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4.0 ENVIRONMENTAL IMPACTS

This chapter evaluates the potential environmental impacts associated with the construction and operation of the proposed Eagle Rock Enrichment Facility (EREF). The chapter is divided into sections that assess the impact to each related resource described in Chapter 3, Description of the Affected Environment. These include land use (4.1), transportation (4.2), geology and soils (4.3), as well as water (4.4), ecological (4.5), air quality (4.6), noise (4.7), historic and cultural (4.8), and visual/scenic (4.9). Other topics included are socioeconomic (4.10), environmental justice (4.11), public and occupational health (4.12), and waste management (4.13).

4.1 LAND USE IMPACTS

4.1.1 Construction Impacts

The proposed Eagle Rock Enrichment Plant (EREF) will be built on land which is currently privately owned by a single landowner. Since the site is currently used for crops and grazing, potential land use impacts will be from site preparation and construction activities.

The proposed EREF site is approximately 1,700 ha (4,200 ac) in size. Construction activities, including permanent plant structures, will disturb about 165 ha (407 ac). Temporary construction facilities, parking areas, material storage, and excavated areas for underground utilities will disturb an additional 75 ha (185 ac). The total disturbed area will, therefore, be 240 ha (592 acres). The temporary construction area will be restored after completion of plant construction. The balance of the property, 1,460 ha (3,608 ac), will be left in a natural state with no designated use. The plot plan and site boundaries of the permanent facilities indicating the areas to be cleared for construction activities are shown in ER Figure 2.1-2, Site Area and Facility Layout Map, and Figure 2.1-3, Existing Conditions Site Aerial Photograph.

During the construction phase of the facility, conventional earth, and rock moving and earth grading equipment will be used. Blasting and mass rock excavation may be required. However, only about 14% of the total site area will be disturbed, affording wildlife of the site an opportunity to move to undisturbed on-site areas as well as additional areas of suitable habitat bordering the plant (see Section 4.5, Ecological Resources Impacts). The construction will also result in a small loss of seasonal cattle grazing lands. No mitigation is necessary to offset this impact.

According to the Kettle Butte, Idaho, U.S.G.S. Quadrangle Map, the proposed property terrain currently ranges in elevation from about 1,556 m (5,106 ft) near U.S. Highway Route 20 to about 1,600 m (5,250 ft) in a small area aat the eastern edge of the property. The terrain in the area of the developed site facility footprint ranges in elevation from about 1,573 m (5,161 ft) above msl in the vicinity of the stormwater basins to 1,588 m (5,210 ft) above msl. Approximately 147 ha (363 ac) will be graded to bring the developed central footprint portion (i.e., building clusters and storage pads that drain to the stormwater basins) of the site to a final grade between 1,573 m (5,161 ft) to 1,585 m (5,200 ft) above msl at the stormwater detention basin. The material excavated will be used for on-site fill. Site preparation will include the cutting and filling of approximately 778,700 m^3 (27,500,000 ft^3) of soil with the deepest cut being 6 m (20 ft) and the deepest fill being 6 m (20 ft). Blasting will be used as necessary to aid in the removal of fractured basalt (hardened lava) where depth to bedrock interferes with the installation of utilities and installation of substructures.

The anticipated effects on the soil during construction activities are limited to a potential short-term increase in soil erosion. However, this will be mitigated by proper construction best management practices (BMPs). These practices include minimizing the construction footprint to the extent possible, limiting site slopes to a horizontal to vertical ratio of four to one or less, the use of a sedimentation detention basin, protection of undisturbed areas with silt fencing and straw bales as appropriate, and site stabilization practices such as placing crushed stone on top of disturbed soil in areas of concentrated runoff. In addition, as indicated in Section 4.2.5, Mitigation Measures (Transportation Impacts), on-site construction roads will be periodically watered down, if required, to control fugitive dust emissions. After construction is complete, the site will be stabilized with natural, low maintenance landscaping and pavement.

Impacts to land and groundwater will be controlled during construction through compliance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit obtained from Region 10 of the U.S. Environmental Protection Agency (EPA). A Spill Prevention, Control and Countermeasures (SPCC) plan will also be implemented during construction to minimize environmental impacts from potential spills and to ensure prompt and appropriate remediation. Potential spills during construction are likely to occur around vehicle maintenance and fueling locations, storage tanks, and painting operations. The SPCC plan will identify sources, locations and quantities of potential spills and response measures. The plan will also identify individuals and their responsibilities for implementation of the plan and provide for prompt notifications to state and local authorities, as required.

Waste management BMPs will be used to minimize solid waste and hazardous waste. These practices include the placement of waste receptacles and trash dumpsters at convenient locations and the designation of vehicle and equipment maintenance areas for the collection of oil, grease and hydraulic fluids. Where practicable, materials suitable for recycling will be collected. If external washing of construction vehicles is necessary, no detergents will be used, and the runoff will be diverted to an on-site retention basin. Adequately maintained sanitary facilities will be provided for construction crews.

4.1.2 Utilities Impacts

The EREF will require the installation of water and electrical utility lines. Sanitary waste will be treated in a packaged domestic Sanitary Sewage Treatment Plant. Solid wastes from the treatment system will be temporarily stored in a holding tank and disposed of at an off-site location. Residual treated sanitary effluent will be directed to the on-site retention basin (see Section 3.4, Water Resources).

Water will be provided from on-site groundwater wells for the proposed facility. Since there are no bodies of water between the site and Idaho Falls, no waterways will be disturbed.

Electrical transmission lines to provide a dual source of electrical feed will be installed as follows. A 161 kV transmission line originating at the existing Bonneville substation approximately 10 miles east of the EREF site will be constructed. This new transmission line will be relocated with an existing 69 kV transmission line right-of-way (row) between the Bonneville substation and the Kettle substation just to the east of the EREF site on Route 20. The new transmission line will then be constructed for a short distance along Route 20 to the site access road. The second 161 kV transmission line to the site will be from the existing Antelope substation which is 27 miles to the west. This transmission line will be constructed entirely along Route 20 to the site access road. Both transmission lines will then be run along the EREF access road to the facility substation. By installing the new transmission lines along existing row and Route 20, land use impacts are minimized. If needed, application for easements along Route 20 will be submitted to the state (IDAPA, 2008k).

Overall land use impacts to the site and vicinity will be changing the use from agriculture to industrial. The area is currently zoned G-1 (grazing), which permits manufacturing process facilities. A majority of the site (approximately 86%) will remain undeveloped, and the placement of most utilities will be along highway easements. Therefore, the impacts to land use will be small.

Federal actions that could have cumulative effects on the area include a Component Test Facility (CTF) supporting the High Temperature Gas Reactor at Idaho National Laboratory. This facility will be > 32 km (20 mi) from the EREF. Although the impact on land use in the region will vary depending on the exact location of the CTF in the INL boundary, additional impacts from the construction of the CTF are expected to be small. AES is unaware of any additional Federal or non-federal actions that will have cumulative land use impacts.

4.1.3 Comparative Land Use Impacts of No Action Alternative Scenarios

Chapter 2 provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants (GCP), USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The land use impacts will be the same since three enrichment plants are built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The land use impacts will be the same or less since only two of three GCPs will be built, but expansion at NEF will impact some additional land.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The land use impacts will be the same or less since only two of three GCPs will be built, but expansion at the American Centrifuge Plant (ACP) will impact some additional land.

4.2 TRANSPORTATION IMPACTS

The proposed Eagle Rock Enrichment Facility (EREF) site is located in Bonneville County, Idaho about 32 km (20 mi) west northwest of Idaho Falls and 0.8 km (0.5 mi) east of the Department of Energy Idaho National Laboratory (INL) boundary. The property is immediately north of U.S. Highway 20 and the proposed site for EREF buildings lies about 2.4 km (1.5 mi) north of U.S. Highway 20. Access roads, described below, will be built to provide direct access to the facility. To the east, U.S. Highway 20 intersects with Interstate 15 on the west side of Idaho Falls, Idaho. To the west of the proposed EREF, U.S. Highway 20 intersects with U.S. Highway 26 northwest of Atomic City. See Figure 2.1-1, 80-Kilometer (50-Mile) Radius with Cities and Roads, which depicts highways in the vicinity of the proposed EREF site. As discussed in Section 3.2, Transportation, there are several rail lines in the region. The nearest rail lines are located in Idaho Falls and include the Union Pacific Yellowstone Branch and Montana Main Branch, and the Eastern Idaho Rail Road line. These rail lines are about 32 km (20 mi) from the proposed EREF site. In addition, a Union Pacific Railroad line (Aberdeen Branch) runs parallel to U.S. Highway 26 about 40 km (25 mi) south of the proposed site. The Scoville Branch leads onto the Idaho National Laboratory ending at the Scoville Siding, which is about 40 to 45 km (25 to 28 mi) from the proposed site.

4.2.1 Impacts of Construction of Highway Entrances and Access Roads

U.S. Highway 20, where it passes the proposed site, is a two-lane highway with 12.5 m (41 ft) of pavement for driving lanes and shoulders, centered on a right-of-way easement of 122 m (400 ft). The posted speed limit is 105 kilometers per hour (65 mph). A packed-dirt road currently provides access to the proposed site from U.S. Highway 20. That road will provide temporary access to the site until two new access roadways off of U.S. Highway 20 are built to support construction and operation activities.

AREVA Enrichment Services (AES) is working with the Idaho Transportation Department (ITD) to design and receive permit approval for access to U.S. Highway 20.

Construction of the highway entrances may result in slightly longer commute times for INL workers and others using the road during high volume hours. Lowered traffic speeds for through traffic may result when commuting construction workers are turning off and onto U.S. Highway 20. Transportation of equipment and material requiring large trucks will occur during times of low traffic volume and therefore will not disrupt traffic on U.S. Highway 20.

Additional impacts from construction of the highway entrances and access roads will include the generation of fugitive dust, vehicle emissions, changes in scenic value, and increased noise levels. In addition, construction of the access roads will impact wildlife and habitat. Construction of the highway entrances will have minimal impacts to wildlife and habitat because the areas for the highway entrances have been previously disturbed.

Air quality impacts from construction and site preparation (including construction of highway entrances and access roads) for the proposed EREF were evaluated using emission factors and air dispersion modeling. Emission rates for fugitive dust were calculated using emission factors provided in AP-42, the U.S. Environmental Protection Agency's Compilation of Air Pollutant Emission Factors (EPA, 1995). A more detailed discussion of air emissions and dispersion modeling can be found in Section 4.6.1, Air Quality Impacts from Construction.

