemical Name	CAS Number	Chemical Name
7439-95-4	Magnesium	7440-09-7	Potassium
7440-23-5	*Sodium	7440-24-6	Strontium
7440-46-2	Cesium	7440-67-7	Zirconium
14808-79-8	Sulfate	16887-00-6	Chloride

*EPA RQ was adjusted to reflect the toxicity of the ionic form most likely found under environmental conditions.

2.3.4 Toxicity Component Scoring

Various methods to assign points to the TES/RQ values were discussed and evaluated. The assignment of a "log scale" scoring system resulted in over-emphasis of those substances that received an RQ or TES of 1 or 10, which overshadowed the other two components of the algorithm (NPL frequency and potential for human exposure) and tended to rank substances solely by their RQ or TES value. A scoring system using a 2/3 cumulative exponential decay was selected as the scoring method for the toxicity component of the priority list. The RQ or TES point assignments are presented in Table 7.

Table 7. Toxicity Component Scoring

Reportable Quantity or Toxicity/Environmental Score	Toxicity Points	Ordinal Rank	Cumulative Ordinal Rank	2/3 Exponential of Cumulative Ordinal Rank (x 600)
1	600	0	0	1.0000
10	400	1	1	0.6667
100	178	2	3	0.2963
1,000	53	3	6	0.0878
5,000	10	4	10	0.0173

2.4 Determination of the Potential for Human Exposure Component of the Ranking Methodology

In the approach for the priority list, ATSDR and EPA identified the most useful and directly relevant data to assess the potential for human exposure to hazardous substances at NPL sites. The exposure component of the algorithm is based on concentrations of the substances in environmental media and exposure status of populations as described in ATSDR health assessments. These two parts of the potential for human exposure portion of the algorithm were assigned a maximum 300 points each; if no concentration data was available for the substance, no points were assigned.

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2.4.1 Concentrations of the Substances in Environmental Media

2.4.1.1 Overview. To provide a means of ranking substances based on concentration data, the following formula for calculating a relative source contribution (SC) was used.

$$SC = \frac{(\bar{C}_a A_a) + (\bar{C}_w A_w) + (\bar{C}_s A_s)}{RQ \text{ or } TES}$$

Where $\bar{C}_x$ = geometric mean concentration of the substance in a particular environmental medium (a = air, w = water, s = soil); A_x = standard exposure assumption for the particular environmental medium to approximate a theoretical daily dose to humans (e.g., 1 liter of drinking water consumed per day); and RQ or TES = the Reportable Quantity or Toxicity/Environmental Score for the substance.

The calculation of the source contribution was included in the methodology to distinguish between those substances that occur at low concentrations but are highly toxic and those substances that occur at higher concentrations but are relatively less toxic.

Note: Because of the complexity and uncertainty associated with calculating a daily dose for radioactive substances, source contribution values were not calculated for these substances.

2.4.1.2 Source of Concentration Data. HazDat served as the source of concentration data for NPL site contaminants. HazDat contains concentration data documented in ATSDR health assessments for NPL (as well as non-NPL) hazardous waste sites. The concentration data in HazDat represent the maximum concentration found in that particular environmental medium at that site. Concentrations were converted to standard units for calculating the estimated daily dose. The HazDat fields used as sources of concentration data are presented in Table 8.

Table 8. HazDat Fields as Sources of Concentration Data

Media Type	HazDat Field Name
Water	Groundwater, public
	Groundwater, private
	Groundwater, unspecified
	Surface water
Soil	Top soil
	Subsurface soil
	Soil unspecified
Air	Air

Note: In the 1992 ranking data presented in Appendix A, the symbol "--" appears in concentration data columns for some substances. This symbol represents a lack of concentration data in HazDat from Public Health Assessments for these substances. ATSDR resources did not permit collection of contaminant concentration data from ATSDR site files for these substances. There are currently ongoing efforts at ATSDR to collect site file concentration data.

2.4.1.3 Calculation of the Geometric Mean Concentration. Substances were evaluated per environmental medium, and the geometric mean concentration was calculated for all "water", "soil", or "air" data across all sites. The geometric mean was chosen over other methods to calculate mean concentration because the geometric mean provides a reliable estimate of average concentration and attenuates distortion of the average by extreme outlying values. Units for geometric mean concentration were converted to mg/kg for soil concentrations, mg/liter for water concentrations, and ppm for air concentrations (particulates were converted from mg/m³ using molecular weight of substance in the calculation. Conversion to standard units allowed a comparison of all substances under consideration for the priority list.

2.4.1.4 Calculation of Theoretical Daily Dose. The agencies applied exposure assumptions for children (e.g., 1 liter of water consumed per day, 200 milligrams of soil ingested per day, and 15 cubic meters of air breathed per day) to determine the theoretical daily dose.

