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4.0 WASTE DESCRIPTION

This chapter describes the type of waste that ***is emplaced and*** will be emplaced in the Waste Isolation Pilot Plant (WIPP) and provides an appraisal of the inventory of physical, chemical, and radionuclide components of the waste. This information supports the development of the performance assessment ***(PA)*** models that are used in predicting the long-term behavior of the repository. This chapter includes a waste description based on the inventories of existing and projected waste reported ***for the CCA (1996a) reported*** in the transuranic (TRU) Waste Baseline Inventory Report (TWBIR) (included in ~~this application as~~ ***CCA*** Appendix BIR) ***and updated for CRA-2004 in Appendix DATA, Attachment F. This chapter also includes*** a description of the projected waste inventory, waste limits derived from both the ~~performance assessment~~ ***PA*** and operational safety and health considerations, and methods of control to ensure compliance with the identified waste limits. ~~In addition~~***Finally***, this chapter provides a discussion of the applicable qualitative and quantitative waste characterization methodologies.

Inventory estimates provided in the CCA (Appendix BIR) represented the information available at that time. It was anticipated that WIPP waste inventory estimates would change as the U.S. Department of Energy (DOE) characterized the contents of waste containers prior to shipment to WIPP and as new TRU wastes were generated. Data on emplaced waste and updated estimates of the entire projected waste inventory are provided in Appendix DATA, Attachments D, E, F and H. The waste-inventory estimates reported in Appendix DATA and in this chapter are based on the available information as of September 30, 2002, unless otherwise noted.

Objectives of this chapter are to:

1. ***Report quantities and characteristics of the waste emplaced in the repository since certification;***
2. ***Describe the current understanding of the WIPP waste inventory (emplaced, stored, and projected waste) in terms of waste components and characteristics;***
3. ***Update waste inventory information for PA and compliance assessment calculations;***
4. ***Reassess waste components and characteristics and associated waste-emplacement limits that may be important to long-term repository behavior; and***
5. ***Identify changes or new information related to the WIPP waste characterization program that have occurred since certification.***

~~Title 40 of the Code of Federal Regulations (CFR) §~~ ***Section*** 194.24(a) ***of 40 CFR Part 194*** specifies that the ~~U.S. Department of Energy (~~DOE~~)~~ shall provide information pertaining to the chemical, radiological, and physical composition of the waste planned to be emplaced in the repository. Specifically, the criterion states

> Any compliance application shall describe the chemical, radiological and physical composition of all existing waste proposed for disposal in the disposal system. To the extent practicable, any compliance application shall also describe the chemical, radiological and physical composition of

> to-be-generated waste proposed for disposal in the disposal system. These descriptions shall include a list of waste components and their approximate quantities in the waste. The list may be derived from process knowledge, current non-destructive examination/assay, or other information and methods.

This waste description includes the definition, sources, types, components, and characteristics of ~~TRU~~ ***the*** waste planned for emplacement in the WIPP. The description provided in this chapter, along with the waste characterization analysis in ~~Appendix WCA~~[1] ***Appendix TRU WASTE, Section TRU WASTE-2.0***, identifies those physical, chemical, and~~/or~~ radiological components of the waste that may singly or in combination affect the ability of the WIPP disposal system to meet the environmental performance standards contained in ~~40 CFR~~ Part 191. This chapter is supported with several appendices. For example, waste related parameters used in ~~performance assessment~~ ***PA*** are discussed in ~~Appendix PAR and Appendix WCA~~ ***Appendix PA, Attachment PAR and Appendix TRU WASTE, Section TRU WASTE-2.0.*** Results of sensitivity analyses with respect to total releases used to generate the mean complementary cumulative distribution function (CCDF) in Section 6.5 are discussed in ~~Appendix SA~~ ***Appendix PA.*** The impact of waste components and characteristics on WIPP performance is discussed in ~~Appendix WCA~~ ***Appendix TRU WASTE, Section TRU WASTE-2.0.*** Limits for waste components are discussed in ***CCA*** Appendix WCL***; and in Appendix TRU WASTE, Section TRU WASTE-3.0*** and summarized in this chapter. ~~(See Table 1-4 in Chapter 1.0 for a list of appendices that provide additional information supporting this chapter.)~~ This chapter also ~~describes~~ ***summarizes*** methods of control that will be employed by the DOE to ensure that only those wastes that are consistent with ~~these descriptions~~ ***those on which the PA is based*** are actually emplaced in the repository. One such control is the WIPP Waste Information System (WWIS) ~~(DOE 1995e 1996b)~~ database for controlling the receipt of and tracking the emplacement of waste (see Section 4.3.2).

Before the final ~~performance assessment~~ ***PA for the CCA*** was designed, ***DOE performed*** waste characterization analyses ~~comprised of~~ ***based on*** iterative preliminary ~~performance assessment~~ ***PA***s, related sensitivity analyses, and dedicated process studies for specific components and characteristics of the waste~~, were performed~~. A list of waste components and characteristics that were considered during these analyses, the list of and rationale for the ones retained for inclusion in the final ~~performance assessment~~ ***PA***, and the ones not included are documented in ***CCA*** Appendix WCL. ***This process has been updated for this recertification application (CRA-2004); waste components and characteristics retained for CRA-2004 PA are documented in Appendix TRU WASTE, Section TRU WASTE-2.0.*** Retained waste components are assigned fixed values in the final ~~performance assessment~~ ***PA*** (see Appendix ~~PAR~~ ***PA, Attachment PAR***) based on information reported in ~~the TWBIR, Revision 3 (Appendix BIR)~~ ***Appendix DATA, Attachment F***. Therefore, during the ~~performance assessment~~ ***PA***, plausible combinations of fixed values for waste components are included in all ~~performance assessment~~ ***PA*** scenario analyses. Important imprecisely known waste characteristics are ~~provided~~ ***assigned*** ranges and distributions (***see*** ~~See Appendix SOTERM and Appendix PAR~~ ***Appendix PA***) from which values are drawn using a Latin hypercube sampling (LHS) technique that ensures that samples are taken from across the entire range of the distribution (***see*** ~~See~~ Section 6.1.5.2).

~~[1] The waste characterization analysis detailed in Appendix WCA was peer reviewed per the criteria in 40 CFR § 194.27(a)(2). Results of this peer review are documented in Section 9.3.2 and in Appendix PEER.~~

Since results demonstrate compliance with the quantitative containment requirements in ~~40 CFR §~~ ***Section*** 191.13, the individual protection requirements in ~~40 CFR §~~ ***Section*** 191.15, and the groundwater protection requirements in ~~40 CFR §~~ ***Section*** 191.24, the fixed values used for waste components define a profile of waste suitable for disposal at WIPP. Following the final ~~performance assessment~~ ***PA for the CCA***, sensitivity analyses determined the contribution of uncertainty in individual input variables to the uncertainty in model predictions (that is, final releases). ***In that sensitivity analysis, there*** ~~There are~~ ***were*** no waste characteristics that ~~have~~ ***had*** a significant impact on the uncertainty about and the location of the mean CCDF reported in ***CCA*** Figure 6-39 (~~See~~ ***see CCA*** Appendix SA for a discussion of this uncertainty). Therefore, setting waste component limits is not based on ~~performance assessment~~ ***PA*** results but is based on ensuring the validity of repository conditions modeled by ~~performance assessment~~ ***PA*** (~~See~~ ***see CCA*** Appendix WCL). ***The same is true for the CRA-2004.*** In addition, the limits are repository-scale limits ~~that should be met~~ ***applicable to the inventory*** at the time of ~~repository~~ decommissioning. The process for demonstrating compliance with these limits is to track the waste-component quantity and the uncertainty associated with that quantity as waste is emplaced in the repository. For example, the curie content for plutonium ***(Pu)*** and ~~it's~~ ***its*** uncertainty (based on the fact that a large percentage of the waste has yet to be generated) can be accumulated as waste is emplaced throughout the operational phase. Then, at the time of decommissioning, when these repository limits apply, the total curie content for ~~plutonium~~ ***Pu*** may be provided with a specified level of confidence, such as 95 percent, to demonstrate compliance with the waste component limits.

Figure 4-1 illustrates the information flow pertaining to the waste description and its relationship to other sections of this chapter as well as Chapter 6.0 and appendices to this application.

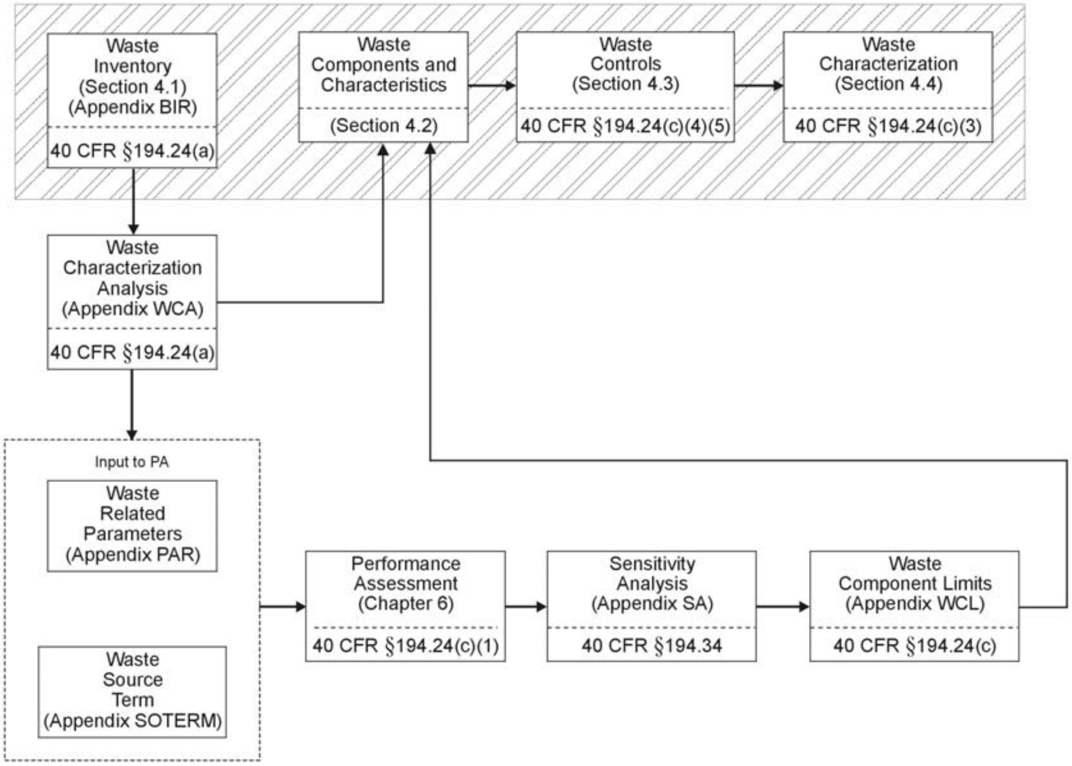
4.1 Waste Inventory

The waste inventory is defined as the quantity of waste that is anticipated to be emplaced in the WIPP ***and that waste that is already emplaced***. This inventory is generally characterized as the nonradionuclide inventory that consists of both physical and chemical waste constituents, generally expressed in units of density or concentration ***(kg/m^3)***; and the radionuclide inventory, which is a tabulation, by specific isotope, of anticipated radionuclides in the waste expressed in units of curies ***(Ci)***.