Emission rates for fugitive dust during construction, as listed in Table 4.6-1, Peak Emission Rates, were estimated for a 10-hour workday, 5 days/week, 52 weeks/year. Fugitive dust would originate predominantly from vehicle traffic on unpaved surfaces, earth moving and excavating equipment, and to a lesser extent from wind erosion. Fugitive dust emissions were estimated using an AP-42 emission factor for construction site preparation that was adjusted to account for dust suppression measures and the fraction of total suspended particulate that is expected to be in the range of particulates less than or equal to 10 micrometers (PM_{10}) in diameter and less than or equal to 2.5 micrometers ($PM_{2.5}$) in diameter. The calculated total work-day average emissions result for PM_{10} emissions was determined to be 21.8 g/s (172.7 lb/hr) and 3.3 g/s (25.9 lb/hr) for $PM_{2.5}$ emissions.

Fugitive air emissions were modeled as a uniform area source with emissions occurring 10 hours per day, 5 days per week, and 52 weeks per year. PM_{10} emissions from fugitive dust were also below the National Ambient Air Quality Standards (NAAQS) (CFR, 2008nn). Fugitive dust emissions estimates were assumed to occur throughout the year and a 90% reduction in the fugitive dust emissions was assumed for dust suppressant activities.

As discussed in Section 4.9, Visual/Scenic Resources Impacts, impacts to visual and scenic resources from construction of the highway entrances and access roads will include the presence of construction equipment and dust. Construction equipment will be out of character with the current uses and features of the site, and the surrounding properties. Construction of the highway entrances and access roads near U.S. Highway 20 will be most visible to the public, including traffic along U.S. Highway 20 and visitors to the Hell’s Half Acre Wilderness Study Area (WSA). Road and road access construction will be relatively short-term; construction equipment will not be tall, thereby minimizing the potential for the equipment to obstruct views, and dust suppression mitigations will be used to minimize visual impacts. Therefore, impacts to visual resources from construction of the highway entrances and access roads will be small.

Noise levels up to 60 dBA are considered “clearly acceptable” under the U.S. Department of Housing and Urban Development (HUD) Land Use Compatibility Guideline for Residential and Livestock Farming Land Uses, “normally acceptable” between 60 and 65 dBA for Residential Land Uses, and “normally acceptable” between 60 and 75 dBA for Livestock Farming Land Uses. Noise levels under 55 dBA would not exceed the U.S. Environmental Protection Agency (EPA) defined goal of 55 dBA for Day-Night Average Sound Level (Ldn) for outdoor spaces (EPA, 1974). As detailed in Section 4.7, Noise Impacts, equipment used during construction of the highway entrances and access roads will generate noise levels that will range from 80 to 95 dBA at 15 m (50 ft). Maximum noise levels from construction of the proposed access roads will be about 89 dBA at the nearest site boundary, about 37 m (120 ft) west of the proposed access roads. These noise levels will only occur during construction of the access road.

Noise associated with construction of the access roads is estimated to be reduced to approximately 51 to 66 dBA at the Hell’s Half Acre Wilderness Study Area (WSA) nearest trail point which is about 0.5 km (0.3 mi) from the nearest proposed highway entrance. Similarly, noise will be reduced to about 44 to 59 dBA at the WSA trailhead which is about 860 m (2,821 ft) from the nearest proposed highway entrance and noise will be reduced to about 37 to 52 dBA at the Wasden Complex archaeological sites which are about 2.3 km (1.4 mi) from the nearest portion of the proposed EREF footprint. Construction noise levels will diminish to about 46 to 61 dBA at the nearest site boundary to the proposed EREF footprint, about 825 m (2,707 ft). As a result, access road construction will be audible at the WSA and along U.S. Highway 20 during certain periods but only during construction activities associated with the highway entrances and a short portion of the access roads.

Noise from construction activities will be similar to traffic noise along U.S. Highway 20 during working hours. Noise levels recorded during peak commute times on U.S. Highway 20 were found to be 57 dBA at 15 m (50 ft) in June 2008. As a result, overall impacts from noise generated by construction of the highway entrances and access roads will be small and temporary.

The new access roads leading to the proposed EREF from U.S. Highway 20 will disturb some animal habitat, displace mobile animals (e.g., birds), and may result in mortality of less mobile animals such as mice. In addition, noise from construction of the highway entrances and access roads will also impact wildlife. As discussed in Section 4.5, Ecological Resources Impacts, noise during construction will result in reduced habitat use by wildlife. Construction of the access road would disturb seeded crested wheatgrass vegetation, which provides less quality habitat for wildlife compared to sagebrush steppe vegetation (see Section 3.5.2, General EcologicalConditions of the Site and Section 3.5.3, Description of Important Wildlife and Plant Species). Because of the lower quality habitat, the use of the crested wheatgrass area by large game animals (e.g., pronghorn) or greater sage grouse is expected to be minimal. Therefore, impacts to wildlife will be primarily on small mammals and common bird species and will be small.

There will be a small potential for fire from construction equipment during site clearing. This risk will be reduced once the site has been cleared. Best Management Practices will be implemented, including keeping equipment exhaust systems cleared of brush, and having on-site fire protection equipment, including water and fire extinguishers.

4.2.2 Transportation Route

The primary transportation route for conveying construction and operation materials, including UF_6, to the proposed site will be by way of Interstate 15 to U.S. Highway 20. The intersection of Interstate 15 and U.S. Highway 20 is about 32 km (20 mi) east of the proposed site. The mode of transportation for conveying construction material will consist of over-the-road trucks, ranging from heavy-duty 18-wheeled trucks and dump trucks, to box- and flatbed-type light-duty delivery trucks. If a rail spur were to be extended to the site, some materials would be delivered by train; however, as stated above, no rail spur is contemplated at this time. Material delivery during operations will similarly include heavy-duty 18-wheeled trucks and dump trucks, and box- and flatbed-type light-duty delivery trucks.

4.2.3 Traffic Patterns

U.S. Highway 20 will provide direct access to the proposed site. U.S. Highway 20 serves as the main east-west thoroughfare for traffic to the INL, located west of the proposed site. Traffic volumes are high Monday through Friday during commuting times. Peak commute times range from about 5:00 a.m. through 7:30 a.m. and about 3:30 p.m. through 6:00 p.m. Traffic volumes are low during non-commute times and weekends. Ingress and egress onto U.S. Highway 20 during commuting times can be difficult. AES is working with the ITD to design and receive permit approval for access to U.S. Highway 20.

According to the ITD, no upgrades are planned to U.S. Highway 20 at this time (BMPO, 2005) (ITD, 2008a) (ITD, 2008b). However, three areas between Idaho Falls and the proposed EREF site were identified by ITD as candidates for passing lanes. One of those areas is about 1.6 km (1.0 mi) east of the proposed site. Current traffic volume for nearby impacted road systems is shown in Table 4.2–1, Current Traffic Volume for the Major Roads in the Vicinity of the Proposed EREF Site.

4.2.4 Traffic Impacts

Section 4.10.2.1 states that the long-term, operational workforce at the proposed EREF will be up to 420 people. Thus, the potential maximum increase in traffic on U.S. Highway 20 due to operational workers is 420 roundtrips per 24 hour day. This is an upper bound estimate since all workers do not work on any given day and there will be three work shifts each day. Three shifts per day, seven days per week totals 21 shift changes per week. Based on five shifts per employee per week, it will require approximately 4.2 employees to staff each position around the clock each week. Since the operational staff will be up to 420, this will result in an average of approximately 100 positions per shift. Allowing for some routine absences, i.e., sick and vacation time, and car pooling, the average vehicles per shift should be less than 100. The day shift (first shift) during the normal work week will generate more vehicles per shift change since some of these positions are not staffed around the clock, e.g., some administration positions. Second and third shifts as well as weekend shifts will have fewer vehicles per shift change than average since all staff positions will not routinely work during these off shifts. Most vehicles will likely travel to and from the site on U.S. Highway 20, through the city of Idaho Falls, Idaho. Therefore, there will be up to 300 operational employee round trips per day which results in up to 600 trips per day.

The maximum potential increase to traffic due to operational deliveries, uranium feed and product, depleted uranium and empty cylinder shipments to and from the facility, and waste removal would be approximately 5,463 roundtrips per year. This value is based on an estimated 2,509 UF_6 and low-level radioactive waste shipments per year, 2,800 non-radiological shipments per year and 154 hazardous, non-hazardous and non-radiological waste shipments per year. Assuming 250 work days per year for material shipments, this will result in about 44 vehicle trips per day on U.S. Highway 20. Table 4.2-2, Annual Shipments to/from the proposed EREF (by Truck) during Operation, presents the materials, container types, and estimated annual number of UF_6 shipments to/from the proposed EREF.

As discussed in Section 3.12, Waste Management, the annual volumes of hazardous wastes will be small. These wastes, which are principally from maintenance operations in the Technical Support Building, will be disposed at a facility that accepts hazardous wastes. Since the quantities of hazardous wastes will be small, wastes would be shipped approximately four times per year. It is expected that each shipment will contain approximately 633 kg (1,395 lbs) of hazardous waste.

The hazardous wastes will be transported to a Resource Conservation Recovery Act (RCRA)-approved treatment, storage, and disposal facility (TSDF). For example, there is a local TSDF, operated by U.S. Ecology, located near Grandview, Idaho. The Grandview facility is a treatment and disposal facility with a permitted disposal area that can accommodate more than 4.5 million m^3 (5.9 million yd^3) of waste. The Grandview facility has submitted a permit modification for an additional 0.57 million m^3 (0.75 million yd^3) and will be submitting a permit for a new landfill cell with a capacity of about 6.9 million m^3 (9 million yd^3). The annual number of deliveries to a hazardous waste receiver is expected to be approximately four.

There are two regional TSDFs that dispose of low level waste (LLW), a U.S. Ecology facility near Richland, Washington and an Energy Solutions facility near Clive, Utah. The U.S. Ecology facility has been in operation since 1968 and is licensed through 2058. It has 40.5 ha (100.0 ac) of disposal area and only about 40% of this capacity has been used during its 40 years of operation. The Energy Solutions facility also accepts mixed low level waste (MLLW) for disposal. The Energy Solutions facility has about 25 years of total capacity (all bulk waste types) remaining under an existing receipt rate of about 5.4 million m^3/yr (7 million yd^3/yr). MLLW is about 10% of bulk waste accepted at the facility.

As reflected in Table 3.12-2, Estimated Annual Non-Radiological Wastes, non-radiological, non-hazardous wastes primarily consist of miscellaneous combustible wastes, miscellaneous scrap metals, spent vehicle motor oil, spent vehicle oil filters and building ventilation air filters. Non-radiological, non-hazardous wastes come from various operations throughout the facility, and will be disposed of at a standard waste disposal site (e.g., landfill). The estimated volume of building ventilation air filters for disposal will fill approximately 185, 6-m^3 (8-yd^3) dumpsters per year. It is expected that the waste disposal company will unload at least two of these dumpsters into the truck per trip. Therefore, approximately 93 truck shipments per year are expected for disposal of these filters.