2.4.1.5 Source Contribution Scoring. Source contributions were scored by taking their natural logarithm and assigning 300 points to the highest log value and linearly distributing the scores between the highest and lowest value. Logarithms were used in order to retain discriminatory ability across the wide range of source contributions.

2.4.2 Exposure Status of Populations

2.4.2.1 Overview. Information concerning documented exposure or potential exposure to a particular substance or to environmental media in which a substance was found was also used in the exposure component. HazDat provides information on exposure or potential exposure to specific substances and to media, such as drinking water, in which substances have been reported. Substances were scored differentially with respect to identification in an ATSDR health assessment of exposure or potential exposure to a particular substance or to exposure or potential exposure to an environmental medium containing the substance.

2.4.2.2 Exposure Status Scoring. Categories of exposure or potential exposure were assigned overlapping ranges of points to account for the decreasing precision and directness of the exposure categories. Information on exposure to a substance was evaluated first; if no information on documented exposure to that substance was located in HazDat, exposure to environmental media containing the substance was then evaluated, and so on, until positive information on exposure status was located. Once exposure status information was located, the substance was scored on the basis of that exposure status. Points within each range were linearly distributed from the highest to the lowest scoring substance. A total of 300 points was possible for this part of the algorithm. The assignment of points to this part of the algorithm is presented in Table 9.

Table 9. Exposure Status Scoring

Exposure Status	Point Range Assignment
(1) Exposure to Contaminant	300 - 200
(2) Exposure to Medium Containing Contaminant	225 - 150
(3) Potential Exposure to Contaminant	175 - 100
(4) Potential Exposure to Medium Containing Contaminant	125 - 1

2.4.3 Populations Surrounding NPL Sites

In the notice announcing the intent to revise the priority list of hazardous substances (56 FR 29485, June 27, 1991), the agencies indicated that estimates of populations surrounding NPL sites would be used to assess the potential for human exposure for substances that lacked concentration data or information on exposure or potential exposure to substances or media. Population data were not used to develop this list because concentration or exposure data were available for all substances found at three or more sites. Because of questions surrounding the usefulness of 1990 Census data (lower than expected reporting of census data) and public comment received from concerned individuals on the use of population data to assess human exposure potential, the agencies decided not to use population data in the listing activity at this time.

3. Generation of the Priority List

Using the data sources and methods described in this support document, ATSDR and EPA ranked the hazard potential of each candidate substance according to the following algorithm:

$$\begin{array}{l} \text{TOTAL SCORE} \\ (1800 \text{ max. points}) \end{array} = \begin{array}{l} \text{NPL FREQUENCY} \\ (600 \text{ points}) \end{array} + \begin{array}{l} \text{TOXICITY} \\ (600 \text{ points}) \end{array} + \begin{array}{l} \text{POTENTIAL FOR HUMAN EXPOSURE} \\ (300 \text{ conc. pts.}) + (300 \text{ exposure pts.}) \end{array}$$

Substances were ordinaly ranked based on their total score. Appendix D provides the 1992 Priority List in rank order. Appendices E and F provide CAS number and alphabetical sorts of the 1992 Priority List, respectively).

3.1 Substances No Longer on the Priority List of Hazardous Substances

A list of 17 substances that appeared on the 1991 Priority List but are not included on the 1992 priority list of 275 hazardous substances is presented in Appendix K. These substances did not meet the criterion for inclusion on the priority list as a result of the use of the most recent information on the toxicity and presence of substances at NPL sites. The agencies acknowledge that the listing of substances for the development of toxicological profiles is not an absolute process. It is the intention of ATSDR to provide a list of substances that is of sufficient length to predict future directions in the profile development process, while not becoming an exhaustive list of substances that is too lengthy to manage and monitor. The substances in Appendix K will not be considered for development of toxicological profiles at this time unless a profile is developed for related forms of the substance that are included on the priority list. Some substances (bromodichloromethane and nitrobenzene) have been the subject of toxicological profiles; these profiles will not be updated nor will attending priority data needs be developed unless additional concern is generated in future listing activities.

4. Future Revisions to the Priority List

ATSDR and EPA intend to evaluate the priority list annually and make further refinements where possible. For example, ATSDR intends to assess the data for naturally occurring substances in order to adjust for natural background concentrations in the environment, as well as identify speciation of substances, where possible.

The HazDat database is a dynamic database; information on contaminants found at hazardous waste sites are continually being added to the system as new data become available. Furthermore, new site and health assessment data will continue to be added as sites are identified

and health assessments are completed. These data are reviewed and quality assurance procedures are taken prior to incorporation into HazDat.

In addition, new sources of information on NPL frequency, toxicity, and potential for human exposure will be evaluated as they become available and will be considered in the development of future priority lists of hazardous substances.