The term TRU waste is defined ~~(EPA 1993)~~ ***in the WIPP Land Withdrawal Act (LWA) (Public Law 102-579 as amended by Public Law 104-201)*** as

> waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes ***per gram of waste***, with half-lives greater than 20 years, ~~per gram of waste,~~ except for (A) high-level radioactive waste~~s~~; (B) waste that the ***Secretary*** ~~Department~~ has determined, with the concurrence of the Administrator, does not need the degree of isolation required by ***the disposal regulations*** ~~this part~~; or (C) waste that the ***Nuclear Regulatory*** Commission has approved for disposal on a case-by-case basis in accordance with ***part 61 of title*** 10, ***Code of Federal Regulations***. ~~CFR Part 61.~~

~~TRU isotopes have atomic numbers greater than uranium (92). In determining the alpha-activity concentration levels for waste classification, only the mass of the waste is used in the concentration calculation. The waste container, plus any added shielding and other packaging, is not included in the mass component of this determination.~~



~~Figure 4-1. Waste Description Information Flow~~

~~Pre-1970~~ TRU waste that ~~has been~~***was*** disposed of ~~by generators~~ in on-site, shallow landfill-type configurations ***prior to the early 1970s*** is referred to as buried waste. In 1970, the U.S. Atomic Energy Commission concluded that TRU waste should ~~have greater confinement from the environment~~***be stored in anticipation of the creation of more confining disposal facilities***. ~~Thus,~~ TRU waste generated since that date has been segregated from other waste types and placed in retrievable storage. Waste generated after ~~the early 1970s~~***1970***, but before implementation of ~~the DOE's TRU~~ ***CBFO certified waste quality assurance (QA) program*** ~~Waste Characterization Quality Assurance Program Plan (QAPP)~~, is referred to as retrievably stored waste. Waste generated after a site's implementation of ~~the~~***CBFO certified QA program*** ~~QAPP~~ is defined as newly generated. ***These and other relevant terms are defined in Appendix DATA, Attachment F.*** ~~TRU waste (DOE 1995b). Implementation of the QAPP occurs after the site's Quality Assurance Project Plans (QAPjPs) have been approved and implemented.~~

Newly generated waste will be characterized in a similar manner to retrievably stored waste, but it will incorporate more real-time, as opposed to historical, acceptable knowledge. ***As of September 30, 2002, approximately*** ~~Approximately~~65 percent of the waste to be disposed of at the WIPP ~~is~~ ***was*** expected to be newly generated waste, as described in the TWBIR (***CCA*** Appendix BIR). ***At the time of the data call for CRA-2004 (September 30, 2002), approximately five percent of the waste DOE plans to dispose in the WIPP had been emplaced in the repository. Approximately 73 percent of the waste to be disposed of in the WIPP is classified as retrievably stored waste, approximately 22 percent of the waste identified by the TRU waste sites to be disposed of at the WIPP is expected to be newly generated waste (see Appendix DATA; Attachment F).***

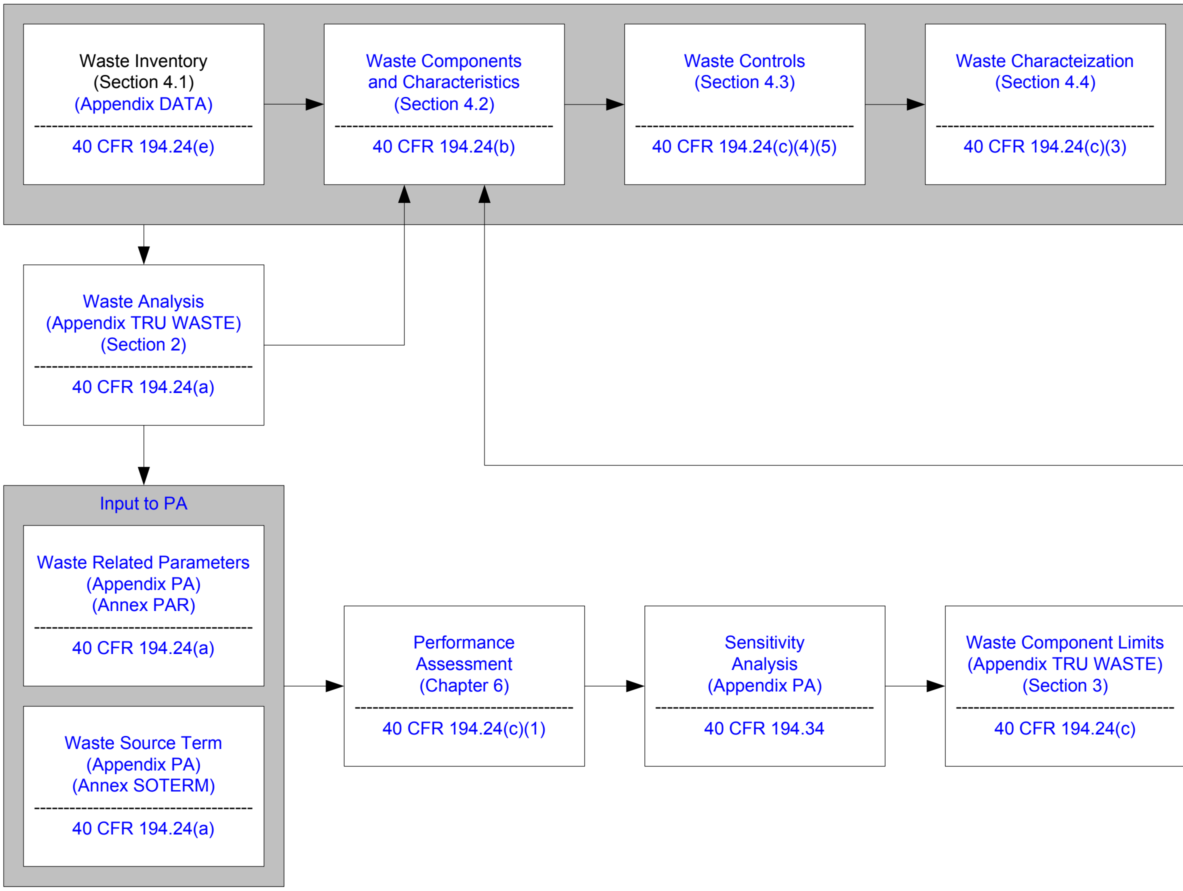


Figure 4-1. Waste Description Information Flow

TRU waste is classified as either contact-handled (CH) or remote-handled (RH) based on the contact dose rate at the surface of the waste container. If the contact dose rate is less than ~~or equal to~~ 200 millirem per hour (2 milliSievert per hour), the waste is defined as CH-TRU (DOE 1988). If, on the other hand, the contact dose rate is greater than ***or equal to*** 200 millirem per hour (2 milliSievert per hour), the waste and its container are defined as RH-TRU (DOE 1988). ***Consistent with the LWA, o***~~O~~nly RH-TRU waste less than or equal to 1000 rem per hour (10 Sievert per hour) is eligible for disposal at the WIPP~~ (DOE 1996a)~~. ***Also, t***~~T~~o meet the requirements as set forth in the ~~WIPP Land Withdrawal Act (~~LWA~~) (U.S. Congress 1992b)~~, the total ~~combined volumes of CH-TRU and RH-TRU waste are not to exceed~~***capacity of WIPP by volume is*** 6.2 million ~~cubic feet~~ ***ft***^{3} (175,564 ~~cubic meters~~ ***m***^{3}) ***of TRU waste***. Moreover, the LWA also specifies that the emplaced RH-TRU waste is not to exceed a total activity of 5.1 million ~~curies~~ ***Ci*** (~ 18.9 × 10^{16} Becquerel) and a total activity concentration of 23 ~~curies~~ ***Ci*** per liter ***maximum activity level*** (averaged over the volume of the canister). No more than five percent of the emplaced RH-TRU waste may exhibit a dose rate in excess of 100 rem per hour (1 Sievert per hour).

~~The last category of waste to be defined is TRU mixed waste, that is, waste that contains both TRU radioactive components and hazardous components as defined in the New Mexico Administrative Code (see NMAC in the Bibliography). Hazardous components of TRU mixed waste to be managed at the WIPP facility are designated in Part A of the WIPP Resource~~

~~Conservation and Recovery Act (RCRA) permit application. The Waste Analysis Plan (WAP) (see Appendix WAP) describes measures to ensure that the wastes received at the WIPP facility are within the scope of the Part A. As stated in Appendix WCA (Section WCA.4.1.3), only four of 60 organic compounds in the waste are expected to have an effect on actinide mobility. None of the four (acetate, citrate, oxalate, and ethylenediaminetetracetate [EDTA]) are listed in Part A of the WIPP RCRA permit application. Consequently, this component of TRU waste is omitted from further discussion in this chapter.~~

4.1.1 Sources of TRU Waste

The DOE's TRU waste, as described in this chapter, is derived primarily from ~~plutonium~~ ***Pu*** fabrication and ~~re~~processing, research and development (R&D), decontamination and decommissioning (D&D), and environmental restoration (ER) programs at ~~various~~ ***DOE*** sites. Most TRU waste generated at the ~~DOE~~ ***TRU waste*** sites results from specific processes and activities that are well defined and well controlled, enabling ~~the DOE~~ ***the sites*** to characterize the waste on the basis of acceptable knowledge ~~of~~***concerning*** the process, input ~~raw~~ materials, and ~~output~~ finished products. Some examples of these operations include

- Production of nuclear products. Production of nuclear products includes reactor operation, radionuclide separation and finishing, and weapons fabrication and manufacturing. The majority of the TRU waste was generated by weapons fabrication and radionuclide separation and finishing processes. More specifically, wastes typically consist of TRU-contaminated material derived from chemical processes, air and liquid filtration, casting, machining, cleaning, product quality sampling, analytical activities, and maintenance and refurbishment of equipment and facilities.

- ~~Plutonium~~ ***Pu*** recovery. ~~Plutonium~~ ***Pu*** recovery wastes are TRU-contaminated items and materials from the recovery of valuable ~~plutonium~~ ***Pu***, including contaminated molds, metals, glass, plastic~~s~~ ***materials***, rags, salts used in electrorefining, precipitates, firebrick, soot, and filters.

- R&D. R&D projects include a variety of hot-cell or glove-box activities that often simulate full-scale operations described above, producing similar TRU wastes. Other types of R&D projects include metallurgical research, actinide separations, process demonstrations, and chemical and physical properties determinations.

- D&D. Facilities and equipment that are no longer needed or usable are decontaminated and decommissioned, resulting in TRU wastes consisting of scrap materials, cleaning agents, tools, piping, filters, ~~p~~***P***lexiglas, gloveboxes, concrete rubble, asphalt, cinder blocks, and other building materials. This is expected to be the largest category by volume of TRU waste to be generated.

- ***ER Programs. The implementation of environmental restoration programs at various DOE sites results in the generation of a variety of materials including contaminated soil, building materials and equipment.***

Operations carried out in glove boxes and hot cells generate both combustible and noncombustible wastes. Combustible waste contains mixtures of paper, plastic~~s~~ ***materials***, rags, cloth clothing, and wood resulting from ~~plutonium~~ ***Pu*** operations. Cloth and paper wipes are used to clean parts and glove boxes. Depending on the operations, damp combustibles are usually used and then wrung out, drained, or dried. Noncombustibles consist primarily of glass and metal. Much of this waste is laboratory equipment and glassware from R&D activities.

Filters are sometimes combinations of combustibles and non-combustibles and come from a variety of sources including high-efficiency particulate air (HEPA) filters, filter media, processed filter media, and prefilters. Prefilters and HEPA filters are used on all ventilation intake and exhaust systems associated with ~~plutonium~~ ***Pu*** operations. Filter frames can be either wood, aluminum, or stainless steel; and the filter media may be paper, Fiberglass, Nomex, or similar material. Filter media are generated from splitting absolute dry box and HEPA filters apart from their frames in the ~~plutonium~~ ***Pu*** process areas. Loose particulate materials that are dislodged from the filters are stabilized and packaged separately from the media. Filter media are packaged in plastic bottles or bags. Filter media may also be mixed with portland cement to neutralize any residual nitric acid.

Graphite waste is produced from molds that are broken, cleaned, or scraped in glove boxes to remove excess ~~plutonium~~ ***Pu***. Graphite is a uniform, well-defined material.

Benelex and Plexiglas are well-defined materials that are used as neutron shielding material and in glove-box construction. Benelex consists mainly of cellulose with residual amounts of the phenolic resin. Plexiglas is a polymethyl methacrylate polymer used for glove-box windows and is generated as waste during the change-out of the glove-box windows.

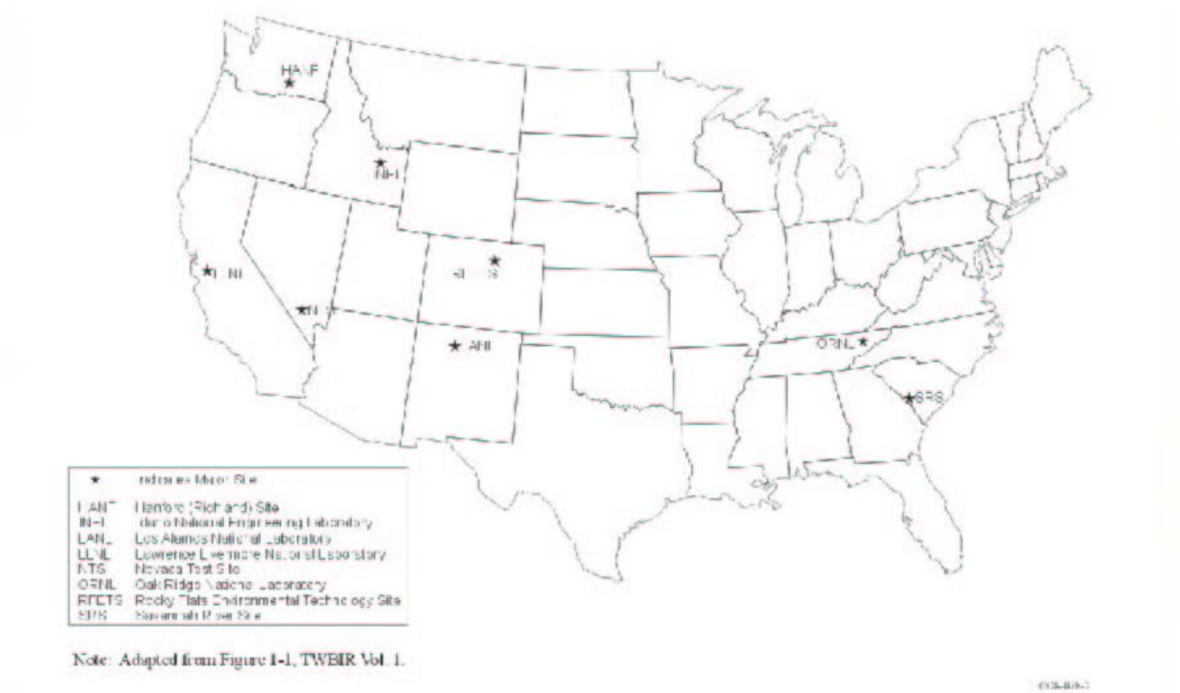
Inorganic process solids include residues from evaporator and other types of storage tanks, grit, firebrick fines, ash, salts, metal oxides, and filter sludge. This waste is typically solidified in portland- or gypsum-based cements.

