PART III, OPERATING UNIT GROUP 18
ADDENDUM C, PROCESS INFORMATION

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Contents

C PROCESS INFORMATION

This Addendum discusses the processes used to dispose of the mixed waste identified as decommissioned, defueled reactor compartments (RCs) in the LLBG Trench 94 operable unit. This addendum includes the following:

- A description of the containers.
- The RC container management practices.
- The disposal packaging to meet secondary containment.
- Special procedures related to disposal of this waste stream in an unlined trench.

Since this trench does not have a liner, disposal of the decommissioned, defueled reactor compartments in LLBG Trench 94 must have an exemption from the liner/leachate collection system requirements. Section C.2 includes an exemption request and justifications for the disposal of defueled reactor compartments in the unlined Trench 94.

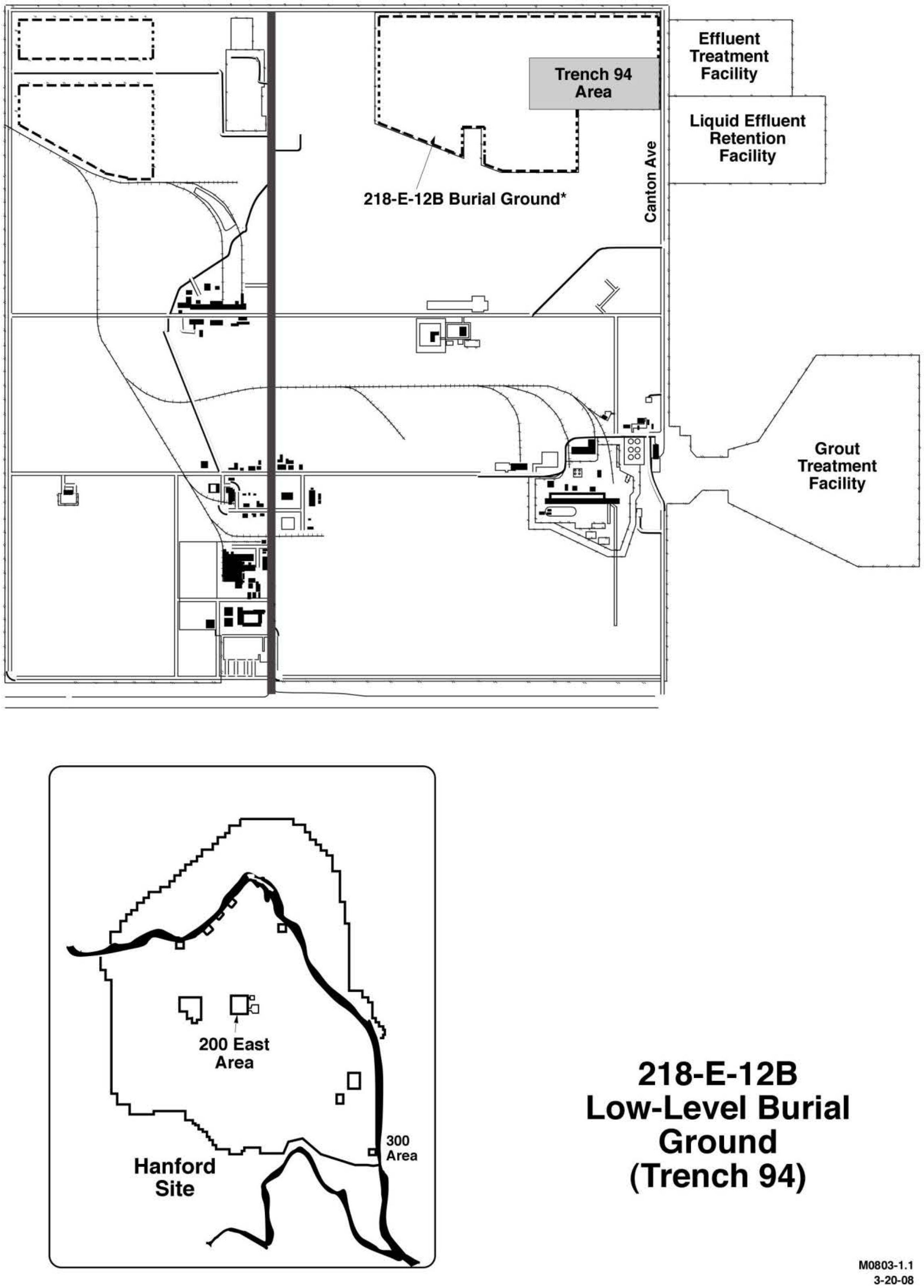


Figure C.1 Location of 218-E-12B Low-Level Burial Ground in the 200 East Area.