Based on discussions with waste disposal companies and experience, it is expected that all other non-radiological, non-hazardous wastes will fill two 6 m^3 (8 yd^3) dumpsters per week. It is expected that the waste disposal company will empty these dumpsters every week using one truck. Therefore, approximately 52 truck shipments per year are expected for disposal of all other non-radiological, non-hazardous wastes. Based on the above, it is expected that approximately 145 to 150 truck shipments will be required per year to remove all non-radiological, non-hazardous wastes from the EREF.

The non-radiological, non-hazardous wastes could be disposed of at a county landfill. The Peterson Hill Landfill in Idaho Falls, ID has a remaining capacity of more than 50-years, which is expected to be adequate for disposal of EREF wastes and other local area wastes. Other regional landfills (e.g., Aberdeen Landfill, Bingham County, Idaho) are also options for disposal of this type of waste material. As discussed in Section 3.12.2, Solid Waste Management industrial waste, including miscellaneous trash, vehicle air filters, empty cutting oil cans, miscellaneous scrap metal, and paper will be shipped off site for minimization and then sent to a licensed waste landfill. During operation, a non-hazardous materials waste recycling plan will be implemented. A waste assessment will be performed to identify which materials will be recycled. Brokers and haulers will be contacted to find an end-market for the materials. Employees will be trained to recycle the identified materials. Recycling bins and containers will be labeled and placed in appropriate locations in the facility. The annual number of deliveries to the non-radiological, non-hazardous waste receiver is expected to be no more than 150.

The combined daily trips (employees, deliveries, waste shipments) during operations will be about 644 vehicle trips per day (600 plus 44). This represents a 28% increase over current daily traffic volume of 2,282 vehicles per day on U.S. Highway 20. Refer to Table 4.2-1, current Traffic Volumes for the Major Roads in the Vicinity of the Proposed EREF Site. Car pooling would be encouraged to minimize the traffic due to employee travel. Shift change times and shipment times to and from the facility could be set so as to occur at times when the traffic volume on U.S. Highway 20 is typically at a minimum.

Referring to Table 4.10-2, Estimated Number of Construction Craft Workers by Annual Pay Ranges, the maximum number of construction workers is expected to be 590 during the peak of the eight-year construction period. Thus, the maximum potential increase to traffic due to construction workers will be 1,180 trips per day. In addition, there will be an average of about 15 roundtrips per day (30 vehicle trips per day) on U.S. Highway 20 due to construction deliveries and waste removal during the first three years of construction (i.e., period of site preparation and major building construction) with reduced delivery and waste removal trips for the remaining construction period (refer to Table 4.2-3, Supply Materials Shipped to the Proposed EREF During the First Three Years of Construction, and Table 4.2-4, Waste Materials Shipped from the Proposed EREF During the First Three Years of Construction. This value does not include the number of truck deliveries for centrifuge and process equipment. Based on experience at European enrichment plants, there will be about two trucks per day delivering centrifuge and process equipment to the facility. These deliveries will occur during the four to five year period that the centrifuges are being assembled for installation in the facility.

Therefore, the combined daily trips (employee and delivery) during construction will be about 1,210 vehicle trips per day on U.S. Highway 20. This represents a 53% increase over current daily traffic volume of 2,282 vehicles per day on U.S. Highway 20. This is the maximum number of additional vehicle trips anticipated even when project construction and operations activities overlap. Car pooling will be encouraged to minimize the traffic due to employee travel. Shift change times and shipment times to and from the site could be set so as to occur at times when traffic volume on U.S. Highway 20 is typically at a minimum.

The impacts of traffic volume increases associated with construction of the EREF will be moderate to large, while the impacts of traffic volume increases associated with operation of the EREF will be small. The moderate to large impact of traffic volume increases associated with construction of the EREF will be mitigated by constructing the highway entrances early in the construction process and designing the highway entrances to minimize the disruption of traffic flow, particularly during the times of peak commute.

Impacts from on-site construction traffic, after the highway entrances and access roads are constructed, will include vehicle emissions, changes in scenic value, increased noise levels, potential vehicle-wildlife collisions, and disturbance of adjacent habitat by wildlife. Traffic volumes will be observable during shift changes and will reduce the scenic quality of the view of the site. Noise levels will be lower than noise levels on U.S. Highway 20 because traffic will be traveling much slower. Wildlife will likely avoid the access roads, particularly when shift changes occur, due to noise; however, some wildlife mortality of birds and small mammals will occur as animals become habituated to the activities on site. Reduced traffic speeds and lighting at night will reduce wildlife mortality.

Impacts of Decontamination and Decommissioning (D&D) will be similar to operations with a slight increase due to a few more daily deliveries of material and waste removal trips and an increase in worker trips when operation and D&D activities are concurrent. The increase in worker trips will not approach the number of workers during construction and, therefore, will be a small increase. Transportation impacts from D&D will be small.

4.2.5 Mitigation Measures

Mitigation measures will be used to reduce traffic volumes, and minimize fugitive dust production, noise, and wildlife mortality. These measures may include the following:

- Encouraging car pooling to minimize traffic due to employee travel.
- Staggering shift changes to reduce the peak traffic volume on U.S. Highway 20.
- Construction and use of acceleration and deceleration lanes to improve traffic flow and safety on U.S. Highway 20 at the proposed EREF highway entrances.
- Using water or surfactants for dust suppression on dirt roads, in clearing and grading operations, and construction activities. Water conservation will be considered when deciding how often dust suppression water sprays would be applied.
- Using adequate containment methods during excavation and other similar operations including minimizing the construction footprint, limiting site slopes to a horizontal to vertical ratio of four to one or less, constructing a sedimentation detention basin, protecting undisturbed areas with silt fencing and straw bales, and placing crushed stone on top of disturbed soil in areas of concentrated runoff.

- Covering open-bodied trucks that transport materials likely to give rise to airborne dust.
- Promptly removing earthen materials on paved roads carried onto the roadway by wind, trucks, or earth moving equipment.
- Promptly stabilizing or covering bare areas once roadway and highway entrance earthmoving activities are completed.
- Maintaining low speed limits on site to reduce noise and minimize impacts to wildlife.

4.2.6 Agency Consultations

U.S. Highway 20 has allowable unit weight capacities ranging from 13,608 kg (30,000 lb) for single axle up to 29,257 kg (64,500 lb) for three-axel vehicles (ITD, 2008d). Overweight capacity can be as high as 90,718 kg (200,000 lbs), depending on the vehicle configuration (ITD, 2008e). AES will obtain permits for oversized or overweight vehicle trips as needed (IDAPA, 2008l). Site access from U.S. Highway 20 will require a state highway access permit for highway modification (IDAPA, 2008k). Similarly, a permit will be obtained for the electric transmission lines aligned in the U.S. Highway 20 right-of-way.

4.2.7 Radioactive Material Transportation

Radioactive material shipments will be transported in packages that meet the requirements of 10 CFR 71 (CFR, 2008e) and 49 CFR 171-178 (CFR, 2008j). The NRC has evaluated the environmental impacts resulting from the transport of nuclear materials in NUREG-0170, Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes (NRC, 1977a), updated by NUREG/CR-4829, Shipping Container Response to Severe Highway and Railway Accident Conditions (NRC, 1987). These references include accident scenarios related to the transportation of radioactive material. The NRC found that these accidents have no significant environmental impacts. The materials that will be transported to and from the EREF are within the scope of the environmental impacts previously evaluated by the NRC. Because these accident-related impacts have been addressed in a previous NRC environmental impact statement (NRC, 1977a), these impacts do not require further evaluation in this report.

The dose equivalent to the public and worker for incident-free transportation as well as the Maximally Exposed Individual (MEI) has been conservatively calculated to illustrate the relative impact resulting from transporting radioactive material. Uranium feed, product, tails and associated low-level waste (LLW) will be transported to and from the EREF. The following sections describe each of these conveyances, associated routes, and the dose contribution to the public and worker, as well as non-radiological environmental impacts associated with vehicle transportation.

4.2.7.1 Radioactive Material Annual Quantities

The annual radioactive material quantity of packages and associated shipments transported to and from the EREF are summarized on Table 4.2-5, Annual Radioactive Material Quantities and Shipments, and are discussed separately below.

4.2.7.1.1 Uranium Feed

The uranium feed for the facility is natural uranium in the form of uranium hexafluoride (UF_6). The UF_6 is transported to the facility in 48Y cylinders. These cylinders are designed, fabricated and shipped in accordance with American National Standard Institute (ANSI) N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Feed cylinders are transported to the site by 18-wheeled trucks, one per truck. Since the facility has an operational capacity of 712 feed cylinders per year (Type 48Y), up to 712 shipments of feed cylinders per year will arrive at the site.

4.2.7.1.2 Uranium Product

The enriched uranium from the facility is transported in 30B cylinders. These cylinders are designed, fabricated and shipped in accordance with ANSI N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Product cylinders are transported from the site to fuel fabrication facilities by modified flat bed truck. Typically, two product cylinders are shipped per truck. There will be approximately 516 product cylinders shipped per year, which would typically result in a shipment frequency of approximately one shipment per 1½ days (258 shipments per year).

4.2.7.1.3 Depleted Uranium Tails

Depleted uranium tails will be shipped to conversion facilities via truck in 48Y cylinders similar to feed cylinders. These cylinders are designed, fabricated and shipped in accordance with ANSI N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Depleted uranium tails will be transported from the site by 18-wheeled trucks, one per truck. Since the facility has an operational capacity of approximately 611 tails cylinders containing depleted uranium per year (Type 48Y), approximately 611 shipments of depleted uranium tails per year will leave the site. At present, depleted uranium tails will be temporarily stored on site until shipment to the conversion facilities.

4.2.7.1.4 Radioactive Waste

Waste materials are transported in packages by truck via highway in accordance with 10 CFR 71 (CFR, 2008b) and 49 CFR 171-178 (CFR, 2008j). Detailed descriptions of radioactive waste (radwaste) materials that will be shipped from the facility for disposal are presented in Section 3.12, Waste Management. Table 3.12-1, Estimated Annual Radiological and Mixed Wastes, presents a summary of these waste materials. Based on the expected generation rate of radwaste, an estimated 477, 55-gallon drums of solid waste are expected annually. Using a nominal 60 drums per radwaste truck shipment, approximately eight radwaste shipments per year are anticipated.

4.2.7.1.5 Empty Cylinders

The number of empty cylinders to be transported annually is as follows: empty feed cylinders (712), empty product cylinders (516), and empty deleted uranium tails cylinders (611). These cylinders are included because they contain decaying residual material (heel) and produce a higher dose equivalent than full 48Y cylinders due to the absence of self-shielding. The empty feed cylinders (with heel) are assumed to be shipped two per truck, totaling 356 shipments per year. The empty product cylinders (with heel) are assumed to be shipped two per truck, totaling 258 shipments per year. The empty depleted uranium tails cylinders (with heel) are assumed to be shipped two per truck, totaling 306 shipments per year.