Soil, asphalt, and sand contaminated from spills or generated from D&D activities may also be present in the waste.

To isolate the radiological and hazardous ~~co-~~contaminants of these wastes from humans and the environment during handling and other life-cycle operations, a primary confinement barrier is used. Both CH-TRU and RH-TRU waste at the WIPP facility will be managed using payload containers that meet the requirements of the U.S. Department of Transportation (DOT) for Type A or equivalent containers (DOE 1995~~d~~***c***). The term payload container in this document refers to drum, drum overpack, canister, standard waste box, or ten-drum overpack unit. Internal to these payload containers may be other secondary layers of confinement, including rigid plastic inner liners and multiple layers of plastic bagging. Each container is vented using one or more filters.

4.1.2 TRU Waste ~~Generator and Storage~~ Sites

The major ~~generator and storage~~ ***TRU waste*** sites ***(referred to as large quantity sites [LQSs])*** ~~(see Figure 4-2)~~ that are ***in the process of shipping or are*** planning to ship their TRU waste to the WIPP for disposal include



~~**Figure 4-2. U.S. DOE TRU Waste Generator and Storage Sites**~~

- ~~Richland~~ Hanford ***Richland*** ~~Site (HANF)~~ ***(Hanford-RL); TRU wastes at Hanford under the purview of the DOE Richland Operations Office***
- ***Hanford River Protection (Hanford-RP); TRU wastes at Hanford under the purview of the DOE Office of River Protection***
- Idaho National Engineering ***and Environmental*** Laboratory (INE***E***L)
- ~~Lawrence Livermore National Laboratory (LLNL)~~
- Los Alamos National Laboratory (LANL)
- ~~Nevada Test Site (NTS)~~
- Oak Ridge National Laboratory (ORNL)
- Rocky Flats Environmental Technology Site (RFETS)
- Savannah River Site (SRS)

Since certification, Lawrence Livermore National Laboratory (LLNL) and the Nevada Test Site (NTS) have been recategorized as small quantity sites (SQSs). In addition, TRU waste at the Hanford Reservation has been divided into two categories: (1) TRU waste overseen by the DOE Richland Operations Office (Hanford-RL) which corresponds to the TRU waste reported by Hanford for the CCA inventory estimate, and (2) TRU waste overseen by the DOE Office of River Protection (Hanford-RP). The DOE Office of River Protection may send both CH-TRU

and RH-TRU waste to the WIPP. The Hanford-RP waste was not included in the Hanford Reservation waste reported for the CCA but is included in the 2004 CRA. The inventories for the SQSs and LQSs are reported in Appendix DATA, Attachment F, Annex J.

At the time of the CCA, ~~The~~ INE***E***L, LANL, and RFETS ***were*** ~~are~~ expected to be among the first of the major ~~generator and storage~~ ***TRU waste*** sites to begin shipping TRU waste to the WIPP. ***As of September 30, 2002, the WIPP had received 1,255 shipments totaling 7,716 m^3 (2.7×10^5 ft^3) of CH-TRU waste, primarily from INEEL, LANL, and RFETS. SRS and Hanford-RL have also made shipments. Emplaced, stored, and projected waste volumes, by TRU waste site, are provided in Tables 4-1 and 4-2. No RH-TRU waste has yet been shipped to the WIPP.***

Table 4-1. Emplaced, Stored, and Projected CH-TRU Waste Inventory as of September 30, 2002[1]

TRU Waste Site	Emplaced CH-TRU Volume (m^3)	Stored CH-TRU Inventory (m^3)	Projected CH-TRU Inventory (m^3)	Disposal CH-TRU Inventory[3] (m^3)
Hanford-RL	9.8×10^1	1.3×10^4	1.3×10^4	4.1×10^4
Hanford-RP	0.0×10^0	3.9×10^3	0.0×10^0	3.9×10^3
INEEL	2.9×10^3	6.1×10^4	1.2×10^2	6.4×10^4
LANL	2.7×10^2	1.2×10^4	3.3×10^3	1.9×10^4
ORNL	0.0×10^0	0.0×10^0	4.5×10^2	9.5×10^2
RFETS	4.3×10^3	5.4×10^3	2.7×10^3	1.5×10^4
SRS	2.0×10^2	1.3×10^4	2.4×10^3	1.8×10^4
SQS[2]	0.0×10^0	1.2×10^3	2.8×10^3	7.1×10^3
Totals	7.7×10^3	1.1×10^5	2.5×10^4	1.7×10^5

Source: Appendix DATA; Attachment F.

[1] *Volume reported by the TRU waste sites as of September 30, 2002. It is not scaled to the disposal volume.*

[2] *Includes currently identified SQSs; at some TRU waste sites, determinations that waste is generated through defense activities have yet to be made. Inventories for those TRU waste sites are not included in this number.*

[3] *This is the TRU waste site inventory scaled as follows: emplaced + stored + 2.11 (projected).*

As ~~the other major~~ ***TRU waste*** sites develop the prerequisite certification programs required for TRU waste disposal at the WIPP, they too will commence shipping waste to the WIPP. Effective implementation by the ~~generator and storage~~ ***TRU waste*** sites of ~~the~~ DOE ~~Carlsbad Area Office (CAO)~~ Quality Assurance Program Document (QAPD) (see ***CCA*** Appendix QAPD) is a prerequisite for granting TRU waste certification authority to the ***TRU waste*** sites. A letter granting such authority will specify the date that the subject ***TRU waste*** sites effectively implemented their characterization and certification program. Any limitations imposed on the certification authority will be described in the letter.

As part of the certification for the project (63 FR 27404), the EPA promulgated a new section to the rule, Title 40 CFR 194.8. Section 194.8 establishes the approval process that must be completed before an individual TRU waste site may ship waste to the WIPP. The EPA approval considers the application of QA provisions to the waste-characterization process, including EPA audits or inspections DOE audits of TRU waste site waste-characterization

Table 4-2. Stored and Projected RH-TRU Waste Inventory as of September 30, 2002[1]

TRU Waste Site	Stored RH-TRU Inventory (m^3)	Projected RH-TRU Inventory (m^3)	Disposal RH-TRU Inventory[3] (m^3)
Hanford-RL	3.8×10^2	9.4×10^3	2.0×10^3
Hanford-RP	4.5×10^3	0.0×10^0	4.5×10^3
INEEL	2.2×10^2	0.0×10^0	2.2×10^2
LANL	1.2×10^2	0.0×10^0	1.2×10^2
ORNL	0.0×10^0	6.6×10^2	1.1×10^2
RFETS	0.0×10^0	0.0×10^0	0.0×10^0
SRS	0.0×10^0	2.3×10^1	4.0×10^0
SQS[2]	9.5×10^1	3.3×10^2	1.5×10^2
Totals	5.3×10^3	1.0×10^4	7.1×10^3

Source: Appendix DATA; Attachment F.

[1] *Volume reported by the TRU waste sites as of September 30, 2002. It is not scaled to the disposal volume.*

[2] *Includes currently identified SQSs; at some TRU waste sites, determinations that waste is generated through defense activities have yet to be made. Inventories for those TRU waste sites are not included in this number.*

[3] *This is the TRU waste site inventory scaled as follows: emplaced + stored + 0.172 (projected)*

programs, and provides for public review and comment. Section 194.8 also applies to the application of process knowledge by the TRU waste sites for waste characterization. The DOE must also implement a system of controls at the TRU waste sites to confirm that the total amount of each waste component emplaced in the disposal system will not exceed established limiting values.

Current information on the EPA approval of TRU waste sites to ship waste to WIPP consistent with the requirements of section 194.8 is provided in Table 4-3. In addition to these TRU waste sites, the Central Characterization Project (CCP) has been initiated by DOE and operates using mobile waste characterization equipment. As of September 30, 2003, CCP was operating and approved to ship waste from SRS, Argonne National Laboratory – East (ANL-E), and Nevada Test Site (NTS).

Table 4-3. Approved TRU Waste Site QA and Waste Characterization Programs as of September 30, 2002

TRU Waste Site
Hanford-RL
INEEL
LANL
RFETS
SRS

Source: WWIS

In addition to the major ~~generator and storage~~ ***TRU waste*** sites, there are currently numerous ~~small-quantity sites (~~SQSs~~)~~ planning to dispose TRU waste at the WIPP. Options to facilitate disposal of the SQS waste at the WIPP include either direct shipment to the WIPP after on-site characterization and certification or shipment to an interim ~~site~~***facility*** for performing waste consolidation, treatment, and/or characterization and certification in accordance with WIPP requirements. The current list of SQSs ***that plan to ship directly to WIPP or to a larger site pending shipment to WIPP*** includes***:***

- ~~Ames Laboratory~~
- Argonne National Laboratory – East ***(ANL-E),***
- Argonne National Laboratory – West ***(ANL-W),***
- Battelle Columbus Laboratories ***(BCL),***
- Bettis Atomic Power Laboratory ***(BAPL),***
- Knolls Atomic Power Laboratory ***(KAPL),***
- ***Knolls Atomic Power Laboratory-Nuclear Fuel Services (KAPL-NFS),***
- ***Lawrence Berkeley National Laboratory (LBNL),***
- ***Lawrence Livermore National Laboratory (LLNL),***
- ~~Massachusetts Institute of Technology~~
- ~~National Institute of Standards and Technology~~
- ***Nevada Test Site (NTS),***
- Paducah Gaseous Diffusion Plant ***(PGDP)***,
- Sandia National Laboratories/NM (SNL)***, and***
- ~~Site A/Plot M (near Chicago, Illinois)~~
- U.S. Army Material Command ***(USAMC).***

As waste-management plans evolve at these TRU waste sites, the list is expected to change. Some TRU waste sites, for example, may ship waste to alternate facilities for processing pending shipment to WIPP. However, as of September 30, 2002, plans for shipment to alternate facilities had not been finalized. The inventories for these SQSs are reported in Appendix DATA, Attachment F, Annex J.

Six SQSs have shipped their waste to an LQS. These include:

- ***ARCO Medical Products Company (ARCO) – Shipped to LANL,***

- Energy Technology Engineering Center ***(ETEC) – Shipped to Hanford-RL,***
- Mound Plant ***– Shipped to SRS,***
- ~~University of~~ Missouri University Research Reactor ***(MURR) – Shipped to ANL-E,***[2]
- Pantex Plant ***- Shipped to LANL, and***
- Teledyne Brown Engineering ***– Shipped to RFETS.***

The inventories for these several SQSs are included in the LQS inventories.

Several SQSs plan to ship waste to WIPP, but their waste had not been determined to be defense waste as of September 30, 2002. These include:

- ***Babcock & Wilcox – Nuclear Engineering Services (B&W-NES),***
- ***Brookhaven National Laboratory (BNL),***
- ***Framatome,***
- General Electric Vallecitos Nuclear Center ***(GE-VNC),***
- ~~Special~~ ***Separations*** Process Research Unit ***(SPRU), and***
- West Valley Demonstration Project ***(WVDP).***

The inventories for these SQSs are reported in Appendix DATA, Attachment F, Annex I. ~~As more SQSs are identified, they will be added to this list.~~

~~Figure 4-2 shows the geographic locations of the major generator and storage sites.~~

4.1.3 TRU Waste Inventory

A summary of the quantity of stored and projected TRU waste and TRU waste components is contained in ~~the TWBIR (see Appendix BIR)~~ ***Appendix DATA, Attachment F***. ~~The TWBIR~~ ***Appendix DATA, Attachment F*** documents ***DOE's current understanding of*** the total inventory of ~~DOE~~ TRU waste and includes both the TRU waste that is planned to be disposed at the WIPP site and the TRU waste that ~~will not~~***is not planned to*** be sent to WIPP ***as of September 30, 2002***. Only the WIPP portion of the TRU waste inventory is used in ~~performance assessment~~ ***PA*** calculations that support the development of ***CRA-2004*** ~~this compliance application~~.

In preparing CRA-2004, DOE initiated a "data call" to obtain current waste inventory information from its TRU waste sites similar to the data call that was conducted prior to 1995 in preparation for the CCA. Each TRU waste site was asked to review previous data submitted

[2] ***Shipment of MURR waste to ANL-E occurred after September 30, 2002.***

regarding its TRU waste and revise those data based on current knowledge of waste at the TRU waste site.

The results of the "data call" were compiled in a database called the Transuranic Waste Baseline Inventory Database (TWBID) Revision 2.1. Data from the TWBID are reported in detail in Appendix DATA, Attachment F and are summarized here. For the CCA, there were essentially two categories of waste: stored waste and projected waste (see CCA Section 4.1.3.1 for definitions). For CRA-2004, there are three categories of waste: emplaced waste, stored waste, and projected waste (see Section 4.1.3.1 for definitions).