C.1 Process Information

The process design capacity of the LLBG Trench 94 is approximately 1,500,000 m^3 (1,962,000 yd^3). Waste management activities will be performed within the boundaries specified in Figure C.1.

Decommissioned, defueled reactor compartments contain radioactivity caused by exposure of structural components to neutrons during normal operation of the ships and submarines. In addition to radioactivity, the reactor compartments disposed in trench 94 contain lead used as shielding and polychlorinated biphenyls (PCBs). The lead used as shielding is regulated as a state-only dangerous waste in accordance with WAC 173-303. The PCBs are regulated in accordance with the TSCA as PCB/radioactive waste under 40 CFR 761.50(b)(7), which allows for PCB disposal without taking into account the PCBs in the waste if the PCB waste meets certain criteria for PCB Bulk Product Waste under 40 CFR 761.62(b)(1).

C.1.1 List of Wastes

The only wastes disposed in LLBG Trench 94 are decommissioned, defueled reactor compartments.

C.1.2 Final Disposal of Decommissioned, Defueled Reactor Compartments

In 1996, the Navy issued an EIS that considered the disposal of reactor plants from cruisers, and from LOS ANGELES and OHIO Class submarines (USN 1996). The record of decision for this EIS selected disposal by land burial of the entire reactor compartment at the LLBG Trench 94. Land disposal of these reactor compartments will require additional capacity beyond the existing size of LLBG Trench 94.

The first 55 defueled reactor compartments were placed on individual columnar foundations in the southeast and southwest corners of the trench. In the 1990s the foundation system was modified to concrete rail foundations that are approximately 3 m (10 ft) wide and 1 m (3 ft) deep spaced approximately 9 m (30 ft) apart. Five sets of these rails were constructed varying in length from 215 m (704 ft) on the south side of the trench to 326 m (1,071 ft) in length near the north side of LLBG Trench 94. There may be several shorter rails or other concrete structures constructed at the east end of excavated area of LLBG Trench 94 for future defueled reactor compartment packages.

C.1.3 Construction Schedule

The LLBG Trench 94 unit boundary is shown in Figure C.1. The current excavated area of LLBG Trench 94 (excluding the north access ramp) is approximately 540 m (1,770 ft) long by 140 m (460 ft) wide at grade level [494 m (1,620 ft) by 98 m (320 ft) on the floor], and typically about 14 m (45 ft) in depth where the defueled reactor compartments packages are placed. Unused portions of the trench can be deeper that 15 m (50 ft). The horizontal and vertical side slopes of LLBG Trench 94 are approximately 1V:1-1/2H. The current LLBG Trench 94 will be excavated northward approximately 46 m (150 ft) (occupying about ½ of the unit boundary area) to accommodate future planned defueled reactor compartment.

Any proposed new construction for the LLBG Trench 94 dangerous waste management unit will be accomplished in accordance with the permit modification process described in Permit Condition I.C.3.

C.2 Release from LLBG Trench 94 Dangerous Waste Management Unit

A waiver to the liner/leachate collection system requirements has been requested. The request for exemption applies only to the decommissioned, defueled reactor compartments disposed in Trench 94 of the 218-E-12B Burial Ground (Figure C.1). This exemption request does not apply to any other waste at the 218-E-12B Burial Ground or to any other burial ground on the Hanford Facility, and is limited to regulatory requirements addressing liner/leachate collection systems. The *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds* (DOE/RL-88-20, Revision 2) submitted in June 2002 included the Appendix 4D titled “Request for Exemption from Lined Trench Requirements at 218-E-12B Burial Ground Trench 94 (Administrative Record Accession Number D9090693).