4.2.7.2 Transportation Modes, Treatment and Packaging

The radioactive materials transported to and from the facility will be transported by truck by way of highway travel only, since rail spurs and barge slips are not available at the proposed facility site.

There will be no treatment of hazardous materials or mixed waste at the EREF that will require a Resource Conservation and Recovery Act (RCRA) permit (CFR, 2008gg). Specific handling of radioactive and mixed wastes is discussed, in detail, in ER Section 3.12, Waste Management. Packaging of product material, radioactive waste and mixed waste will be in accordance with plant implementation procedures that follow 10 CFR 71 (CFR, 2008e) and 49 CFR 171-178 (CFR, 2008j). Product shipments will have additional packaging controls in accordance with ANSI N14.1, Uranium Hexafluoride - Packaging for Transport (ANSI, applicable version). Radwaste materials will have additional packaging controls in accordance with each respective disposal or processing site's acceptance criteria.

4.2.7.3 Transportation Routes and Distances

The proposed site is located in eastern Idaho about 32 km (20 mi) west northwest of Idaho Falls, Idaho and immediately east of the Department of Energy (DOE) Idaho National Laboratory (INL) in Bonneville County, Idaho. The primary transportation route between the site and the conversion, fuel fabrication and disposal facilities is via U.S. Highway 20 to Interstate 15 on the west edge of Idaho Falls, about 32 km (20 mi) east of the site.

The feed and product materials of the facility will be transported by truck via highway travel only. Most of the feed material is expected to be obtained from UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL, although a small amount could come from other non-domestic sources. Empty feed cylinders (with heel) are assumed to be returned from the EREF to the UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL, as well as to ports for overseas shipping near Portsmouth, VA, and Baltimore, MD. The product could be transported to fuel fabrication facilities near Richland, WA, Columbia, SC, and Wilmington, NC, and to the ports for overseas shipping near Portsmouth, VA, and Baltimore, MD. Empty product cylinders (with heel) are assumed to be returned to the EREF from the fuel fabrication facilities near Richland, WA, Columbia, SC, and Wilmington, NC. The designation of the supplier of UF_6 and the product receiver is the responsibility of the utility customer.

Waste generated from the enrichment process may be shipped to a number of disposal sites or processors depending on the physical and chemical form of the waste. Potential disposal sites or processors are located near Hanford, WA; Clive UT; Oak Ridge, TN; Paducah, KY; and Portsmouth, OH. Radioactive waste shipments could be transported to disposal sites or processors located near Hanford, WA, Clive UT, and Oak Ridge, TN. Depleted uranium tails cylinders could be transported to depleted UF_6 conversion facilities located near Paducah, KY, and Portsmouth, OH. To obtain cylinders for depleted uranium tails, empty depleted uranium tails cylinders are assumed to be transported to the EREF from UF_6 conversion facilities near Port Hope, Ontario and Metropolis, IL; from depleted UF_6 conversion facilities near Paducah, KY, and Portsmouth, OH; and from ports for overseas shipping near Portsmouth, VA, and Baltimore, MD. Refer to Section 3.12.2.1, Radioactive and Mixed Wastes, for disposition options of other wastes. Table 4.2-6, Potential Transportation Origins/Destinations and Distances, presents potential origins and destination sites for the transportation of radioactive material along with the approximate distances as generated from the TRAGIS computer code (Johnson, 2003).

4.2.7.4 Incident-Free Dose Radiological Impact

RADTRAN (Weiner, 2006) was used to calculate the incident-free dose based on TRAGIS location-specific results, applicable NRC RADTRAN model inputs used in NUREG-1790 (NRC, 2005b), and transportation impact assessments performed by DOE (DOE, 1999) (DOE, 2001b) (DOE, 2002c). The NRC and DOE RADTRAN model inputs are similar to the EREF model inputs designed for the uranium enrichment cycle radioactive material shipments. Differences in EREF model inputs are due to site location and throughput as presented in Table 4.2-5, annual Radioactive Material Quantities and Shipments, Table 4.2-6, Potential Transportation Origins/Destinations and Distances, and Table 4.2-7, TRAGIS Output.

Table 4.2-8, Annual Incident-Free Dose from Radioactive Material Transportation, presents the incident-free dose for workers and the public affected by the transportation of radioactive materials to and from the EREF. A scenario based methodology was used to estimate the dose to the MEI based on conservative shipment parameters and exposure durations. The MEI results are given per individual in Section 4.2.7.4.2, Maximally Exposed Individual. Table 4.2-9, EREF Non-Radiological Environmental Impact from Vehicle Emissions, presents the non-radiological environmental impact of radioactive material transportation to and from the EREF.

4.2.7.4.1 Worker and Public

This section summarizes the incident-free transportation environmental impacts during the 30 year normal operations for the EREF. Transportation categories include the transport of full and empty feed cylinders, full and empty product cylinders, full and empty depleted uranium tails cylinders, and radwaste containers. Containers are loaded onto trailers for truck transportation to and from the EREF. The incident-free dose to the worker and public during the transportation of radioactive material is calculated using the TRAGIS (Johnson, 2003) and RADTRAN (Weiner, 2006) computer codes.

The TRAGIS code was run for the origin/destination combinations presented on Table 4.2-6, Potential Transportation Origins/Destinations and Distances. TRAGIS inputs for Highway Route Controlled Quantity (HRCQ) route characteristics account for required state inspections. State inspections are not required for routine commercial transportation, therefore, the TRAGIS input for commercial route characteristics do not include state inspections. In all route cases the exclusive-use, radioactive material shipments will retain two-drivers, and prohibit use of links prohibiting truck use, ferry crossings, and roads with hazardous materials prohibitions.

The TRAGIS output for the various cases are presented in Table 4.2-7, TRAGIS Output. Figure 4.2-1 through Figure 4.2-6 show the potential transportation routes for each category of radioactive material. To assess the most conservative (maximum) impact, the facilities for each type of shipment were chosen for analysis based on the furthest distance and to a lesser degree, population density. From the results presented in Table 4.2-7, TRAGIS Output, results, it is clear that the following origin/destination routes will have the highest impact per shipment, and therefore will demonstrate the most conservative impact.

- Feed: Portsmouth, VA
- Product: Wilmington, NC
- Radwaste: Oak Ridge, TN
- Depleted Uranium Tails: Portsmouth, OH
- Empty Feed: Portsmouth, VA
- Empty Product: Wilmington, NC
- Empty Depleted Uranium Tails: Portsmouth, VA

The TRAGIS demographic results from Table 4.2-7, TRAGIS Output, are inputs to RADTRAN for each route. RADTRAN input parameters based on packaging and route characteristics are presented on Table 4.2-10, RADTRAN Input. References for each major input source are provided in Table 4.2-10, RADTRAN Input.

The dose rate input at a distance of 1.0 m (3.3 ft) from the container is based on varying references (NRC, 2005b; NRC, 2006; DOE, 1999; DOE, 2001b; DOE, 2002c) showing a range of dose rates gathered from calculated or historical measurements for each waste type. In all instances for any waste type, the maximum dose rate recorded is 0.01 mSv/hr (1.00 mrem/hr). Therefore, a conservative value of 0.01 mSv/hr (1.00 mrem/hr) was used for all of the full cylinder container/vehicle dose rate values for the RADTRAN cases for the EREF. Empty cylinder dose rates are higher because they contain decaying residual material (heel) and produce a higher dose equivalent than full cylinders due to the absence of self-shielding. Based on actual cylinder transportation experience, container/vehicle dose rate values for empty feed cylinders and empty depleted uranium tails cylinders are assumed to have an average dose rate of 0.03 mSv/hr (3.00 mrem/hr) at 1.0 m (3.3 ft), and container/vehicle dose rate values for empty product cylinders are assumed to have an average dose rate of 0.05 mSv/hr (5.00 mrem/hr) at 1.0 m (3.3 ft).

The number of annual shipments for each material is presented on Table 4.2-5, Annual Radioactive Material Quantities and Shipments. The number of containers per truck assumed is as described in Sections 4.2.7.1.1 through 4.2.7.1.5. Other RADTRAN inputs are as reflected in Table 4.2-10, RADTRAN Input.

RADTRAN results for incident-free transportation dose to the worker (crew) and public (off-link, on-link, rest and inspection stops) are summarized on Table 4.2-8, Annual Incident-Free Dose from Radioactive Material Transportation. The transportation dose is for dose incurred during exclusive use transport, and is exclusive of worker dose associated with EREF on-site shipment preparation activities. The dose is conservative based on the maximum impact, origin/destination scenarios for each radioactive material type, and the container dose rate. The dose is an annual dose averaged over the facility license life.

4.2.7.4.2 Maximally Exposed Individual

A maximally exposed individual (MEI) is a person who may receive the highest radiation dose from a shipment to and/or from the EREF. The MEI impact is the potential dose for individuals exposed to any one shipment given the maximum exposure for all pathways. The shipment dose is independent of source, and is based on the postulated exposure scenarios. The incident-free MEI scenario assumptions are taken from the other uranium enrichment cycle environmental analyses such as the DOE Final Programmatic Environmental Impact Statement for Depleted Uranium (FPEIS) (DOE, 1999) and the DOE/Argonne National Laboratory (ANL) Transportation Impact Assessment for Shipment of Uranium Hexafluoride (DOE, 2001b). The analysis is based on assumptions about exposure durations, dose rate, and the number of times an individual may be exposed to an offsite shipment. The assumptions for workers and the public are as follows (DOE, 1999):

<u>Workers</u>

Truck Crew Members: Truck crew members are assumed to be occupational radiation workers and will be monitored by a dosimetry program. Therefore, the maximum allowable dose will be limited by 10 CFR 20 (CFR, 2008x).

Non-radiation workers, or the general public will receive much less exposure, as demonstrated below.

<u>Public</u>

Inspectors: Inspectors are assumed to be either federal or state vehicle inspectors. Inspectors are not assumed to be monitored by a dosimetry program. An average exposure distance of 3.0 m (10 ft) and an exposure duration of 30 minutes are assumed.

Resident: A resident is assumed to live 30.0 m (98 ft) from a site entrance route. Shipments pass at an average speed of 24 km/hr (15 mph), and the resident is exposed unshielded. Cumulative doses are assessed for each site on the basis of the number of shipments entering or exiting the site, with the assumption that the resident is present for 100% of the shipments.

Person in Traffic Obstruction: A person is assumed to be stopped next to a shipment (e.g., because of traffic slowdown). The person is assumed to be exposed unshielded at a distance of 1.0 m (3.3 ft) for 30 minutes.