For ~~the~~ DOE to consider disposal system performance at full capacity, it ***is***~~was~~ necessary to scale the waste volumes reported by the ***TRU waste*** sites ~~in the TWBIR~~. This is because the ***volume identified by the TRU waste sites is less than the available volume of the repository, 175,564 m^3 (6.2 million ft^3)*** ~~TWBIR does not identify 6.2 million cubic feet (175,564 cubic meters) of existing or projected waste~~. The projected inventory ***reported by the TRU waste sites*** ~~in the TWBIR~~ is scaled ~~if needed~~, to achieve a disposal ~~limit~~ ***inventory*** equal to the ~~design limit~~ ***repository volume specified by the WIPP LWA***. ***The repository volume remains unchanged.*** ~~For RH-TRU waste volume, the TWBIR identified a sufficient quantity of retrievably stored waste, such that scaling is not required for WIPP's RH-TRU waste disposal limit of 250,000 cubic feet (7,079 cubic meters).~~

As of September 30, 2002, the TRU waste sites reported a total CH-TRU waste stored inventory of 1.1×10^5 m^3 (3.9×10^6 ft^3) and a total RH-TRU waste stored inventory of 5.3×10^3 m^3 (1.9×10^5 ft^3) (see Tables 4-1 and 4-2). This is DOE's current estimate of the stored inventory destined for WIPP. In addition to identified stored volumes, the TRU waste sites project that an additional 2.5×10^4 m^3 (8.8×10^5 ft^3) of CH-TRU waste and 1.0×10^4 m^3 (3.5×10^5 ft^3) of RH-TRU waste will be generated in the future.

The stored CH-TRU waste inventory currently reported by the TRU waste sites is larger than the same inventory reported in the CCA. SRS, RFETS, Hanford, and INEEL all reported increased stored CH-TRU volumes based on new information about their waste and increased accessibility to the waste. The Hanford-RP waste was not included in the previous Hanford estimate used in the CCA, although the TWBIR indicated that it might be included in the WIPP inventory at some time in the future. Several SQSs (BCL, BAPL, KAPL, and PGDP) have identified small inventories of CH-TRU stored waste since the CCA was submitted.

While the TRU waste sites are reporting larger quantities of CH-TRU waste in storage, they are reporting smaller quantities of CH-TRU waste in the projected category. The shift from reporting waste as stored rather than projected reflects progress at the TRU waste sites towards cleanup and closure.

Overall, the anticipated CH-TRU waste inventory (stored plus projected) remaining for disposal at WIPP has decreased by an amount that is essentially equivalent to the inventory of CH-TRU waste emplaced in the repository. The total inventory (emplaced plus anticipated) of CH-TRU waste is less than the disposal limit of 168,485 m^3. Therefore, for PA calculations, the CH-TRU waste projected inventory is scaled to produce a disposal inventory equal to the repository limit.

The stored RH-TRU waste inventory currently being reported by the TRU waste sites represents an increase in the stored RH-TRU waste inventory reported in the CCA inventory estimate. Hanford-RP and Hanford-RL both reported more stored RH-TRU waste based on new information about it and increased accessibility to the waste. ANL-E, BAPL, and SNL added small amounts of stored RH-TRU waste to their inventories. ORNL moved all of their RH-TRU waste into the projected waste category because they plan to process the waste using segregation, size reduction, and evaporative drying. As its entire RH-TRU waste inventory will be processed, the ORNL RH-TRU waste is reported only as a projected inventory.

While the stored RH-TRU estimates have increased in the CRA-2004, the projected RH-TRU inventory estimates for CRA-2004 are less than what they were in the CCA inventory estimate. The greatest decrease in projected RH-TRU waste inventory was reported by Hanford-RL. The TRU waste sites report a decrease in the anticipated (stored plus projected) RH-TRU waste inventory for disposal at WIPP, a drop from over 2.6×10^4 m^3 ***(***9.2×10^5 ft^3***) reported in the CCA to about*** 1.0×10^4 m^3 ***(***3.5×10^5 ft^3***) as of September 30, 2002.***

Nevertheless, the anticipated volume of RH-TRU reported for the CRA-2004 is greater than the repository limit for RH-TRU. Therefore, for PA calculations, the RH-TRU projected inventory is scaled down so the total disposal volume of RH TRU equals the repository limit of 7,079 m^3 ***(***2.5×10^5 ft^3***).***

~~Although updates are made to the TWBIR based on new information received from ongoing waste identification and characterization activities at the generator and storage sites, the TWBIR is an inventory report and not a summary of TRU waste characterization data. For waste shipped to the WIPP, waste characterization data associated with each container are entered into the WWIS for tracking purposes. A description of the WWIS is given in Section 4.3.2.~~

In support of ~~performance assessment~~ ***the CCA PA***, it was necessary for ~~the~~ DOE to roll-up waste information on a repository scale. To this end, the TWBIR describes a process for grouping individual waste streams with similar physical and chemical properties into waste profiles, based on the waste matrix code (WMC) assigned by ~~the~~ DOE TRU waste ~~generator and storage~~ sites. ***The same process was followed for CRA-2004 (see Appendix DATA, Attachment F and Appendix TRU WASTE, Section TRU WASTE-2.0).*** Waste profiles with similar WMCs are ~~then~~ combined across the DOE TRU waste system to provide estimated total volumes and total waste material parameters (WMPs). WMPs and waste components (as used in ~~40 CFR §~~ ***Section*** 194.24) are synonymous. Individual waste streams are evaluated to estimate the occurrence and quantities of ~~nonradioactive~~ WMPs (for example, cellulosics ***materials***, ~~plastics,~~ iron-base metal and alloys, etc.) and are identified in ***Appendix TRU WASTE, Section TRU WASTE-2.0*** ~~Appendix WCA~~ as having either a significant or negligible effect on the performance of the WIPP repository. ~~See Table 4-1 for a listing of these waste components and their associated characteristics.~~

~~**Table 4-1. Waste Characteristics and Components That are Expected to Have Significant and Negligible Effects**~~

~~**Characteristic**~~	~~**Component**~~	~~**Effect on Performance**~~
~~**Characteristics and Components Expected to Have a Significant Effect**~~		
~~radioactivity in curies of each isotope~~	~~radioactivity in curies of each isotope~~	~~used in calculation for normal release~~
~~TRU radioactivity at closure~~	~~á-emitting TRU radionuclides, $t_{1/2}$ > 20 years~~	~~determines waste unit factor~~
~~solubility~~	~~radionuclides~~	~~actinide mobility~~
~~colloid formation~~	~~radionuclides, cellulose, soils, plastics, rubber~~	~~actinide mobility~~
~~redox state~~	~~radionuclides~~	~~actinide mobility~~
~~redox potential~~	~~ferrous metals~~	~~actinide oxidation state; actinide mobility~~
~~gas (H_2) generation~~	~~ferrous metals~~	~~increase in H_2 pressure~~
~~microbial substrate: CH_4 generation~~	~~cellulose~~	~~increase in gas pressure~~
~~microbial substrate: CH_4 generation~~	~~plastics, rubber~~	~~increase in gas pressure~~
~~particle diameter~~	~~solid waste components~~	~~spalling release~~
~~microbial nutrients: CH_4 generation~~	~~sulfates~~	~~increase in gas pressure~~
~~microbial nutrients: CH_4 generation~~	~~nitrates~~	~~increase in gas pressure~~
~~compressibility and shear strength~~	~~solid waste components~~	~~effect on creep closure, cuttings, caving, spalling~~
~~**Characteristics and Components Expected to Have a Negligible Effect**~~		
~~permeability~~	~~solid waste components~~	~~negligible effect on brine movement, gas storage~~
~~porosity~~	~~solid waste components~~	~~negligible effect on brine movement~~
~~microbial nutrients, CO_2 generation~~	~~sulfates~~	~~negligible: MgO reacts with CO_2~~
~~microbial nutrients, CO_2 generation~~	~~nitrates~~	~~negligible: MgO backfill reacts with CO_2~~
~~microbial substrate: CO_2 generation~~	~~cellulose~~	~~negligible: MgO backfill reacts with CO_2~~
~~microbial substrate: CO_2 generation~~	~~plastics, rubber~~	~~negligible: MgO backfill reacts with CO_2~~
~~gas generation~~	~~water in the waste~~	~~enhances initial gas generation~~

4.1.3.1 Inventory Terminology

The following definitions are provided to help clarify the information contained in this chapter. Most of the definitions from the CCA have been included in this section without change. For CRA-2004, some definitions have been refined and others have been added.

Anticipated waste inventory – The sum of the stored and projected TRU waste inventories at DOE TRU waste sites that have not been emplaced at WIPP.

As-Generated Waste – The chemical and physical status of waste when it is generated. The as-generated term applies to both stored and ~~future~~ ***projected*** waste.

Disposal Inventory – The volume used for CRA-2004 PA calculations. The LWA sets the total amount of TRU waste allowed in the WIPP at 175,564 m^3 (6,200,000 ft^3).

The "Agreement for Consultation and Cooperation" limits the RH-TRU inventory to 7,079 m^3 (250,000 ft^3) (DOE/NM 1981).

~~Disposal Inventory – The inventory volume defined for WIPP emplacement to be used for performance assessment calculations is the disposal inventory. The LWA defines the total amount of TRU waste allowed for disposal in the WIPP as 6.2 million cubic feet (175,564 cubic meters) (U.S. Congress 1992b). Consistent with 40 CFR § 194.24(g), this is the maximum quantity of TRU waste which will be emplaced in the repository. The WIPP limit of RH-TRU inventory is 250,000 cubic feet (7,079 cubic meters), as set by the Consultation and Cooperation Agreement between the DOE and the state of New Mexico (DOE and state of New Mexico 1981).~~

Emplaced waste inventory – Waste that has been placed in the repository as of September 30, 2002.

Final Waste Form – The expected physical form of a waste stream. The use of the final waste form helps to group waste streams that are expected to have similar physical and chemical properties at the time of disposal. Waste is assigned to one of 11 final waste forms: solidified inorganics, salt, solidified organics, soils, uncategorized metal, lead/cadmium metal, inorganic non-metal, combustible, graphite, heterogeneous, and filter.

~~Final Waste Form – The final waste form of a waste stream consists of a series of WMCs that are grouped together, which for performance assessment purposes have similar physical and chemical properties. The final waste form applies to both stored and projected inventory. Table 4-2 presents anticipated WMCs for TRU waste and indicates the final waste form typically assigned to each WMC for the TWBIR. There are 11 final waste forms used in the TWBIR. Each of the 11 final waste forms described in Table 4-2 identify a material property common to the numerous waste streams grouped under it.~~

September 30, 2002 (the inventory date) – The date used for determining the emplaced waste inventory included in CRA-2004 and the date TRU waste sites have used as the basis for their revised inventory estimates.

Projected Inventory – The part of the TRU inventory that has not been generated but is ~~currently~~ estimated to be generated at some time in the future by the TRU waste ~~generator and storage~~ sites~~, is known as projected inventory~~. The projected inventory is the same as the to-be-generated waste referred to in ~~40 CFR §~~ ***Section*** 194.24(a).

Stored Inventory – ***Also referred to as "retrievably stored" inventory.*** The part of the ***anticipated waste inventory stored in such a fashion that it can be readily retrieved. Retrievably stored waste includes waste stored at the TRU waste sites since the early 1970s in buildings or berms with earthen cover and does not include waste generated prior to 1970. Retrievably stored waste also includes waste in underground storage tanks, ponds, and as***

~~Table 4-2. WMCs and Their Anticipated Final Waste Form~~

~~Final Waste Form~~	~~WMCs~~
~~Solidified Inorganics~~	~~L1000, L1100, L1110, L1120, L1130, L1140, L1190, 1200, L1210, L1220, L1230, L1240, L1290, S3000, S3100, S3110, S3111, S3112, S3113, S3115, S3118, S3119, S3120, S3121, S3122, S3123, S3124, S3125, S3129, S3130, S3131, S3132, S3139, S3144, S3150, S3160, S3190, S3900, X6000, X6200, X6300, X6400, X6900, X7300, X7500, X7510, X7520, X7530, X7590, L9000, Z1110, Z1190~~
~~Salt~~	~~S3000, S3140, S3141, S3142, S3143, S3149, S3900, L9000~~
~~Solidified Organics~~	~~L2000, L2100, L2110, L2120, L2190, L2200, L2210, L2220, L2290, L2900, S3000, S3114, S3200, S3210, S3211, S3212, S3219, S3220, S3221, S3222, S3223, S3229, S3230, S3290, S3900, S5340, X6000, X6100, X6190, X6900, L9000, Z1110, Z1190~~
~~Soils~~	~~S4000, S4100, S4200, S4300, S4900~~
~~Uncategorized Metal (Metal Waste Other Than Lead and/or Cadmium)~~	~~S3116, S5000, S5100, S5110, S5111, S5119, S5190, X6200, X7000, X7290, X7400, X7430, X7490, X7520, Z1140, Z1190, Z2100~~
~~Lead and Cadmium Metal~~	~~S5000, S5100, S5110, S5112, S5113, S5119, S5190, X6220, X7000, X7200, X7210, X7211, X7212, X7219, X7220, X7290, X7400, X7410, X7420, X7490, Z2100~~
~~Inorganic Nonmetal~~	~~S3117, S3118, S3160, S5000, S5100, S5120, S5121, S5122, S5123, S5124, S5125, S5126, S5129, S5190, Z1120, Z1150, Z1190~~
~~Combustible~~	~~S5000, S5300, S5310, S5311, S5312, S5313, S5319, S5320, S5330, S5390, Z1130, Z1190, Z1200~~
~~Graphite~~	~~S5000, S5126~~
~~Heterogeneous~~	~~S5000, S5100, S5400, S5420, S5440, S5450, S5460, S5490, X7520, Z2900~~
~~Filter~~	~~S5000, S5410~~

~~Source: Adapted from TWBIR, Revision 3, Table 2-1.~~
~~+ WIPP is limited to 7079 cubic meters of RH TRU waste.~~

decontamination and decommissioning material identified for disposal that requires retrieval at the TRU waste sites.