The exemption request concludes that the defueled reactor compartment waste form prevents the generation of any contaminated leachate for a minimum of 600 years and likely 2,000 years, well beyond the expected lifetime of the minimum technological liner/leachate system design.

The exemption request incorporates site specific studies conducted in 1992 for LLBG Trench 94 that show that shielding lead from the defueled reactor compartments would not migrate to the Columbia River for hundreds of thousands of years even under a conservative case assuming a wetter future climate with a recharge rate into the ground (after evapotranspiration) of 6cm (0.2 ft) per year over 10 times the current typical recharge at the Hanford Site [0.5cm (0.02 ft) per year]. The conservative case also assumes that no closure cover is installed.

C.3 Landfills

The following sections provide a description of the reactor compartments disposed in the LLBG Trench 94 dangerous waste management unit, their management, and their construction to support secondary containment, and removal of liquids.

C.3.1 Description of Reactor Compartments

Decommissioned, defueled reactor compartments are the only type of waste disposed in LLBG Trench 94 operable unit. Each reactor compartment package is that section of the ship containing the nuclear reactor. The nature and physical characteristics of the defueled reactor compartment packages disposed of in LLBG Trench 94 are the same. However, the package size and weight vary depending on the class of ship from which they came. The nuclear reactor consists of the reactor vessel, steam generators, pumps, valves, and piping. Figure C.2 provides typical dimensions and weights of reactor compartment packages. The reactor compartments are completely sealed by welding to prevent release of the radioactive and dangerous materials contained within the reactor compartments. All nuclear fuel has been removed from the reactor compartments; therefore, the radioactive materials remaining in the reactor compartments consist only of activation products from operation of the nuclear reactors. Figures C.2 and C.3 provide general cross-sections of typical submarine and cruiser reactor compartment packages. Before shipment to the Hanford Facility, the reactor compartment is removed from the decommissioned/defueled ship.

Once prepared for shipment, the reactor compartment is a completely sealed unit.

The reactor compartments each contain more than 90.7 metric tons of permanently installed lead shielding in the form of panels or poured-in-place lead contained within thick metal sheathing plates. The thick metal encapsulation of this lead, as originally constructed, meets the treatment standards of 40 CFR 268.42, Treatment Code MACRO, for disposal of radioactive lead solids, including lead shielding, if the treatment standard were to apply. Work during the reactor compartment preparation process maintains this encapsulation with no treatment of the lead shielding occurring. Figures C.2 and C.3 provide cross-sections of typical reactor compartment packages. Major structural components are shown. The ship's hull and inner bulkheads provide barriers for containment of materials within the reactor compartment packages and provide strength to the packages. External structures installed by Puget Sound Naval Shipyard (PSNS) provide additional strength and containment to seal the packages.

Waste containers are required to be at least 90 percent full when placed in a landfill to minimize subsidence. Although this rule is not directly applicable to the reactor compartments, which are a unique, integrated waste form that is both containment and waste, the capacity of the reactor compartment package structure to withstand soil loading at trench 94 was evaluated. For submarine reactor compartments (Figure C.2), the hull and external structure on each end make up the outer containment boundary. These structures easily can withstand the soil pressure of burial. Cruiser reactor compartments (Figure C.3) would perform comparably given their thick external structure. All of the radioactivity and lead, in the reactor compartments are contained within these boundaries. Burial of the reactor compartment packages will not compromise their containment integrity. There will not be subsidence in the landfill cover due to package containment failure over the cover's engineered design life as a moisture barrier.

C.3.2 Containment Evaluation

The reactor compartments are a unique, integrated waste form that is both containment and waste. Thus, the entire reactor compartment disposal package is the waste under evaluation.