Person at Truck Service Station: A person is assumed to be exposed at an average distance of 20.0 m (66 ft) for a duration of two hours. This receptor could be a worker at a truck stop.

The conservative vehicle dose rate assumption of 0.05 mSv/hr (5.00 mrem/hr), i.e., the average dose for empty products cylinders, at 1.0 m (3.3 ft) was used for the MEI calculation.

<u>Worker MEI Dose</u>

Truck crew members are trained radiation workers, and will receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period of time. Although unlikely, it is assumed that the maximum exposure for a crew member could occur. For any radioactive material type shipments, the crew member doses will be limited to 0.05 Sv (5.00 rem) per year, i.e., the limit for occupational exposures specified in 10 CFR 20 (CFR, 2008x). Therefore, a MEI worker could receive a potential maximum dose of 0.05 Sv/yr (5.00 rem/yr).

<u>Public MEI Dose</u>

From other enrichment cycle analyses (DOE, 1999; DOE, 2002c) that use the above assumptions, the MEI exposure scenario exhibiting the maximum dose to the public is the Person in Traffic Obstruction. For any given facility using these same assumptions, the Person in Traffic Obstruction scenario will always yield the most conservative or maximum exposure for all public exposure scenarios. This is because the only other input to the calculation is the shipment dose rate, which is a constant across all shipment scenarios. For the EREF, the empty product cylinder shipments will yield the most conservative exposure. An exposure to empty product cylinder shipments of 0.05 mSv/hr (5.00 mrem/hr) at 1.0 m (3.3 ft) exposes an individual stuck in traffic along side the vehicle for 30 minutes. This equates to a public MEI dose of .025 mSv (2.50 mrem) for one trip. There are 2,509 total radiological shipments per year of which 258 shipments per year are of empty product cylinders. On average, this is about one shipment per work day. In a scenario where a commuter will become stuck in traffic next to an EREF radioactive material truck every work day of the year, 260-days (52 weeks/year x 5 days/week), the MEI of the public could receive a potential maximum dose of 260 times 0.025 mSv/yr (2.50 mrem/yr) or 6.50 mSv/yr (0.65 rem/yr).

4.2.7.5 Non-Radiological Environmental Impact

4.2.7.5.1 Vehicle Emissions Fatality Risk

The non-radiological impact from incident-free transportation to/from the EREF is analyzed for fatality risk from vehicle emissions. The vehicle emissions are independent of source material and dependent on the class of vehicle. Consistent with other uranium enrichment cycle analyses such as those presented in NUREG-1790 (NRC, 2005b), DOE/ANL Transportation Impact Assessment for Shipment of Uranium Hexafluoride (DOE, 2001b) and the DOE Transportation Handbook (DOE, 2002c), the "Vehicle Emission Unit Risk Factors for Transportation Risk Assessments" risk analysis (Biwer, 1999) is used as a vehicle emission rate source for the EREF analysis. The conservative Class VIIIB vehicle emission rate of 8.36 E-10 fatalities/km (1.35 E-09 fatalities/mi) per 1 person/km^2 is used to calculate risk.

The risk for each link is the product of the annual round-trip distance, population density, and the vehicle emission rate:

Risk = link distance x 2 (round-trip) x annual shipments x population density x vehicle emission rate.

Table 4.2-9, EREF Non-Radiological Environmental Impact from Vehicle Emissions, summarizes the maximum route distances, population densities and subsequent emission risk by material type for workers and the public.

4.2.7.5.2 Accident, Fatality, and Injury Risk

The non-radiological impact from radioactive material transportation to/from the EREF is analyzed for vehicle accidents, accident fatalities, and accident injuries. The impact is in terms of annual risk based on the weighted incident rate (weighted by distance) and the maximum distance traveled per year. The incident rates are based on the rate data per individual state from "State-Level Accident Rates of Surface Freight Transportation: A Reexamination," Table 4 (Saricks, 1999). The distance traveled through each state is from TRAGIS output. All road designations for incident rate data are for interstate travel only, since primary and secondary road distances are not significant contributors to the total route distance.

Table 4.2-11 through Table 4.2-14 presents the weighted incident rate calculation for accidents, fatalities, and injuries for shipment of feed/empty feed/empty depleted uranium tails cylinders, product/empty product cylinders, radwaste, and depleted uranium tails cylinders, respectively. The weighted incident rates are multiplied by the total round-trip distances traveled for each respective route to yield risk per round-trip (route distance x 2). The total annual risk is the sum of all shipment risks per year.

Table 4.2-15, EREF Non-Radiological Environmental Impact from Vehicle Incidents presents the risk per trip and subsequent annual total risk for transportation incidents given the maximum route distance for radioactive material transportation to/from the EREF.

4.2.8 Cumulative Impacts

Cumulative traffic impacts will include traffic volumes associated with the EREF in combination with existing traffic on U.S. Highway 20. There are currently about 2,282 daily vehicle trips on U.S. Highway 20, this includes traffic associated with INL and the city of Idaho Falls. AES does not know of any Federal, State or private development plans within 16 km (10 mi) of the EREF. The cumulative impact of existing traffic and EREF traffic will result in a range of total daily vehicle trips between 2,926 trips per day (current traffic levels plus EREF operations traffic) and 4,136 trips per day (current traffic levels plus EREF construction and EREF operations traffic). During the construction timeframe of the EREF, the cumulative transportation impacts will be moderate to large. During the operations timeframe of the EREF, the cumulative transportation impacts will be small. The transportation impacts due to construction will be temporary and will only last for two to three years. The mitigation measures for the traffic increase during the construction phase of the EREF are defined in Section 4.2.5, Mitigation Measures.

4.2.9 Comparative Transportation Impacts of No Action Alternative Scenarios

Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The transportation impacts will be the same since three enrichment plants are built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The transportation impacts for a LES centrifuge plant with increased capacity will be greater because it will concentrate the shipments in one location.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The transportation impacts for a USEC centrifuge plant with increased capacity will be greater because it will concentrate the shipments in one location.

TABLES

Table 4.2-1 Current Traffic Volume for the Major Roads in the Vicinity of the Proposed EREF Site

(Page 1 of 1)

Road Name	Average Traffic Volume Vehicles Per Day	Average Traffic Volume Vehicles Per Year [c]
U.S. Highway 20	2,282 [a]	832,930
Interstate-15 south side of Idaho Falls	20,041 [a]	7,314,965
U.S. Highway 26	1,100 [b]	401,500
U.S. Highway 20 at the U.S. Highway 26 intersection	1,900 [b]	693,500
U.S. Highway 20 at the I-15 intersection	21,000 [b]	7,665,000

Notes:

(a) Source: (ITD, 2008c).

(b) Source: (ITD, 2007).

(c) Assumes 365 travel days in a year.

Table 4.2-2 Annual Shipments To/From the Proposed EREF (by Truck) During Operation (Page 1 of 1)

Material	Container Type	Estimated Number of Shipments per Year [(a)]
Natural U Feed (UF_6)	48Y	712
Enriched U Product (UF_6)	30B	258
Depleted U (UF_6)	48Y	611
Hazardous Waste	208 liter (55 gallon) drum	4
Non-radiological, Non-Hazardous Waste	6 m^3 (8 yd^3) waste receptacle	150
Solid Waste (low-level waste)	208 liter (55 gallon) drum	8
Empty Feed (UF_6)	48Y	356
Empty Product	30B	258
Empty Depleted Uranium Tails	48Y	306

(a) 48Y cylinders are shipped one per truck when full and two per truck when empty. 30B cylinders are typically shipped two per truck, although up to five cylinders per truck can be shipped.

Table 4.2-3 Supply Materials Shipped to the Proposed EREF During the First Three Years of Construction

(Page 1 of 1)

Mode of Shipment	Year	Type of Supply Material	Origin of Shipment	Estimated Number of Shipments
Truck	1	Concrete	Local	[ ]
Truck	1	Steel Panels	U.S.A.	[ ]
Truck	1	Structural and Miscellaneous Steel	Idaho	[ ]
Truck	1	Piping Spool Pieces	Idaho	[ ]
Truck	1	Overhead Cranes	U.S.A.	[ ]
Truck	1	HVAC Units	U.S.A	[ ]
Truck	1	Ductwork	Local	[ ]
Truck	1	Electric Motors	Local	[ ]
Truck	1	Electrical Wire, Conduit, and Cable Tray	Local	[ ]
Truck	2	Concrete	Local	[ ]
Truck	2	Steel Panels	U.S.A.	[ ]
Truck	2	Structural and Miscellaneous Steel	Local	[ ]
Truck	2	Built-up Roofing	Local	[ ]
Truck	2	Piping Spool Pieces	Idaho	[ ]
Truck	2	Overhead Cranes	U.S.A.	[ ]
Truck	2	HVAC Units	U.S.A.	[ ]
Truck	2	Ductwork	Local	[ ]
Truck	2	Electric Motors	Local	[ ]
Truck	2	Electrical Wire, Conduit, and Cable Tray	Local	[ ]
Truck	3	Concrete	Local	[ ]
Truck	3	Steel Panels	U.S.A.	[ ]
Truck	3	Piping Spool Pieces	Idaho	[ ]
Truck	3	Electrical Wire, Conduit, and Cable Tray	Local	[ ]
Truck		Centrifuges or Parts		[ ]

Information in “[ ]” is Proprietary Commercial Information withheld in accordance with 10 CFR 2.390

Table 4.2-4 Waste Materials Shipped from the Proposed EREF During the First Three Years of Construction

(Page 1 of 1)

Mode of Shipment	Year	Type of Waste Material	Destination of Shipment	Estimated Number of Shipments
Truck	1	Construction Debris	Landfill	[ ]
Truck	2	Construction Debris	Landfill	[ ]
Truck	3	Construction Debris	Landfill	[ ]

Information in "[ ]" is Proprietary Commercial Information withheld in accordance with 10 CFR 2.390

Table 4.2-5 Annual Radioactive Material Quantities and Shipments
(Page 1 of 1)

Material	Container Type	Container/year	Containers/Truck Shipment	Shipments/year
Feed	48Y	712	1	712
Product	30B	516	2	258
Depleted Uranium Tails	48Y	611	1	611
Radwaste	55-gallon Drums	477	60	8
Empty Feed	48Y	712	2	356
Empty Product	30B	516	2	258
Empty Depleted Uranium Tails	48Y	611	2	306

Table 4.2-6 Potential Transportation Origins/Destinations and Distances
(Page 1 of 1)