Scaling – The process of adjusting, if needed, the projected inventory to the ~~design~~ ***repository*** limit (disposal inventory) is called scaling. Scaling is needed in ~~performance assessment~~ ***PA*** to model the WIPP repository at full capacity (6.2 million ~~cubic feet~~ ***ft^3*** ~~by statute~~ ***as set by the LWA***). ***The scaling factor used in the CRA-2004 for CH-TRU waste is 2.11. This is only applied to the projected component of a waste stream. The scaling factor for RH-TRU waste is 0.172, which is also only applied to the projected component of a waste stream.***

~~Based on the inventory identified in Revision 3 of the TWBIR, the scaling factor is calculated to be 2.05 (see Appendix BIR [Revision 3, 2-3]).~~

~~Stored Inventory + Projected Inventory (2.05) = Disposal Inventory~~

Scaled Inventory – Synonymous with disposal inventory. The scaled inventory is the volume that fills WIPP capacity and is used for PA calculations. This volume is calculated as the sum of the disposal volumes for all WIPP-eligible waste streams after application of RH-TRU waste and CH-TRU waste scaling computations to each WIPP-eligible projected TRU waste stream.

WIPP Waste Inventory – The sum of the emplaced waste inventory and the anticipated waste inventory.

Waste Characteristic – Section 194.2 defines waste characteristic as a property of the waste that has an impact on the containment of waste in the disposal system.

Waste Component - Section 194.2 defines waste component as an aspect of the total inventory of the waste that influences a waste characteristic.

Waste Matrix Codes (WMCs) – Codes developed by DOE, in response to the Federal Facility Compliance Act (~~U.S. Congress 1992a~~ ***Public Law 102-386***), ~~as a methodology~~ to aid in categorizing mixed waste streams in the DOE system into a series of five-digit alphanumeric codes (for example, S5400; Heterogeneous Debris) that represent different physical and chemical matrices. Using guidance prepared by ~~the~~ DOE (DOE 1995~~f~~***e***), the WMC is assigned by the TRU waste ~~generator and storage~~ sites for all mixed waste streams and ~~some~~ unmixed waste streams. ~~The TWBIR~~ ***CRA-2004*** has adopted this system to remain consistent with common terminology used by the DOE ***TRU*** waste ~~generator and storage~~ sites. WMCs are verified with radiographic examination (using either real-time radiography [RTR] or an equivalent methodology) and/or visual examination.

Waste Stream Profile – This is a description of a CH-TRU or RH-TRU waste stream. ~~Examples of information included in a w~~ ***W***aste stream profile***s include*** ~~are~~

- waste stream description***;***
- waste stream source description, ***waste stream identification codes, final waste form;***
- ~~currently used identification codes, including the DOE TRU waste site matrix description;~~
- ~~final waste form assigned by the TRU waste generator and storage sites;~~
- as-generated waste form volumes and final waste form volumes,
- estimated ~~minimum,~~ average ***values for WMP densities;*** ~~, and maximum weights of waste components per cubic meter of final waste form volume (for example, iron-base metal and alloys, aluminum-base metal and alloys, cellulosics, etc.)~~;
- identification of whether the waste is CH-TRU or RH-TRU;
- final waste form radionuclide inventory (activity in ~~curies~~ ***Ci*** per cubic meter); and
- comments provided by the TRU waste ~~generator and storage~~ sites to further explain the data provided.

~~Site-Specific Waste Profile – This represents a final waste form at a particular DOE TRU waste generator and storage site. That is, one or more waste stream profiles at a particular DOE TRU waste site that have been placed in the same final waste form are summarized in the site-specific waste profile. Examples of information included in a site-specific waste profile are~~

- ~~DOE TRU waste generator and storage site identification;~~
- ~~final waste form that the profile represents;~~
- ~~listing of the waste streams (represented by waste stream profiles provided by the TRU waste generator and storage sites) that are included in the site-specific waste profile, including the waste stream identification;~~
- ~~final waste form volumes (both stored and currently projected); and~~
- ~~summary of minimum, average, and maximum weights of WMPs per cubic meter of final waste form volume on a site basic (for example, iron-base metal and alloys, aluminum-base metal and alloys, cellulosics, etc.).~~

WIPP Waste Profile – The WIPP waste profile represents a summary of TRU wastes at all ~~DOE~~ TRU waste ~~generator and storage~~ sites that have an identical final waste form. ~~Examples of information included in a~~ WIPP waste profile***s include***: ~~are~~

- the final waste form that the profile represents;
- ***a*** listing of the ~~DOE~~ TRU waste sites (represented by the same final waste form) that are included in the WIPP waste profile~~,~~***;*** ~~including the name of the DOE TRU waste site;~~
- final waste form volumes of stored and ~~currently~~ projected waste for each ***TRU waste*** site***;*** and
- ***a*** summary of ***the WMP*** ~~minimum, volume-weighted~~ average ***densities***~~, and maximum weights of WMPs per cubic meter of final waste form volume on a WIPP basis (for example, iron-base metal and alloys, aluminum-base metal and alloys, cellulosics~~, ~~etc.)~~.

Waste Material Parameters (WMP***)*** – This is one or more of the ~~nonradioactive~~ TRU waste stream constituents. The 12 WMPs have been grouped by their chemical and physical properties as shown in the following list.

<u>Inorganics</u>

- Iron-based metals and alloys — includes iron and steel alloys in the waste and does not include the waste container materials.
- Aluminum-based metals and alloys.
- Other metal and alloys — includes all other metals found in the waste materials (for example, copper, lead, zirconium, tantalum, etc.). The lead portion of lead rubber gloves and aprons is also included in this category.
- Other inorganic materials — includes inorganic nonmetal waste materials such as concrete, glass, firebrick, ceramics, sand, and inorganic sorbents.

- Vitrified materials — includes waste that has been melted or fused at high temperatures with glass-forming additives such as soil or silica to form a homogeneous glass-like matrix.

Organics

- Cellulosic ***Material***s — includes those materials generally derived from high-polymer plant carbohydrates. Examples are paper, cardboard, kimwipes, wood, cellophane, cloth, etc.
- Rubber — includes natural or synthetic elastic latex materials. Examples are Hypalon, neoprene, surgical gloves, leaded-rubber gloves (rubber part only), etc.~~)~~
- Plastics — includes generally synthetic materials, often derived from petroleum feedstock. Examples are polyethylene, polyvinylchloride, Lucite, Teflon, etc.~~.~~

Solidified Materials

- Inorganic matrix — includes any homogenous materials consisting of sludge or aqueous-based liquids that are solidified with cement, Envirostone, or other solidification agents. Examples are wastewater treatment sludge, cemented aqueous liquids, inorganic particulates, etc.~~)~~
- Organic matrix — includes cemented organic resins, solidified organic liquids, and sludges.
- Cement — includes the cement used in solidifying liquids, particulates, and sludges.

Soils

- Soils — generally consists of naturally occurring soils that have been contaminated with inorganic radioactive waste materials.

Although not considered to be a waste component, the associated packaging materials are also listed because they also provide input to the ~~performance assessment~~ ***PA*** calculations.

Packaging Materials

- Steel — weight of the steel component of the standard container. Any necessary overpacking is included in the weight of steel.
- Plastics — weight of any standard plastic secondary confinement within the container.
- Lead — weight of the lead shielding.

The estimated WMP information is expressed in units of kilograms per cubic meter ~~of waste matrix~~ ***corresponding to the volume the waste package will occupy in the repository***. This unit facilitates scaling the material parameters to address various volumes for ~~performance assessment~~ ***PA*** calculations and sensitivity analysis.

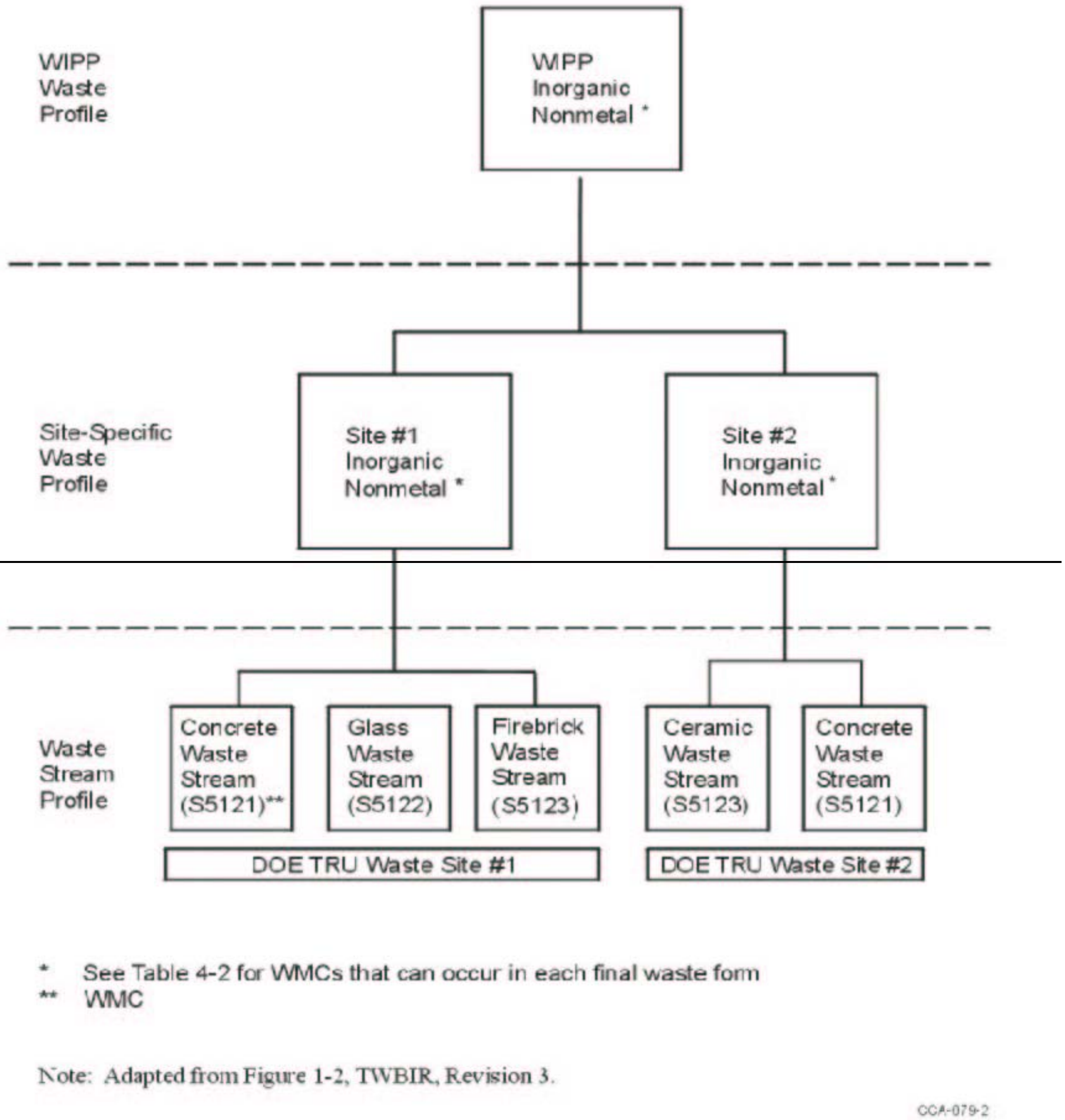
4.1.3.2 Nonradionuclide Inventory Roll-***U***p

The DOE uses the eleven final waste forms ~~in the TWBIR~~ as an intermediate step in determining the inventory of ~~nonradioactive~~ ***nonradionuclide*** waste components. These final waste forms are a convenient way for the DOE to categorize waste for the purpose of waste management and waste characterization prior to shipment to the WIPP. Waste streams at each TRU waste ~~generator and storage~~ site with similar WMCs are grouped together into one of the 11 final waste forms. ~~as shown in Table 4-2~~. ~~An example of the methodology for grouping waste stream information is illustrated in Figure 4-3.~~ The grouping of individual waste stream profiles into a ~~site-specific~~ ***WIPP*** waste profile is based on the similar physical and chemical properties of the waste streams. ~~In the example in Figure 4-3, because of their similar properties for performance assessment modeling, concrete waste, glass waste, firebrick waste, and ceramic waste mainly influence the estimation of porosity and permeability in the waste panel region (see Figure 6-13) of the model. Therefore, the three streams within the DOE TRU Waste Site #1 and the two at DOE TRU Waste Site #2 can be grouped together at each site based on similar physical and chemical properties and placed into the site-specific waste profile inorganic nonmetal waste, with the final waste form defined in Table 4-2.~~

Current estimates of the final waste form volumes for CH-TRU and RH-TRU waste are provided in Table 4-4. For comparison, estimates ~~Estimates~~ of the ~~WIPP~~ final waste-form volumes for CH-TRU and RH-TRU waste ***from the CCA are also provided in Table 4-4***~~4-3~~. ***The relative contribution of heterogeneous debris, solidified organics, and filters to the current reported CH-TRU waste volume has increased when compared to the CCA inventory estimate. The most notable increase is in the heterogeneous debris category. SRS, LANL, RFETS, and INEEL all reported larger expected volumes of heterogeneous debris in the CRA-2004 data call than they reported for the CCA inventory estimate. Larger volumes of heterogeneous debris are expected to come from the FB (F-Canyon at SRS) and HB (H-Canyon at SRS) process lines, facility and equipment operations at LANL, decontamination and decommissioning at RFETS, and the start-up of the Advanced Mixed Waste Treatment Facility (AMWTF) at INEEL.***

The relative contribution of uncategorized metal, graphite, soil and combustibles to the current reported CH-TRU waste volume has decreased when compared to the CCA inventory estimate. The most notable decrease is in the uncategorized metal category. Hanford-RL, LANL, and INEEL all reported smaller expected volumes of uncategorized metal in the CRA-2004 data call than in the CCA inventory estimate due primarily to reassignment of the waste to other forms based on new characterization information.