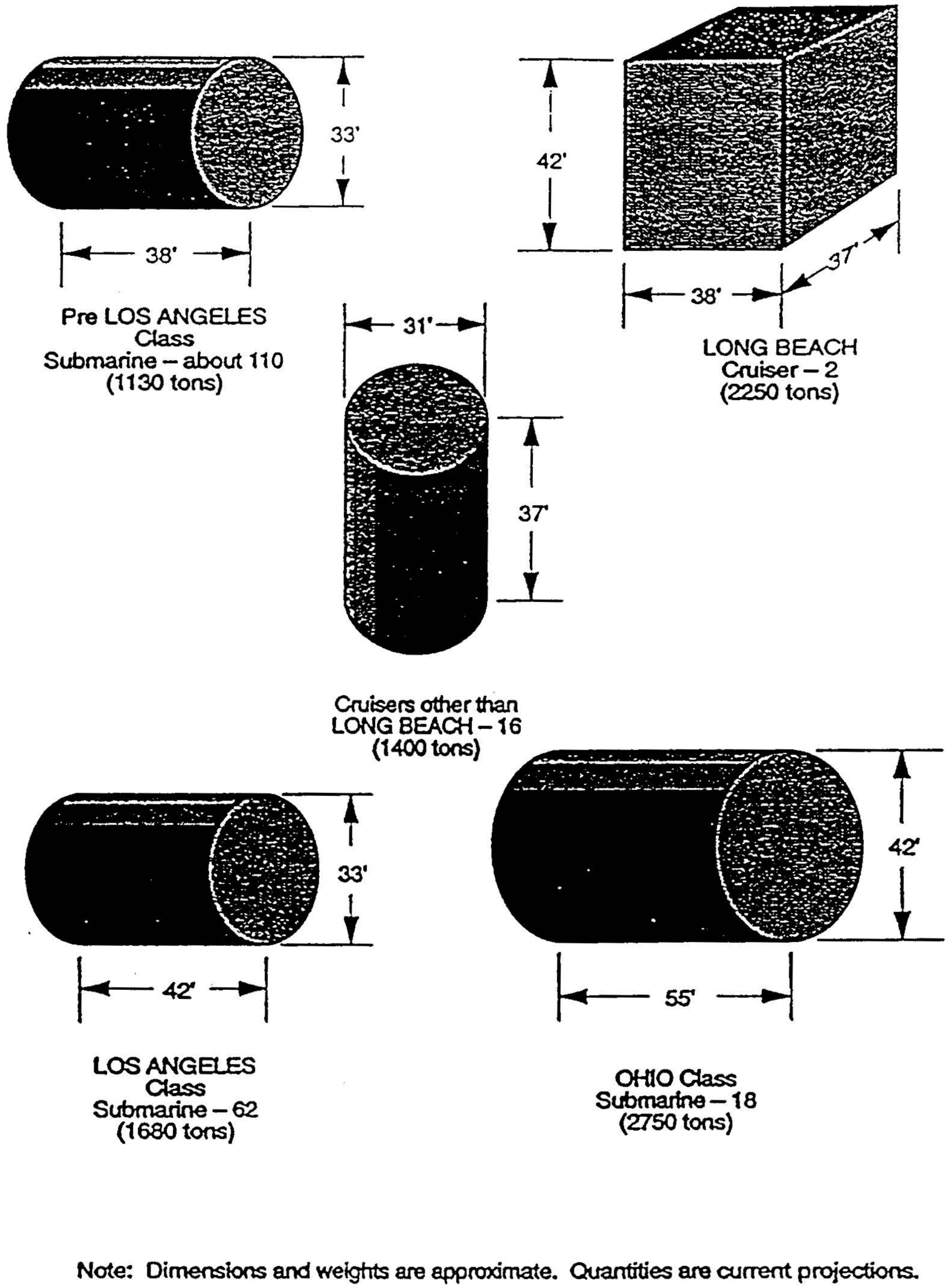
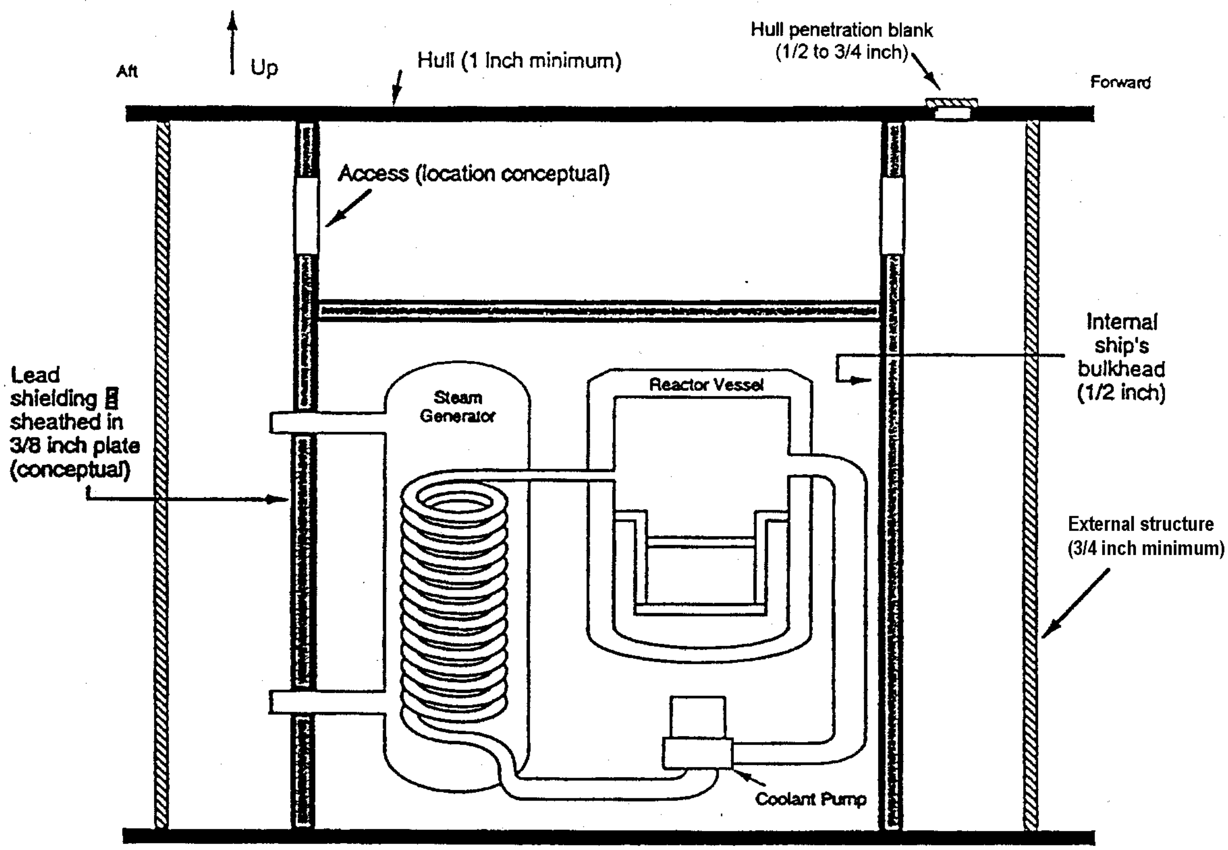