Facility	To or From EREF	Type Description	Route Characteristic	Distance km (mi)
UF_6 Conversion Facility * Port Hope, Ontario	to/from to	Feed/Empty Feed Empty Depleted Uranium Tails	Commercial	3546.7 (2204.1)
UF_6 Conversion Facility Metropolis, IL	to/from to	Feed/Empty Feed Empty Depleted Uranium Tails	Commercial	2579.7 (1603.0)
UF_6 Conversion Facility Overseas Port: Portsmouth, VA	to/from to	Feed/Empty Feed Empty Depleted Uranium Tails	Commercial	3789.1 (2354.5)
UF_6 Conversion Facility Overseas Port: Baltimore, MD	to/from to	Feed/Empty Feed Empty Depleted Uranium Tails	Commercial	3557.0 (2210.3)
Fuel Fabrication Facility Richland, WA	from/to	Product/Empty Product	HRCQ	948.4 (589.3)
Fuel Fabrication Facility Columbia, SC	from/to	Product/Empty Product	HRCQ	3743.5 (2326.2)
Fuel Fabrication Facility Wilmington, NC	from/to	Product/Empty Product	HRCQ	4109.3 (2553.5)
Fuel Fabrication Facility Overseas Port: Portsmouth, VA	from	Product	HRCQ	4021.9 (2499.1)
Fuel Fabrication Facility Overseas Port: Baltimore, MD	from	Product	HRCQ	3760.5 (2336.8)
U.S. Ecology Hanford, WA	from	Radwaste Disposal	Commercial	870.5 (540.9)
Energy Solutions Clive, UT	from	Radwaste Disposal	Commercial	474.5 (294.8)
Energy Solutions Oak Ridge, TN	from	Radwaste Disposal	Commercial	3068.3 (1906.6)
Depleted UF_6 Conversion Facility Paducah, KY	from/to	Depleted UF_6 Disposal/Empty Depleted Uranium Tails	Commercial	2610.3 (1622.0)
Depleted UF_6 Conversion Facility Portsmouth, OH	from/to	Depleted UF_6 Disposal/Empty Depleted Uranium Tails	Commercial	3002.0 (1865.4)

Note: HRCQ = Highway Route Controlled Quantity for fissile material.

* Added 241-km (150-mi) and one stop to TRAGIS output.

Table 4.2-7 TRAGIS Output

Facility	Rest or Inspect/Rest Stops	Link	Distance km	Distance (mi)	Population Density people/km^2	Population Density (people/mi^2)
UF_6 Conversion Facility * Port Hope, Ontario	9	Rural Suburban Urban	2820.3 648.2 78.3	(1752.8) (402.8) (48.7)	11.3 295.4 2493.1	(29.2) (765.2) (6457.1)
UF_6 Conversion Facility Metropolis, IL	6	Rural Suburban Urban	2157.2 368.6 54.0	(1340.4) (229.0) (33.5)	9.2 340.3 2268.9	(23.8) (881.3) (5876.4)
UF6 Conversion Facility Overseas Port: Portsmouth, VA (Commercial)	9	Rural Suburban Urban	2915.4 768.9 105.2	(1811.6) (477.8) (65.4)	11.4 338.1 2297.9	(29.5) (875.6) (5951.6)
UF6 Conversion Facility Overseas Port: Baltimore, MD (Commercial)	9	Rural Suburban Urban	2705.6 772.3 79	(1681.2) (479.9) (49.1)	11.8 308.3 2353.6	(30.5) (798.6) (6095.9)
Fuel Fabrication Facility Richland, WA	2/2	Rural Suburban Urban	797.4 138.0 13.0	(495.5) (85.8) (8.1)	9.7 295.9 2182.9	(25.0) (766.3) (5653.7)
Fuel Fabrication Facility Columbia, SC	10/10	Rural Suburban Urban	2836.2 832.8 74.2	(1762.4) (517.5) (46.1)	11.1 312.5 2179.5	(28.8) (809.4) (5644.9)
Fuel Fabrication Facility Wilmington, NC	9/11	Rural Suburban Urban	3006.8 1013.9 88.4	(1868.4) (630.0) (54.9)	11.6 330.5 2150.1	(30.2) (856.1) (5568.8)
Fuel Fabrication Facility Overseas Port: Portsmouth, VA (HRCQ)	9/10	Suburban Urban Rural	3034.3 908.9 78.9	(1885.5) (564.8) (49.0)	12.6 310.1 2245.4	(32.7) (803.2) (5815.6)
Fuel Fabrication Facility Overseas Port: Baltimore, MD (HRCQ)	10/10	Suburban Urban Rural	2820 850.9 89.7	(1752.3) (528.7) (55.8)	12.4 307.1 2293.3	(32.1) (795.5) (5939.6)
U.S. Ecology Hanford, WA	2	Rural Suburban Urban	751.2 103.1 16.3	(466.8) (64.1) (10.1)	7.3 347.0 2188.0	(19.0) (898.8) (5666.8)
Energy Solutions Clive, UT	1	Rural Suburban Urban	359.5 95.5 19.3	(223.4) (59.4) (12.0)	10.1 350.1 2377.7	(26.1) (906.7) (6158.3)
Energy Solutions Oak Ridge, TN	7	Rural Suburban Urban	2481.4 523.7 63.3	(1541.9) (325.4) (39.3)	10.4 320.3 2281.5	(27.0) (829.5) (5909.1)
Depleted UF_6 Conversion Facility Paducah, KY	6	Rural Suburban Urban	2179.9 376.6 54.0	(1354.6) (234.0) (33.5)	9.3 339.3 2268.9	(24.0) (878.8) (5876.4)
Depleted UF_6 Conversion Facility Portsmouth, OH	7	Rural Suburban Urban	2452.9 493.9 55.4	(1524.2) (306.9) (34.4)	10.7 317.2 2294.4	(27.8) (821.6) (5942.4)

*Added 241-km (150-mi) and one stop to TRAGIS output to account for that portion of the route located in Canada. TRAGIS only accounts for U.S. routes. (NRC, 2005b; NRC, 2006)

Table 4.2-8 Annual Incident-Free Dose from Radioactive Material Transportation (Page 1 of 1)

		Incident-Free Dose, person-Sv/yr (person-rem/yr)			
	Radioactive	Worker		Public	
Origin/Destination	Material	Crew	Off-Link	On-Link	Stops
Portsmouth, VA	Feed	8.39E-02 (8.39E+00)	7.69E-03 (7.69E-01)	1.57E-01 (1.57E+01)	1.68E-02 (1.68E+00)
Wilmington, NC	Product	2.49E-02 (2.49E+00)	3.85E-03 (3.85E-01)	6.74E-02 (6.74E+00)	2.58E-02 (2.58E+00)
Portsmouth, OH	Depleted Uranium Tails	5.49E-02 (5.49E+00)	4.10E-03 (4.10E-01)	8.58E-02 (8.58E+00)	1.14E-02 (1.14E+00)
Oak Ridge, TN	Radwaste	1.49E-03 (1.49E-01)	1.27E-04 (1.27E-02)	2.68E-03 (2.68E-01)	3.32E-04 (3.32E-02)]
Portsmouth, VA	Empty Feed	1.26E-01 (1.26E+01)	2.16E-02 (2.16E+00)	4.40E-01 (4.40E+01)	4.73E-02 (4.73E+00)
Wilmington, NC	Empty Product	1.24E-01 (1.24E+01)	1.93E-02 (1.93E+00)	3.37E-01 (3.37E+01)	1.29E-01 (1.29E+01)
Portsmouth, VA	Empty Depleted Uranium Tails	1.10E-01 (1.10E+01)	1.89E-02 (1.89E+00)	3.85E-01 (3.85E+01)	4.13E-02 (4.13E+00)

Table 4.2-9 EREF Non-Radiological Environmental Impact from Vehicle Emissions (Page 1 of 1)

Facility	Link	Distance [(b)] km	Annual [(c)] Shipments	Population Density Worker [(d)] crew/km^2	Population Density Public [(b)] person/km^2	Annual Risk [(a)], fatalities Worker	Annual Risk [(a)], fatalities Public
Feed	Rural	2915.4	712	2	11.4	6.94E-03	3.96E-02
	Suburban	768.9			338.1	1.83E-03	3.09E-01
	Urban	105.2			2297.9	2.50E-04	2.88E-01
	Totals:					9.02E-03	6.37E-01
Product	Rural	3006.8	258	2	11.6	2.59E-03	1.50E-02
	Suburban	1013.9			330.5	8.75E-04	1.45E-01
	Urban	88.4			2150.1	7.63E-05	8.20E-02
	Totals:					3.55E-03	2.42E-01
Radioactive Waste	Rural	2481.4	8	2	10.4	6.64E-05	3.45E-04
	Suburban	523.7			320.3	1.40E-05	2.24E-03
	Urban	63.3			2281.5	1.69E-06	1.93E-03
	Totals:					8.21E-05	4.52E-03
Depleted Uranium Tails	Rural	2452.9	621[(e)]	2	10.7	5.09E-03	2.73E-02
	Suburban	493.9			317.2	1.03E-03	1.63E-01
	Urban	55.4			2294.4	1.15E-04	1.32E-01
	Totals:					6.23E-03	3.22E-01
Empty Feed	Rural	2915.4	356	2	11.4	3.47E-03	1.98E-02
	Suburban	768.9			338.1	9.15E-04	1.55E-01
	Urban	105.2			2297.9	1.25E-04	1.44E-01
	Totals:					4.51E-03	3.18E-01
Empty Product	Rural	3006.8	258	2	11.6	2.59E-03	1.50E-02
	Suburban	1013.9			330.5	8.75E-04	1.45E-01
	Urban	88.4			2150.1	7.63E-05	8.20E-02
	Totals:					3.55E-03	2.42E-01
Empty Depleted Uranium Tails	Rural	2915.4	311[(e)]	2	11.4	3.03E-03	1.73E-02
	Suburban	768.9			338.1	8.00E-04	1.35E-01
	Urban	105.2			2297.9	1.09E-04	1.26E-01
	Totals:					3.94E-03	2.78E-01
Sum of Totals:						3.09E-02	2.04E+00

(a) Risk based on 8.36 E-10 fatalities/km (1.35 E-09 fatalities/mi) per 1 person/km^2 (Biwer, 1999). Distance is doubled for round-trip transport.
(b) From Table 4.2-7, TRAGIS Output..
(c) From Table 4.2-5, Annual Radioactive Material and Quantities and Shipments.
(d) From Table 4.2-10, RADTRAN Input.
(e) Values used are greater than the calculated number of cylinders, therefore, the environmental impact due to vehicle emissions is conservative.