The relative contribution of inorganic non-metal, filters, soils, solidified organics, and solidified inorganics to the current reported RH-TRU waste volume has increased when compared to the CCA estimate. The most notable increase is in the solidified inorganic category. Hanford-RP and Hanford-RL reported larger expected volumes of solidified inorganics in the CRA-2004 data call than in the CCA inventory estimate. Larger



~~**Figure 4-3. Schematic of Waste Stream Profile Methodology**~~

volumes of solidified inorganics are expected from Hanford-RP due to the waste in underground storage tanks.

The relative contribution of uncategorized metal to the currently reported RH-TRU volume has decreased when compared to the CCA estimate. Hanford-RL reassigned a significant volume of waste that was reported as uncategorized metal in the CCA to other forms based on new characterization information.

To establish the nonradioactive waste component inventory, ~~the~~ DOE accumulated WMP information ***(as WMP average densities in units of kg/m³)*** in the ~~TWBIR~~ ***CRA-2004 data call*** by final waste form. This accumulation is shown as a series of tables (Tables ~~3-1~~ ***DATA-F-10*** through ~~3-18~~ ***DATA-F-30*** in Appendix ~~BIR~~ ***DATA, Attachment F***). ~~in the TWBIR.~~

~~**Table 4-3. Anticipated Nonradionuclide TRU Waste Inventory for the WIPP**~~

~~**Final Waste Forms**~~	~~**Stored Volumes (cubic meters)**~~	~~**Projected Volumes (cubic meters)**~~	~~**Anticipated Volumes (cubic meters)**~~	~~**WIPP Disposal Volumes (cubic meters)**~~
~~CH-Waste~~				
~~Combustible~~	~~5.8E+03~~	~~4.6E+03~~	~~1.0E+04~~	~~1.4E+04~~
~~Filter~~	~~2.2E+02~~	~~5.1E+02~~	~~7.3E+02~~	~~1.2E+03~~
~~Graphite~~	~~5.1E+02~~	~~4.8E+01~~	~~5.6E+02~~	~~6.0E+02~~
~~Heterogeneous~~	~~2.7E+04~~	~~1.3E+04~~	~~4.0E+04~~	~~5.1E+04~~
~~Inorganic Nonmetal~~	~~3.1E+03~~	~~9.4E+02~~	~~4.1E+03~~	~~4.9E+03~~
~~Lead and Cadmium Metal Waste~~	~~3.5E+01~~	~~3.3E+02~~	~~3.7E+02~~	~~6.6E+02~~
~~Salt Waste~~	~~2.1E+01~~	~~3.3E+02~~	~~3.5E+02~~	~~6.4E+02~~
~~Soils~~	~~4.1E+02~~	~~6.0E+03~~	~~6.4E+03~~	~~1.2E+04~~
~~Solidified Inorganics~~	~~9.6E+03~~	~~4.5E+03~~	~~1.4E+04~~	~~1.8E+04~~
~~Solidified Organics~~	~~9.1E+02~~	~~7.5E+01~~	~~9.8E+02~~	~~1.1E+03~~
~~Uncategorized Metal~~	~~1.1E+04~~	~~2.3E+04~~	~~3.4E+04~~	~~5.4E+04~~
~~Total CH Volumes~~	~~5.8E+04~~	~~5.4E+04~~	~~1.1E+05~~	~~1.6E+05~~
~~RH-Waste~~				
~~Combustible~~	~~3.6E+01~~	~~4.9E+01~~	~~8.5E+01~~	
~~Heterogeneous~~	~~2.3E+03~~	~~5.5E+03~~	~~7.8E+03~~	
~~Inorganic Non-Metal~~	~~4.6E+01~~	~~2.1E+01~~	~~6.8E+01~~	
~~Lead and Cadmium Metal Waste~~	~~7.1E+00~~	~~6.7E+01~~	~~7.4E+01~~	
~~Solidified Inorganics~~	~~1.1E+03~~	~~2.3E+02~~	~~1.3E+03~~	
~~Solidified Organics~~	~~3.6E+00~~	~~0.0E+00~~	~~3.6E+00~~	
~~Uncategorized Metal~~	~~1.2E+02~~	~~1.7E+04~~	~~1.8E+04~~	
~~Total RH Volumes~~	~~3.6E+03~~	~~2.3E+04~~	~~2.7E+04~~	~~7.1E+03~~[1]
~~Total TRU Waste Volumes~~	~~6.2E+04~~	~~7.7E+04~~	~~1.4E+05~~	~~1.7E+05~~

~~Source: Adapted from TWBIR, Revision 3, Table 2-1~~

[1] ~~WIPP is limited to 7,079 cubic meters of RH-TRU waste.~~

These ***average densities*** are further summed to determine the total WIPP waste component disposal inventory for CH-TRU and RH-TRU waste and are given in ***Tables DATA-F-31 and DATA-F-32 of Appendix DATA, Attachment F, and are reproduced here with a comparison to the CCA inventory values in*** Tables 4-***5***~~4~~ ***(CH-TRU waste)*** and 4-***6***~~5~~ ***(RH-TRU waste)***, respectively. It should be noted that MgO is not listed in these tables. Since MgO is not a component of the waste, it is not regarded as a WMP. A discussion of the MgO ~~backfill~~ is contained in Chapter 3.0***; CCA*** Appendix BACK ***and CCA*** Appendix SOTERM***; Appendix BARRIERS; and Appendix PA, Attachment SOTERM.***

Table 4-4. Nonradionuclide TRU Waste Inventory for the WIPP

Final Waste Forms	Current Inventory Volumes (m^3)				Volumes Reported in the CCA (m^3) [1]			
	Emplaced	Stored	Projected	WIPP Disposal	Emplaced	Stored	Projected	WIPP Disposal
	CH-TRU Waste				CH-TRU Waste			
Combustible	6.1×10^{2}	4.3×10^{3}	1.9×10^{3}	8.9×10^{3}	--	5.8×10^{3}	4.6×10^{3}	1.4×10^{4}
Filter	3.4×10^{2}	9.9×10^{2}	5.9×10^{2}	2.6×10^{3}	--	2.2×10^{2}	5.1×10^{2}	1.2×10^{3}
Graphite	0.0×10^{0}	1.2×10^{2}	1.3×10^{0}	1.2×10^{2}	--	5.1×10^{2}	4.8×10^{1}	6.0×10^{2}
Heterogeneous	5.7×10^{2}	4.9×10^{4}	9.7×10^{3}	7.0×10^{4}	--	2.7×10^{4}	1.3×10^{4}	5.1×10^{4}
Inorganic Nonmetal	9.7×10^{2}	1.1×10^{4}	6.8×10^{1}	1.2×10^{4}	--	3.1×10^{3}	9.4×10^{2}	4.9×10^{3}
Lead and Cadmium Metal Waste	8.1×10^{1}	1.4×10^{2}	3.2×10^{1}	2.9×10^{2}	--	3.5×10^{1}	3.3×10^{2}	6.6×10^{2}
Salt Waste	1.5×10^{3}	1.5×10^{2}	1.9×10^{2}	2.1×10^{3}	--	2.1×10^{1}	3.3×10^{2}	6.4×10^{2}
Soils	0.0×10^{0}	3.0×10^{2}	6.0×10^{3}	1.3×10^{4}	--	4.1×10^{2}	6.0×10^{3}	1.2×10^{4}
Solidified Inorganics	3.3×10^{3}	3.5×10^{4}	7.3×10^{2}	4.0×10^{4}	--	9.6×10^{3}	4.5×10^{3}	1.8×10^{4}
Solidified Organics	0.0×10^{0}	5.2×10^{3}	3.8×10^{2}	6.0×10^{3}	--	9.1×10^{2}	7.5×10^{1}	1.1×10^{3}
Uncategorized Metal	3.6×10^{2}	2.4×10^{3}	5.1×10^{3}	1.4×10^{4}	--	1.1×10^{4}	2.3×10^{4}	5.4×10^{4}
Total CH-TRU Waste Volumes	7.7×10^{3}	1.1×10^{5}	2.5×10^{4}	1.7×10^{5}	--	5.8×10^{4}	5.4×10^{4}	1.6×10^{5}

Source: Current inventory volumes - Appendix DATA, Attachment F; Volume reported in the CCA – TWBIR Revision 3

[1] *Comparisons between the current inventory values and the values reported in the CCA are made in detail in Appendix DATA, Attachment F, Annex B*

[2] *The WIPP is limited to 7,079 m^3 of RH-TRU waste by agreement with the State of New Mexico.*

Table 4-4. Nonradionuclide TRU Waste Inventory for the WIPP — Continued

Final Waste Forms	Current Inventory Volumes (m^3)				Volumes Reported in the CCA (m^3) [1]			
	Emplaced	Stored	Projected	WIPP Disposal	Emplaced	Stored	Projected	WIPP Disposal
	RH-TRU Waste				RH-TRU Waste			
Combustible	--	1.8×10^{1}	8.9×10^{-1}	1.8×10^{1}	--	3.6×10^{1}	4.9×10^{1}	--
Filter	--	8.9×10^{0}	8.9×10^{0}	1.0×10^{1}	--	--	--	--
Heterogeneous	--	6.1×10^{2}	3.8×10^{3}	1.3×10^{3}	--	2.3×10^{3}	5.5×10^{3}	--
Inorganic Non-Metal	--	4.3×10^{1}	4.4×10^{1}	5.1×10^{1}	--	4.6×10^{1}	2.1×10^{1}	--
Lead and Cadmium Metal Waste	--	1.2×10^{1}	7.1×10^{0}	1.3×10^{1}	--	7.1×10^{0}	6.7×10^{1}	--
Soils	--	0.0×10^{0}	2.0×10^{2}	3.4×10^{-1}	--	--	--	--
Solidified Inorganics	--	4.5×10^{3}	3.3×10^{2}	4.6×10^{3}	--	1.1×10^{3}	2.3×10^{2}	--
Solidified Organics	--	9.5×10^{0}	0.0×10^{0}	9.5×10^{0}	--	3.6×10^{0}	0.0×10^{0}	--
Uncategorized Metal	--	8.4×10^{1}	6.1×10^{3}	1.1×10^{3}	--	1.2×10^{2}	1.7×10^{4}	--
Total RH-TRU Waste Volumes[2]	--	5.3×10^{3}	1.0×10^{4}	7.1×10^{3}	--	3.6×10^{3}	2.3×10^{4}	– –
Total TRU Waste Volumes	7.7×10^{3}	1.1×10^{5}	3.5×10^{4}	1.8×10^{5}	-	6.2×10^{4}	7.7×10^{4}	1.7×10^{5}

Source: Current inventory volumes - Appendix DATA, Attachment F; Volume reported in the CCA – TWBIR Revision 3

[1] Comparisons between the current inventory values and the values reported in the CCA are made in detail in Appendix DATA; Attachment F, Annex B

[2] The WIPP is limited to 7,079 m^3 of RH-TRU waste by agreement with the State of New Mexico.