Figure C.2 Comparison of Reactor Compartment Packages.



General Notes:

(1) PSNS installed structure is cross hatched:

(2) There are a limited number of small diameter penetrations through the hull (e.g., about 10 with maximum 6 inch diameter is typical for pre-LOS ANGELES Class ships). These are sealed with 1/2 to 3/4 inch blanks (typical location shown).

(3) On some submarines, the aft end of the hull tapers inwards with an external shelf (at least 3/8-inch thick) forming a ballast tank external to the hull.

Figure C.3 General Cross-Section of Typical Submarine Reactor Compartment Package.

C.3.2.1 Containment Lifetime of the Reactor Compartment Package

Based on the containment thicknesses presented in Figures C.2 and C.3, and the predicted corrosion rates, the containment lifetime of the reactor compartments can be calculated. For submarine reactor compartments, the earliest time to penetration of the 1.27-centimeter-thick plates (covering small diameter hull penetrations on older reactor compartments at trench 94) is 143 years, using the maximum pitting corrosion rate of 0.0089 centimeter per year. Using the expected pitting corrosion rate of 0.0025 centimeter per year, the covers would not be penetrated for 500 years. It would take 1.5 times as long to penetrate the 1.9-centimeter-thick hull penetration covers currently installed on submarine reactor compartments and the minimum 1.9-centimeter-thick plate forming the ends of submarine reactor compartment packages. It would take even longer to penetrate the minimum 3.18-centimeter-thick exterior structure of cruiser reactor compartment packages.

C.3.2.2 Integrity of the Reactor Compartment Package

The thick structure of reactor compartment packages inherently provides a very high-integrity waste package. The packages have substantial ability to contain waste for a long time.