Table 4.2-10 RADTRAN Input
(Page 1 of 1)

Input Parameter	Value		Reference	Section
48Y Packaging Length, m (ft)	3.8	(12.5)	NRC, 2005	Table D-4
48Y Packaging Diameter, m (ft)	1.22	(4.0)	NRC, 2005	Table D-4
30B Packaging Length, m (ft)	2.06	(6.8)	NRC, 2005	Table D-5
30B Packaging Diameter, m (ft)	0.76	(2.5)	NRC, 2005	Table D-5
55-gallon Drum Packaging Length, m (ft)	0.889	(2.9)	DOE, 2002c	Table 6.1
55-gallon Drum Packaging Diameter, m (ft)	0.61	(2.0)	DOE, 2002c	Table 6.1
Distance to Package, m (ft)	5	(16.4)	* Weiner, 2006	page 27
Dose Rate at 1-m from Vehicle/Package, mSv/hr (mrem/hr)	0.01 to 0.05	(1 to 5)	**	
Vehicle Speed, Rural, km/hr (mi/hr)	88.49	(55)	DOE, 2002c	Table 6.11
Vehicle Speed, Suburban, km/hr (mi/hr)	40.25	(25)	DOE, 2002c	Table 6.11
Vehicle Speed, Urban, km/hr (mi/hr)	24.16	(15)	DOE, 2002c	Table 6.11
Number of Truck Crew	2		NRC, 2005	Table D-13
Number of People in Adjacent Vehicle	2		NRC, 2005	Table D-13
Vehicle Density - Rural, vehicles/hr	1155		Weiner, 2006	page 34
Vehicle Density - Suburban, vehicles/hr	2414		Weiner, 2006	page 34
Vehicle Density - Urban, vehicles/hr	5490		Weiner, 2006	page 34
Shielding Factors	1***			
People at Stops	25		NRC, 2005	Table D-13
Stop Distance, m (ft)	20	(65.6)	NRC, 2005	Table D-13
Stop Time, h/stop	0.5		Weiner, 2006	Default
Farm Fraction	1		Weiner, 2006	page 36

* RADTRAN Manual suggests 3 to 7, 5 is mid range.

** Conservative value based on NRC, 2005b; NRC, 2006; DOE, 1999; DOE, 2001b; DOE, 2002c, and actual cylinder transportation experience.

*** 1 equals no shielding.

Table 4.2-11 Feed, Empty Feed, and Empty Depleted Uranium Tails Cylinders Non-Radiological Incident Risk

(Page 1 of 1)

State	Incident Rate [a] Accidents Accidents / trk-km (Accidents / trk-mi)	Fatalities Fatalities / trk-km (Fatalities / trk-mi)	Injuries Injuries / trk-km (Injuries / trk-mi)	Route Distance [b] km, (mi)	Risk Accidents	Fatalities	Injuries
IA	1.12E-07 (1.80E-07)	9.40E-09 (1.51E-08)	8.60E-08 (1.38E-07)	21.4 (13.3)	2.40E-06	2.01E-07	1.84E-06
ID	2.95E-07 (4.75E-07)	3.80E-09 (6.12E-09)	3.07E-07 (4.94E-07)	270.0 (167.8)	7.97E-05	1.03E-06	8.29E-05
IL	2.22E-07 (3.57E-07)	8.30E-09 (1.34E-08)	1.50E-07 (2.41E-07)	209.1 (129.9)	4.64E-05	1.74E-06	3.14E-05
IN	2.25E-07 (3.62E-07)	6.70E-09 (1.08E-08)	1.40E-07 (2.25E-07)	197.8 (122.9)	4.45E-05	1.33E-06	2.77E-05
KY	3.10E-07 (4.99E-07)	1.28E-08 (2.06E-08)	2.21E-07 (3.56E-07)	306.3 (190.3)	9.49E-05	3.92E-06	6.77E-05
MO	4.64E-07 (7.47E-07)	1.24E-08 (2.00E-08)	3.14E-07 (5.05E-07)	607.0 (377.2)	2.82E-04	7.53E-06	1.91E-04
NE	3.19E-07 (5.13E-07)	1.37E-08 (2.20E-08)	1.97E-07 (3.17E-07)	722.0 (448.6)	2.30E-04	9.89E-06	1.42E-04
VA	3.93E-07 (6.32E-07)	1.61E-08 (2.59E-08)	3.10E-07 (4.99E-07)	462.0 (287.1)	1.82E-04	7.44E-06	1.43E-04
WV	1.72E-07 (2.77E-07)	1.68E-08 (2.70E-08)	1.12E-07 (1.80E-07)	296.0 (183.9)	5.09E-05	4.97E-06	3.31E-05
WY	6.74E-07 (1.08E-06)	1.08E-08 (1.74E-08)	3.23E-07 (5.20E-07)	697.8 (433.6)	4.70E-04	7.54E-06	2.25E-04
Sum (per trip):				3789.1 (2354.5)	1.48E-03	4.56E-05	9.46E-04
Annual Feed Risk (risk/trip x 712 ship/yr x 2 round-trip/ship):					2.11E+00	6.49E-02	1.35E+00
Annual Empty Feed Risk (risk/trip x 356 ship/yr x 2 round-trip/ship):					1.06E+00	3.24E-02	6.74E-01
Annual Empty Depleted Uranium Risk (risk/trip x 311[c] ship/yr x 2 round-trip/ship):					9.22E-01	2.83E-02	5.88E-01

(a) From Table 4 (Saricks, 1999).
(b) From TRAGIS.
(c) Value used is greater than the calculated number of cylinders; therefore, the environmental impact due to non-radiological incident risk is conservative.

Table 4.2-12 Product and Empty Product Cylinders Non-Radiological Incident Risk (Page 1 of 1)

State	Incident Rate [a] Accidents Accidents / trk-km (Accidents / trk-mi)	Fatalities Fatalities / trk-km (Fatalities / trk-mi)	Injuries Injuries / trk-km (Injuries / trk-mi)	Route Distance [b] km, (mi)	Risk Accidents	Fatalities	Injuries
CO	4.46E-07 (7.18E-07)	1.14E-08 (1.83E-08)	3.15E-07 (5.07E-07)	416.7 (258.9)	1.86E-04	4.75E-06	1.31E-04
ID	2.95E-07 (4.75E-07)	3.80E-09 (6.12E-09)	3.07E-07 (4.94E-07)	210.2 (130.6)	6.20E-05	7.99E-07	6.45E-05
IL	2.22E-07 (3.57E-07)	8.30E-09 (1.34E-08)	1.50E-07 (2.41E-07)	281.6 (175.0)	6.25E-05	2.34E-06	4.22E-05
KS	2.84E-07 (4.57E-07)	5.20E-09 (8.37E-09)	2.54E-07 (4.09E-07)	695.6 (432.2)	1.98E-04	3.62E-06	1.77E-04
KY	3.10E-07 (4.99E-07)	1.28E-08 (2.06E-08)	2.21E-07 (3.56E-07)	149.8 (93.1)	4.64E-05	1.92E-06	3.31E-05
MO	4.64E-07 (7.47E-07)	1.24E-08 (2.00E-08)	3.14E-07 (5.05E-07)	403.6 (250.8)	1.87E-04	5.00E-06	1.27E-04
NC	3.46E-07 (5.57E-07)	1.49E-08 (2.40E-08)	3.17E-07 (5.10E-07)	684.6 (425.4)	2.37E-04	1.02E-05	2.17E-04
TN	1.23E-07 (1.98E-07)	1.00E-08 (1.61E-08)	9.20E-08 (1.48E-07)	471.1 (292.7)	5.79E-05	4.71E-06	4.33E-05
UT	2.90E-07 (4.67E-07)	1.19E-08 (1.92E-08)	2.53E-07 (4.07E-07)	206.5 (128.3)	5.99E-05	2.46E-06	5.22E-05
WY	6.74E-07 (1.08E-06)	1.08E-08 (1.74E-08)	3.23E-07 (5.20E-07)	589.8 (366.5)	3.98E-04	6.37E-06	1.91E-04
Sum (per trip):				4109.3 (2553.5)	1.49E-03	4.22E-05	1.08E-03
Annual Product Risk (risk/trip x 258 ship/yr x 2 round-trip/ship):					7.71E-01	2.18E-02	5.56E-01
Annual Empty Product Risk (risk/trip x 258 ship/yr x 2 round-trip/ship):					7.71E-01	2.18E-02	5.56E-01

(a) From Table 4 (Saricks, 1999).
(b) From TRAGIS.

Table 4.2-13 Radwaste Shipments Non-Radiological Incident Risk (Page 1 of 1)

State	Incident Rate [a] Accidents Accidents / trk-km (Accidents / trk-mi)	Fatalities Fatalities / trk-km (Fatalities / trk-mi)	Injuries Injuries / trk-km (Injuries / trk-mi)	Route Distance [b] km, (mi)	Risk Accidents	Fatalities	Injuries
ID	2.95E-07 (4.75E-07)	3.80E-09 (6.12E-09)	3.07E-07 (4.94E-07)	270.0 (167.8)	7.97E-05	1.03E-06	8.29E-05
IL	2.22E-07 (3.57E-07)	8.30E-09 (1.34E-08)	1.50E-07 (2.41E-07)	264.1 (164.1)	5.86E-05	2.19E-06	3.96E-05
IA	1.12E-07 (1.80E-07)	9.40E-09 (1.51E-08)	8.60E-08 (1.38E-07)	21.4 (13.3)	2.40E-06	2.01E-07	1.84E-06
KY	3.10E-07 (4.99E-07)	1.28E-08 (2.06E-08)	2.21E-07 (3.56E-07)	149.8 (93.1)	4.64E-05	1.92E-06	3.31E-05
MO	4.64E-07 (7.47E-07)	1.24E-08 (2.00E-08)	3.14E-07 (5.05E-07)	607.0 (377.2)	2.82E-04	7.53E-06	1.91E-04
NE	3.19E-07 (5.13E-07)	1.37E-08 (2.20E-08)	1.97E-07 (3.17E-07)	722.0 (448.6)	2.30E-04	9.89E-06	1.42E-04
TN	1.23E-07 (1.98E-07)	1.00E-08 (1.61E-08)	9.20E-08 (1.48E-07)	336.4 (209.0)	4.14E-05	3.36E-06	3.09E-05
WY	6.74E-07 (1.08E-06)	1.08E-08 (1.74E-08)	3.23E-07 (5.20E-07)	697.8 (433.6)	4.70E-04	7.54E-06	2.25E-04
Sum (per trip):				3068.3 (1906.6)	1.21E-03	3.37E-05	7.47E-04
Annual Radwaste Risk (risk/trip x 8 ship/yr x 2 round-trip/ship):					1.94E-02	5.38E-04	1.19E-02

(a) From Table 4 (Saricks, 1999).
(b) From TRAGIS.