~~The~~ DOE reports the average density for WMPs because these values are used to generate the waste-related inputs for ~~performance assessment~~ ***PA***. Section 3.4 of the TWBIR recommends use of the average value, based on the methodology used to obtain and report data. ~~Section 3.3 of the TWBIR provides a formula for determining the average WMP densities.~~ ***CRA-2004 also uses average values for the WMPs to generate waste-related inputs for PA.***

Analysis of the current inventory estimate and the CCA inventory estimate for CH-TRU waste shows that waste materials expected for shipment to WIPP have changed slightly since the CCA. The relative occurrence (expressed as the kg/m^3 of a given material in the waste) of iron (Fe), aluminum (Al), and other metal alloys is smaller in the current inventory estimate than it was in the CCA inventory estimate. In addition, the relative occurrence of solidified organics, cement, soils, and vitrified material is smaller in the current inventory estimate than it was in the CCA inventory estimate. In contrast, the relative occurrence of cellulosic, plastic, and rubber (CPR) materials and other inorganic materials is larger in the current inventory estimate than it was in the CCA inventory estimate. The current inventory estimate reflects a shift from an expected waste form consisting of 40 percent metals, 15 percent CPR materials and 45 percent other materials reported in the CCA to a waste form that consists of 34 percent metals, 25 percent CPR materials and 41 percent other materials. The current inventory estimate reflects a higher occurrence of CPR materials primarily because of a process change at INEEL. At the time of the CCA, INEEL expected to thermally treat a significant quantity of waste that contained higher than average quantities of CPR materials. Through the process of thermal treatment, the CPR materials in the waste would be destroyed. INEEL currently plans to supercompact the waste that they had originally planned to thermally treat. Supercompaction does not destroy CPR materials in the waste. As a consequence, the waste expected to come to WIPP from INEEL has increased CPR materials relative to those reported for the CCA.

~~Table 4-4. WIPP CH-TRU WMP Disposal Inventory~~

~~Waste Components~~	~~Average (kilograms per cubic meter)~~
~~Iron Base Metal and Alloys~~	~~170~~
~~Aluminum Base Metal and Alloys~~	~~18~~
~~Other Metal and Alloys~~	~~67~~
~~Other Inorganic Materials~~	~~31~~
~~Vitrified~~	~~55~~
~~Cellulosics~~	~~54~~
~~Rubber~~	~~10~~
~~Plastics~~	~~34~~
~~Solidified Inorganic Material~~	~~54~~
~~Solidified Organic Material~~	~~5.6~~
~~Cement (Solidified)~~	~~50~~
~~Soils~~	~~44~~
~~Container Materials - kilograms per cubic meter~~	
~~Steel~~	~~139~~
~~Plastic and Liners~~	~~26~~

~~*Source*: Adapted from TWBIR, Revision 3, Table 2-2.~~

1 ***Table 4-5. WIPP CH-TRU Waste and Container Material Disposal Inventory***

Waste Materials	***Average Density Based on Current Inventory (kg/m^3)***	***Average Density Reported in the CCA (kg/m^3)***
	Waste Materials	
Fe-Base Metal/Alloys	1.1×10^{2}	1.7×10^{2}
Al-Base Metal/Alloys	1.4×10^{1}	1.8×10^{1}
Other Metal/Alloys	3.0×10^{1}	6.7×10^{1}
Other Inorganic Materials	4.2×10^{1}	3.1×10^{1}
Vitrified Materials	6.2×10^{0}	5.5×10^{1}
Cellulosic Material	5.8×10^{1}	5.4×10^{1}
Rubber	1.4×10^{1}	1.0×10^{1}
Plastic	4.2×10^{1}	3.4×10^{1}
Solidified Inorganic Materials	7.7×10^{1}	5.4×10^{1}
Solidified Organic Materials	1.6×10^{1}	5.6×10^{0}
Cement (Solidified)	2.9×10^{1}	5.0×10^{1}
Soil	1.9×10^{1}	4.4×10^{1}
	Container Materials	
Steel	1.7×10^{2}	1.4×10^{2}
Plastic and Liners	1.6×10^{1}	2.6×10^{1}
Lead	1.4×10^{-2}	0.0×10^{0}

Source: Appendix DATA, Attachment F.

2 ~~**Table 4-5. WIPP RH-TRU WMP Disposal Inventory**~~

~~**Waste Components**~~	~~**Average (kilograms per cubic meter)**~~
~~Iron Base Metal and Alloys~~	~~10~~
~~Aluminum Base Metal and Alloys~~	~~7.1~~
~~Other Metal and Alloys~~	~~250~~
~~Other Inorganic Materials~~	~~64~~
~~Vitrified~~	~~4.7~~
~~Cellulosics~~	~~17~~
~~Rubber~~	~~3.3~~
~~Plastics~~	~~15~~
~~Solidified Inorganic Material~~	~~22~~
~~Solidified Organic Material~~	~~.093~~
~~Cement (Solidified)~~	~~19~~
~~Soils~~	~~1~~
~~Container Materials - kilograms per cubic meter~~	
~~Steel~~	~~446~~
~~Plastic and Liners~~	~~3.1~~
~~Lead~~	~~465~~
~~Steel Plug~~	~~2145~~

~~*Source:* Adapted from TWBIR, Revision 3, Table 2-2.~~

Table 4-6. WIPP RH-TRU Waste and Container Material Disposal Inventory

Waste Materials	***Average Density Based on Current Inventory (kg/m^3)***	***Average Density Reported in the CCA (kg/m^3)***
Waste Materials		
Fe-Base Metal/Alloys	1.1×10^{2}	1.0×10^{1}
Al-Base Metal/Alloys	2.5×10^{0}	7.1×10^{0}
Other Metal/Alloys	3.2×10^{1}	2.5×10^{2}
Other Inorganic Materials	3.5×10^{1}	6.4×10^{1}
Vitrified Materials	5.7×10^{-2}	4.7×10^{0}
Cellulosic Material	4.5×10^{0}	1.7×10^{1}
Rubber	3.1×10^{0}	3.3×10^{0}
Plastic	4.9×10^{0}	1.5×10^{1}
Solidified Inorganic Materials	3.9×10^{1}	2.2×10^{1}
Solidified Organic Materials	4.0×10^{0}	9.3×10^{-1}
Cement (Solidified)	8.7×10^{-1}	1.0×10^{0}
Soil	2.6×10^{1}	
Container Materials		
Steel	4.8×10^{2}	4.5×10^{2}
Plastic and Liners	1.4×10^{0}	3.1×10^{0}
Lead	4.4×10^{2}	4.7×10^{2}

Source: Appendix DATA, Attachment F

The container materials for CH-TRU waste are primarily steel, plastic, and lead. The current inventory estimate reflects a higher occurrence of steel, a lower occurrence of plastic, and a higher occurrence of lead in the packages coming to WIPP when compared to the CCA inventory estimate. Additional steel in packages currently planned to come to WIPP results from the planned increased use of overpacks (Type A or equivalent packages, pipe overpacks, ten-drum overpacks, 100-gallon drum overpacks, etc.). The increased use of overpack containers in the current inventory estimate also leads to a reduction in the use of plastic liners in packages coming to WIPP. Thus, the density of plastic packaging material is smaller than it was in the CCA inventory estimate.

~~With regard to t~~***T***he inventory of chemical components of the waste (needed for scoping calculations to determine their importance on performance)~~, this information~~ was requested ***in the CRA-2004 data call*** ~~from the generator/storage sites by the DOE subsequent to the issuance of Revision 2 of the TWBIR~~. The information requested by ~~the~~ DOE was specific to solidified waste forms destined for disposal at the WIPP and included complexing agents, nitrates, sulfates, phosphates, and cement. ~~A summary of this supplemental information can be found in Sections 3.3.1, 3.3.2, and 3.3.3 of the TWBIR, Revision 3~~. ***A summary of this information can be found in Appendix DATA, Attachment F.*** Additional information addressing the impact, limits, and characterization (or noncharacterization) of these chemical components is provided in Appendix ***TRU WASTE, Sections TRU WASTE-2.0 and TRU WASTE-3.0.*** ~~WCA~~, ~~Appendix WCL, Section 4.4, and Tables 4-1 and 4-13~~. The importance of these chemical components to

~~performance assessment~~ ***PA*** is assessed in Appendix ***TRU WASTE, Section TRU WASTE-2.0***~~WCA~~.

4.1.3.3 Radionuclide Inventory Roll-***U***p

Estimates of the radionuclide inventory are included in ~~the TWBIR~~ ***Appendix DATA, Attachment F.*** ~~Generators~~ ***TRU waste sites*** derive these estimates based on acceptable knowledge including any quantitative results that may be available. ***In the data call for CRA-2004, TRU waste sites reported estimated values for radionuclide activities on a waste stream basis including both the stored and projected components.*** The ***actual activity*** ~~radioactive inventory~~ of disposed waste ~~will be~~ ***is*** determined quantitatively prior to shipment***,*** as discussed in Section ~~4.2.2~~ ***4.4.2***.

~~The estimates of radioactivity provided by the generator and storage sites are for stored waste only. Assuming the radionuclide distribution for projected waste to be the same as the stored waste inventory.~~

The disposal radionuclide inventory for PA is a calculated value based on the radionuclide activities reported for emplaced, stored, and projected waste. The radionuclide activities in the projected component of the waste are scaled using the scaling factor and added to the radionuclide activities for stored and emplaced components of the waste.

~~For the CCA, it is possible to scale the activity of the stored radionuclide inventory to the full WIPP repository. This assumption is reasonable because no new waste forms or waste generating processes are anticipated for the future and radionuclide distributions for the DOE weapons program activities are well known. The WIPP disposal radionuclide inventory has been estimated on the basis of these assumptions by first calculating the activity per unit volume (that is, curies per cubic meter) of each radionuclide that is present in the stored waste at each site.~~ This calculation is based on all radionuclide activities decayed to the end of ~~1995~~ ***2001***. Radioactive decay and build-up calculations were ~~are~~ performed ~~annually and reported in the TWBIR~~ using the commercially available code ORIGEN2 (Croff 1980). The levels of radioactivity reported include contributions from both parent and daughter decay products. ~~The curies per cubic meter calculated for each radionuclide in the stored waste at each site are then multiplied by the volume of projected waste to estimate the total curies of each radionuclide in the projected waste. The curies for the stored and the projected waste for each individual radionuclide at all sites are then added to obtain the total curies for CH-TRU and RH-TRU waste.~~ For CH-TRU waste, the total ~~curies~~ ***Ci*** for each radionuclide is divided by the CH-TRU disposal ~~inventory~~ ***volume*** to obtain a ~~curies~~ ***Ci*** per cubic meter concentration for each radionuclide on a repository level. For RH-TRU waste, the total decayed WIPP ~~curies~~ ***Ci*** for each radionuclide is divided by the ~~sum of the stored and actual projected~~ RH-TRU ~~waste~~ ***disposal*** volume to obtain a radionuclide concentration in ~~curies~~ ***Ci*** per cubic meter.

The WIPP disposal radionuclide inventory ~~to be~~ used in ~~this application~~ ***PA*** for both CH-TRU and RH-TRU wastes is shown in Table 4-***7***~~6~~. ***Activities at closure (2033) are used in PA.*** The table shows individual radionuclide activity in ~~curies~~ ***Ci*** for both CH-TRU and RH-TRU waste. Based on the total ~~curies~~ ***Ci*** shown in Table 4-***7***~~6~~ and to the extent to which each radionuclide is regulated by ~~40 CFR §~~ ***Section*** 191.13, approximately ~~99.9~~ ***98.6*** percent of the regulated CH-TRU activity at repository closure is contributed by ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am.