The integrity of the reactor compartment is its ability to provide a containment barrier to prevent the lead shielding from contacting the environment. The time required for corrosion of the reactor compartment to allow exposure of lead to the environment depends on the corrosion rate of steel in trench 94, the thickness of the steel barriers, and the ability of the reactor compartment to withstand soil pressure after its structure is weakened by corrosion.

C.3.3 Landfill Design

This section addresses landfill design features of LLBG Trench 94.

C.3.3.1 Access Ramp

LLBG Trench 94 has an access ramp from the northwest corner of the trench. The access ramp allows for the transfer of the decommissioned, defueled reactor compartments into Trench 94.

C.3.3.2 Truck Unloading Area

A truck unloading area is located at the top of the access ramp to provide an area for transfer of the decommissioned, defueled reactor compartments.

C.3.3.3 Seismic Conditions

Potential hazards from seismic events include faulting, slope failure, and liquefaction. Disruption of the trench by faulting is not considered a significant risk because (1) no major faults have been identified in Trench 94 (DOE/RW-0164) and (2) only one central fault at Gable Mountain on the Hanford Site shows evidence of movement within the last 13,000 years (WHC-SD-ER-TI-0003). The potential for slope failure is considered low, because granular materials typically have high strengths relative to the maximum sideslope angles expected for the lined trenches. Liquefaction occurs in loose, poorly graded granular materials that are subjected to shaking from seismic events. Saturated soils are most susceptible because of high dynamic pore pressures that temporarily lower the effective stress. During this process, the soil particles are rearranged into a more dense configuration, with a resulting decrease in volume. The foundation materials at Trench 94 are not considered susceptible to liquefaction because the materials are well graded, unsaturated, and relatively dense.

C.3.3.4 Subsidence Potential

Subsidence of undisturbed foundation materials is generally the result of dissolution, fluid extraction (water or petroleum), or mining. The potential for subsidence is negligible based on the following.

- Soils underlying Trench 94 are coarse-grained sands and gravels, which are not subject to piping that can cause transport of soil and resulting subsidence.
- The groundwater level is deep, at least 39.7 meters (130 feet) below the base of the trench and does not affect bearing soils.
- Soil and rock types below Trench 94 are not soluble.
- No mining or tunneling has been noted. If the groundwater level was lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater table below the lined trenches.
- Soils are well graded and relatively dense.

C.3.3.4.1 Sinkhole Potential

Extensive borings in and around Trench 94 (Addendum D, Groundwater Monitoring) have not identified any soluble materials in the foundation soils or underlying sediments. Consequently, the potential for any sinkhole development is negligible.

C.3.3.5 Run-On and Run-Off Control Systems

Because of the sandy soils, small drainage area, and arid climate at Trench 94, storm water run-on and run-off are not expected to require major engineered structures. Interceptor and drainage ditches, and berms are adequate for run-on and run-off control. The 25-year, 24-hour precipitation event is the design storm used to size the lined trench systems. Beyond this, surface water evaluation is highly site-specific, and appropriate analyses are performed as part of detailed design for each lined trench.

Run-on is controlled by berms around the perimeter of the Trench 94. Any overland flow approaching the trench is intercepted by the berms and conveyed to suitable discharge points. All the berms are designed to handle the peak 25-year flow from the potential drainage area.

C.3.3.6 Maintenance

The berms require periodic maintenance to ensure proper performance. The most frequent maintenance activity, beyond periodic inspection, is cleaning the berms to remove obstructions caused by windblown soil and vegetation, (e.g., tumbleweeds). After rare storm events, regrading of the berm might be required to repair erosion damage. This is expected to occur infrequently; however inspections will be conducted in Accordance with Addendum I, Inspections.

C.3.3.7 Control of Wind Dispersal

Wind dispersal of mixed waste for decommissioned, defueled reactor compartments is prevented by the design and containment of the disposal container. No additional measures are necessary.

C.3.3.8 Liquids in Landfills

Free liquids requirements are identified in WAC 173-303-665(13) and WAC 173-303-140(4)(b). Residual liquids in reactor compartments meet these requirements as described in the waste analysis plan (Addendum B).

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