~~**Table 4-6. Important Radionuclides Considered in Performance Assessment**~~

~~Radionuclide~~	~~Inventory at Closure (Curies)~~	~~EPA Units at Closure~~	~~EPA Units at 10,000 years~~	~~Release Calculations (1)~~		
				~~Cuttings, Cavings, & Spall Release~~	~~Direct Brine Release~~	~~Culebra Release~~
~~Pu-238~~	~~1.94E+06~~	~~5.63E+03~~	~~1.32E-22~~	~~x~~	~~x~~	~~(2)~~
~~Pu-239~~	~~7.95E+05~~	~~2.31E+03~~	~~1.73E+03~~	~~x~~	~~x~~	~~x~~
~~Am-241~~	~~4.88E+05~~	~~1.42E+03~~	~~1.55E-01~~	~~x~~	~~x~~	~~x~~
~~Pu-240~~	~~2.14E+05~~	~~6.23E+02~~	~~2.16E+02~~	~~x~~	~~x~~	~~c~~
~~Cs-137~~	~~9.31E+04~~	~~2.71E+01~~	~~0.00E+00~~	~~x~~	–	–
~~Sr-90~~	~~8.73E+04~~	~~2.54E+01~~	~~0.00E+00~~	~~x~~	–	–
~~U-233~~	~~1.95E+03~~	~~5.67E+00~~	~~5.44E+00~~	~~x~~	~~x~~	~~c~~
~~U-234~~	~~7.51E+02~~	~~2.18E+00~~	~~4.09E+00~~	~~x~~	~~x~~	~~x~~
~~Th-230~~	~~3.06E-01~~	~~8.88E-03~~	~~3.56E+00~~	–	~~x~~	~~x~~
~~Pu-242~~	~~1.17E+03~~	~~3.40E+00~~	~~3.34E+00~~	–	~~x~~	~~c~~
~~Th-229~~	~~9.97E+00~~	~~2.90E-02~~	~~3.40E+00~~	–	~~x~~	~~c~~
~~Np-237~~	~~6.49E+01~~	~~1.89E-01~~	~~4.82E-01~~	–	~~x~~	–
~~Cm-245~~	~~1.15E+02~~	~~3.33E-01~~	~~1.48E-01~~	–	~~x~~	–
~~Ra-226~~	~~1.14E+01~~	~~3.32E-02~~	~~2.77E-01~~	–	–	–
~~Pb-210~~	~~8.75E+00~~	~~2.54E-02~~	~~2.77E-01~~	–	~~x~~	–
~~U-238~~	~~5.01E+01~~	~~1.46E-01~~	~~1.46E-01~~	–	~~x~~	–
~~U-236~~	~~6.72E-01~~	~~1.95E-03~~	~~1.16E-01~~	–	~~x~~	–
~~Am-243~~	~~3.25E+01~~	~~9.45E-02~~	~~3.69E-02~~	–	~~x~~	–
~~U-235~~	~~1.75E+01~~	~~5.08E-02~~	~~7.06E-02~~	–	~~x~~	–
~~Cm-243~~	~~2.07E+01~~	~~6.03E-02~~	~~0.00E+00~~	–	~~x~~	–
~~U-232~~	~~1.79E+01~~	~~5.21E-02~~	~~0.00E+00~~	–	–	–
~~C-14~~	~~1.28E+01~~	~~3.72E-02~~	~~1.11E-02~~	–	–	–
~~Th-232~~	~~1.01E+00~~	~~2.92E-02~~	~~2.92E-02~~	–	~~x~~	–
~~Ac-227~~	~~5.05E-01~~	~~1.47E-03~~	~~1.28E-02~~	–	–	–
~~Pa-231~~	~~4.67E-01~~	~~1.36E-03~~	~~1.28E-02~~	–	–	–
~~Cm-248~~	~~3.72E-02~~	~~1.08E-04~~	~~1.06E-04~~	–	~~x~~	–
~~Pu-244~~	~~1.51E-06~~	~~4.40E-09~~	~~1.26E-08~~	–	~~x~~	–
~~Pu-241~~	~~3.94E+05~~	~~(3)~~	~~(3)~~	~~x~~	~~x~~	–
~~Cm-244~~	~~7.44E+03~~	~~(3)~~	~~(3)~~	~~x~~	~~x~~	–
~~Percent of EPA Units at closure included in calculation~~				~~99.96%~~	~~99.48%~~	~~43.45%~~
~~Percent of EPA Units at 10,000 years included in calculation~~				~~99.40%~~	~~99.98%~~	~~99.92%~~

~~(1) See Section 6.3 for a discussion of scenarios analyzed by performance assessment and the release pathways.~~
~~(2) Pu-238 was included in the Salado transport calculations but the release to the Culebra was too low to merit calculation of its transport within the Culebra. The EPA unit percent total at closure increases to 99.47% with Pu-238 added; the percent at 10,000 years is unaffected.~~
~~(3) Pu-241 and Cm-244 are not regulated by 40 CFR Part 191 but are included because their daughters, Am241 and Pu240 respectively, are significant to performance~~
~~x indicates an isotope included in calculation~~
~~c indicates isotopes that are combined for transport with isotopes having similar characteristics.~~

Table 4-7. Radionuclides Considered in PA

Radionuclide	Current Inventory Values			Values Reported in the CCA			Release Calculations (1)			
	Inventory at Closure (Ci)	EPA Units		Inventory at Closure (Ci)	EPA Units		Cuttings, Cavings, and Spall Release	Direct Brine Release	Salado Release	Culebra Release
		At Closure(4)	At 10,000 years		At Closure	At 10,000 years				
^{238}Pu	1.25×10^{6}	5.04×10^{3}	2.61×10^{-23}	1.94×10^{6}	5.64×10^{3}	1.32×10^{-22}	x	x	(2)	(2)
^{239}Pu	6.65×10^{5}	2.68×10^{3}	2.01×10^{3}	7.95×10^{5}	2.31×10^{3}	1.73×10^{3}	x	x	x	x
^{241}Am	4.58×10^{5}	1.84×10^{3}	2.48×10^{-4}	4.88×10^{5}	1.42×10^{3}	1.78×10^{-4}	x	x	x	x
^{240}Pu	1.08×10^{5}	4.36×10^{2}	1.51×10^{2}	2.14×10^{5}	6.22×10^{2}	2.16×10^{2}	x	x	c	c
^{137}Cs	1.79×10^{5}	7.19×10^{1}	0.00×10^{0}	9.31×10^{4}	2.71×10^{1}	0.00×10^{0}	x	--	--	--
^{90}Sr	1.42×10^{5}	5.71×10^{1}	0.00×10^{0}	8.73×10^{4}	2.54×10^{1}	0.00×10^{0}	x	--	--	--
^{233}U	1.27×10^{3}	5.12×10^{0}	4.91×10^{0}	1.95×10^{3}	5.67×10^{0}	5.44×10^{0}	x	x	c	c
^{229}Th	5.39×10^{0}	2.17×10^{-2}	3.04×10^{0}	9.97×10^{0}	2.90×10^{-2}	3.40×10^{0}	--	x	c	c
^{234}U	3.19×10^{2}	1.28×10^{0}	3.03×10^{0}	7.51×10^{2}	2.18×10^{0}	4.10×10^{0}	x	x	x	x
^{230}Th	1.76×10^{-1}	7.07×10^{-3}	2.64×10^{0}	3.06×10^{-1}	8.90×10^{-3}	3.55×10^{0}	--	x	x	x
^{238}U	1.54×10^{2}	6.21×10^{-1}	6.21×10^{-1}	5.01×10^{1}	1.46×10^{-1}	1.46×10^{-1}	--	x	--	--
^{237}Np	1.01×10^{1}	4.06×10^{-2}	4.27×10^{-1}	6.49×10^{1}	1.89×10^{-1}	4.83×10^{-1}	--	x	--	--
^{232}Th	6.83×10^{0}	2.75×10^{-1}	2.75×10^{-1}	1.01×10^{0}	2.94×10^{-2}	2.94×10^{-2}	--	x	--	--
^{226}Ra	6.28×10^{0}	2.53×10^{-2}	2.07×10^{-1}	1.14×10^{1}	3.31×10^{-2}	2.77×10^{-1}	--	--	--	--
^{210}Pb	4.94×10^{0}	1.99×10^{-2}	2.07×10^{-1}	8.75×10^{0}	2.54×10^{-2}	2.77×10^{-1}	--	x	--	--
^{242}Pu	2.71×10^{1}	1.09×10^{-1}	1.07×10^{-1}	1.17×10^{3}	3.40×10^{0}	3.34×10^{0}	--	x	c	c
^{243}Am	2.17×10^{1}	8.75×10^{-2}	5.74×10^{-2}	3.25×10^{1}	9.45×10^{-2}	3.69×10^{-2}	--	x	--	--
^{236}U	1.65×10^{0}	6.66×10^{-3}	8.62×10^{-2}	6.72×10^{-1}	1.95×10^{-3}	1.16×10^{-1}	--	x	--	--
^{235}U	2.28×10^{0}	9.18×10^{-3}	3.21×10^{-2}	1.75×10^{1}	5.09×10^{-2}	7.06×10^{-2}	--	x	--	--
^{14}C	3.25×10^{0}	1.31×10^{-2}	3.90×10^{-3}	1.28×10^{1}	3.72×10^{-2}	1.11×10^{-2}	--	--		
^{232}U	3.06×10^{0}	1.23×10^{-2}	0.00×10^{0}	1.79×10^{1}	5.20×10^{-2}	0.00×10^{0}	--	--	--	--
^{227}Ac	9.57×10^{-1}	3.85×10^{-3}	8.06×10^{-3}	5.05×10^{-1}	1.47×10^{-3}	1.28×10^{-2}	--	--	--	--
^{231}Pa	1.21×10^{0}	4.88×10^{-3}	8.06×10^{-3}	4.67×10^{-1}	1.36×10^{-3}	1.28×10^{-2}	--	--	--	--
^{243}Cm	4.07×10^{-1}	1.64×10^{-3}	0.00×10^{0}	2.07×10^{1}	6.02×10^{-2}	0.00×10^{0}	--	x	--	--
^{248}Cm	9.32×10^{-2}	3.75×10^{-4}	3.68×10^{-4}	3.72×10^{-2}	1.08×10^{-4}	1.06×10^{-4}	--	x	--	--
^{245}Cm	1.92×10^{-2}	7.72×10^{-5}	3.97×10^{-5}	1.15×10^{-2}	3.40×10^{-5}	1.85 × 10-^{5}	--	x	--	--

Table 4-7. Radionuclides Considered in PA — Continued

Radionuclide	Current Inventory Values			Values Reported in the CCA			Release Calculations (1)			
	Inventory at Closure (Ci)	EPA Units		Inventory at Closure (Ci)	EPA Units		Cuttings, Cavings, and Spall Release	Direct Brine Release	Salado Release	Culebra Release
		At Closure(4)	At 10,000 years		At Closure	At 10,000 years				
^{244}Pu	1.10×10^{-3}	4.44×10^{-6}	4.47×10^{-6}	1.51×10^{-6}	4.34×10^{-9}	1.26×10^{-8}	--	x	--	--
^{244}Cm	2.51×10^{3}	(3)	(3)	7.44×10^{3}	(3)	(3)	x	x	--	--
^{241}Pu	5.38×10^{5}	(3)	(3)	3.94×10^{5}	(3)	(3)	x	x	--	--
Percent of EPA Units at closure represented by nuclides in source term							99.98%	98.71%	48.95%	48.95%
Percent of EPA Units at 10,000 years represented by nuclides in source term							99.65%	99.99%	99.92%	99.92%

Source: Appendix TRU Waste, Section TRU Waste-2.0

1. See Section 6.3 for a discussion of scenarios analyzed by PA and the release pathways.
2. Pu-238 was included in the Salado transport calculations but the release to the Culebra was too low to merit calculation of its transport within the Culebra. The EPA unit percent total at closure increases to 98.71% with Pu-238 added; the percent at 10,000 years is unaffected.

3. Pu-241 and Cm-244 are not listed by Part 191 of the Code of Federal Regulations but are included because their daughters, ^{241}Am and ^{240}Pu, respectively, are significant to performance
4. At closure is decayed through 2033.

x indicates an isotope included in calculation.
c indicates isotopes that are combined for transport with isotopes having similar characteristics.

Approximately ~~99.4~~ ***99.5*** percent of the regulated RH-TRU activity at repository closure is contributed by ^{137}Cs, ^{90}Sr, ^{239}Pu, ^{240}Pu, ^{241}Am, and ^{238}Pu (~~See Appendix WCA, Section WCA.8.2~~ ***derived from data in TRU WASTE, Section TRU WASTE-2.0, Table TRU WASTE-9). The same radionuclides were identified in the CCA as the largest contributors to the regulated CH-TRU waste and RH-TRU waste activity at repository closure (see CCA Appendix WCA, Section 8.2). Overall, activity for all TRU radionuclides has decreased from 3.44 × 10⁶ Ci (at 2033) reported in the CCA to 2.48 × 10⁶ Ci (at 2033) in the current inventory estimate. The results for RH-TRU waste show variations in individual radionuclide activity and an overall increase in reported activity since the CCA.***

The values presented in ***Table 4-7***~~6~~ are used as input to the ~~performance assessment~~ ***PA*** calculations. A more detailed examination of the programs prepared by ~~the~~ DOE to collect supplemental radiological data ~~is~~***are*** provided in Section 4.4.

In addition to the inventory in ***Table 4-7***~~6~~*,* ~~the~~ DOE has determined the average radionuclide inventory for each of the ~~569~~ ***779 (693 CH-TRU waste streams and 86 RH-TRU waste streams)*** CH-TRU and ~~one~~ RH-TRU waste streams ~~in the conceptual models~~ (see Appendix ~~BIR, Revision 3, Appendix B-2~~ ***DATA, Attachment F***)*.* ***In the conceptual model for PA, the distribution of 693 CH-TRU waste streams and one RH-TRU waste stream (representing all of 86 the RH-TRU waste)*** ~~The distribution of waste streams is~~ ***are*** randomly sampled in the ~~performance assessment~~ ***PA*** ~~process~~ to determine releases due to inadvertent human intrusion. This process is discussed in Section 6.4.12.4 and assumes that each container in the waste stream has the average radionuclide inventory for that stream.

4.2 Waste Components and Characteristics

This section of the application is provided to document compliance with the provisions of ~~40 CFR §~~ ***Section*** 194.24(b) and describes, in summary fashion,

- those components or characteristics of the waste that are most important in terms of their impact on the performance of the WIPP disposal system and
- the limits imposed by ~~the~~ DOE on the significant components or characteristics of the waste to ensure that ~~future~~ emplaced waste will behave in a manner that is consistent with the inventory assumed for the performance calculations.

4.2.1 Identification and Qualification

~~The following text is responsive to the criterion at 40 CFR § 194.24(b).~~

The waste characteristics and components expected to be most significant to performance are the predominant radionuclides and their associated characteristics and components affecting actinide mobility. These are summarized in Table 4-***8***~~7~~***; they are unchanged from the CCA***.