Table 4.2-14 Depleted Uranium Tails Cylinders Non-Radiological Incident Risk (Page 1 of 1)

State	Incident Rate [a] Accidents Accidents / trk-km (Accidents / trk-mi)	Fatalities Fatalities / trk-km (Fatalities / trk-mi)	Injuries Injuries / trk-km (Injuries / trk-mi)	Route Distance [b] km, (mi)	Risk Accidents	Fatalities	Injuries
ID	2.95E-07 (4.75E-07)	3.80E-09 (6.12E-09)	3.07E-07 (4.94E-07)	270.0 (167.8)	7.97E-05	1.03E-06	8.29E-05
IL	2.22E-07 (3.57E-07)	8.30E-09 (1.34E-08)	1.50E-07 (2.41E-07)	347.8 (216.1)	7.72E-05	2.89E-06	5.22E-05
IN	2.25E-07 (3.62E-07)	6.70E-09 (1.08E-08)	1.40E-07 (2.25E-07)	274.9 (170.8)	6.18E-05	1.84E-06	3.85E-05
IA	1.12E-07 (1.80E-07)	9.40E-09 (1.51E-08)	8.60E-08 (1.38E-07)	491.3 (305.3)	5.50E-05	4.62E-06	4.23E-05
KY	3.10E-07 (4.99E-07)	1.28E-08 (2.06E-08)	2.21E-07 (3.56E-07)	10.9 (6.8)	3.39E-06	1.40E-07	2.42E-06
NE	3.19E-07 (5.13E-07)	1.37E-08 (2.20E-08)	1.97E-07 (3.17E-07)	728.6 (452.7)	2.32E-04	9.98E-06	1.44E-04
OH	1.64E-07 (2.64E-07)	3.90E-09 (6.28E-09)	1.40E-07 (2.25E-07)	180.9 (112.4)	2.97E-05	7.05E-07	2.53E-05
WY	6.74E-07 (1.08E-06)	1.08E-08 (1.74E-08)	3.23E-07 (5.20E-07)	697.8 (433.6)	4.70E-04	7.54E-06	2.25E-04
Sum (per trip):				3002.0 (1865.4)	1.01E-03	2.87E-05	6.12E-04
Annual Depleted Uranium Tails Risk (risk/trip x 621[c] ship/yr x 2 round-trip/ship):					1.25E+00	3.57E-02	7.61E-01

(a) From Table 4 (Saricks, 1999).
(b) From TRAGIS.
(c) Value used is greater than the calculated number of cylinders, therefore, the environmental impact due to non-radiological incident risk is conservative.

Table 4.2-15 EREF Non-Radiological Environmental Impact from Vehicle Incidents (Page 1 of 1)

Radioactive Material	Annual Risk * Accidents	Fatalities	Injuries
Feed	2.11E+00	6.49E-02	1.35E+00
Product	7.71E-01	2.18E-02	5.56E-01
Radioactive Waste	1.94E-02	5.38E-04	1.19E-02
Depleted Uranium Tails	1.25E+00	3.57E-02	7.61E-01
Empty Feed	1.06E+00	3.24E-02	6.74E-01
Empty Product	7.71E-01	2.18E-02	5.56E-01
Empty Depleted Uranium Tails	9.22E-01	2.83E-02	5.88E-01
Sum:	6.90E+00	2.05E-01	4.49E+00

* From Table 4.2-11 through Table 4.2-14.

FIGURES

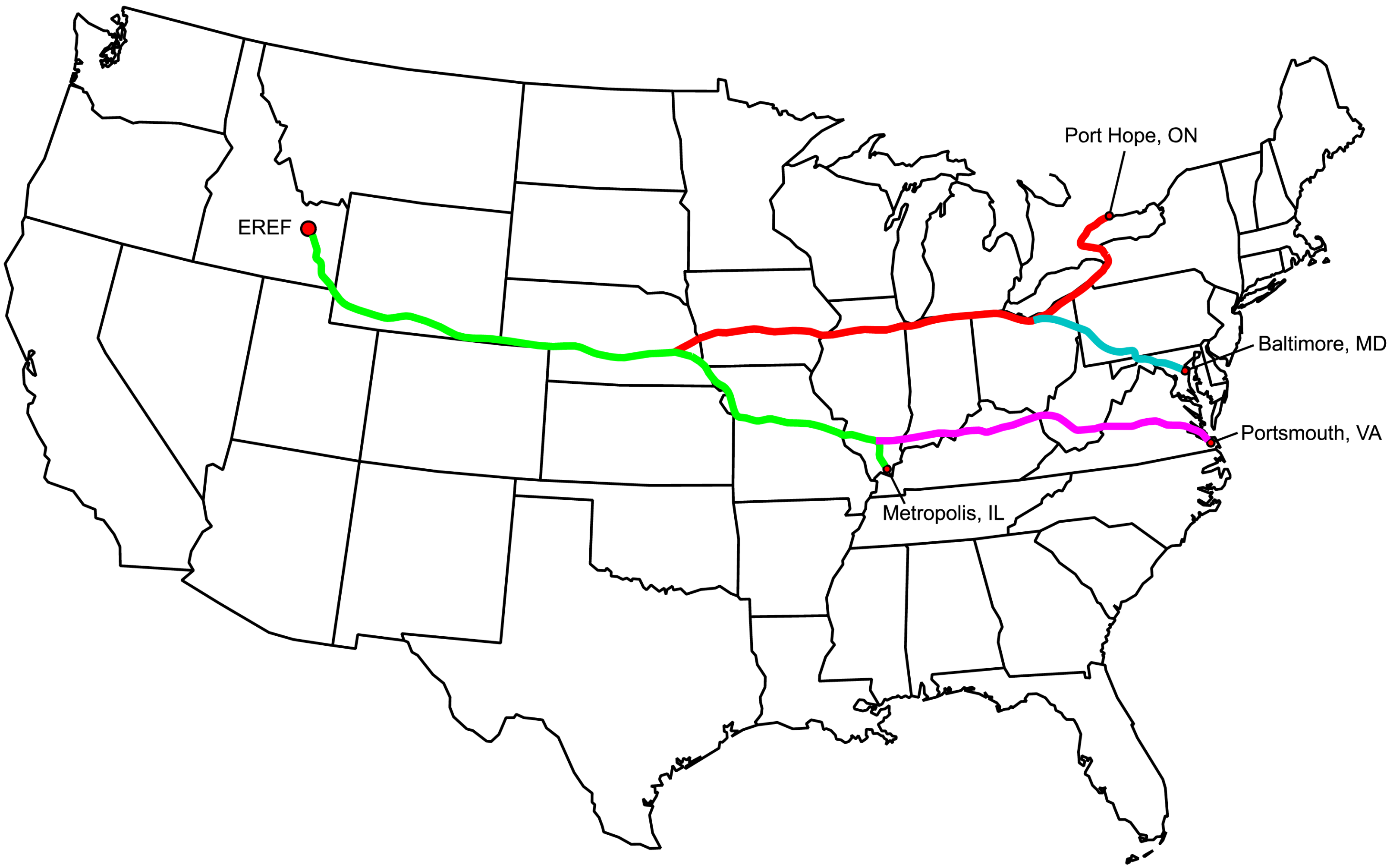

FIGURE 4.2-1 **Rev. 0**

Potential Feed / Empty Feed
Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

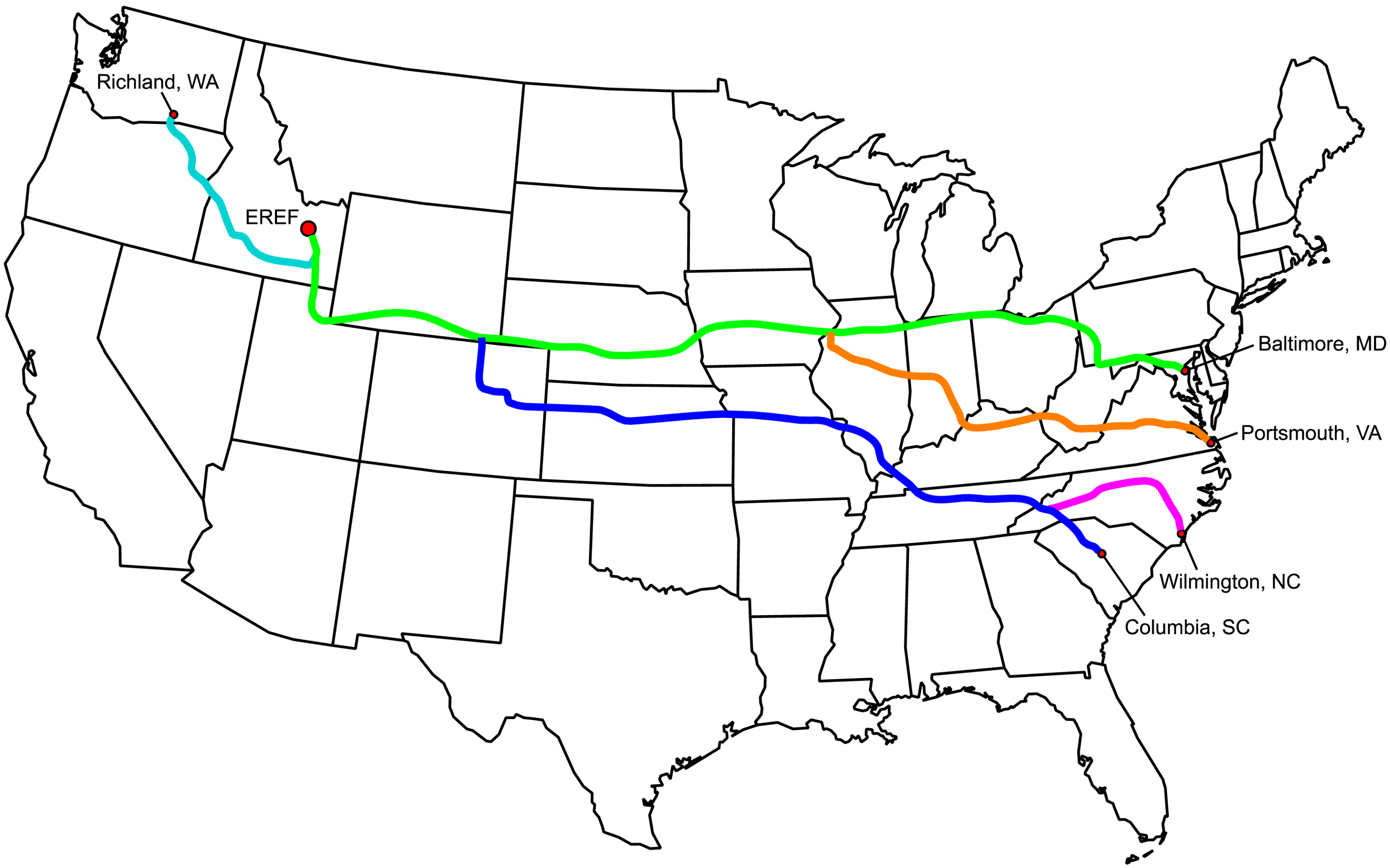

FIGURE 4.2-2 **Rev. 0**

Potential Product Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

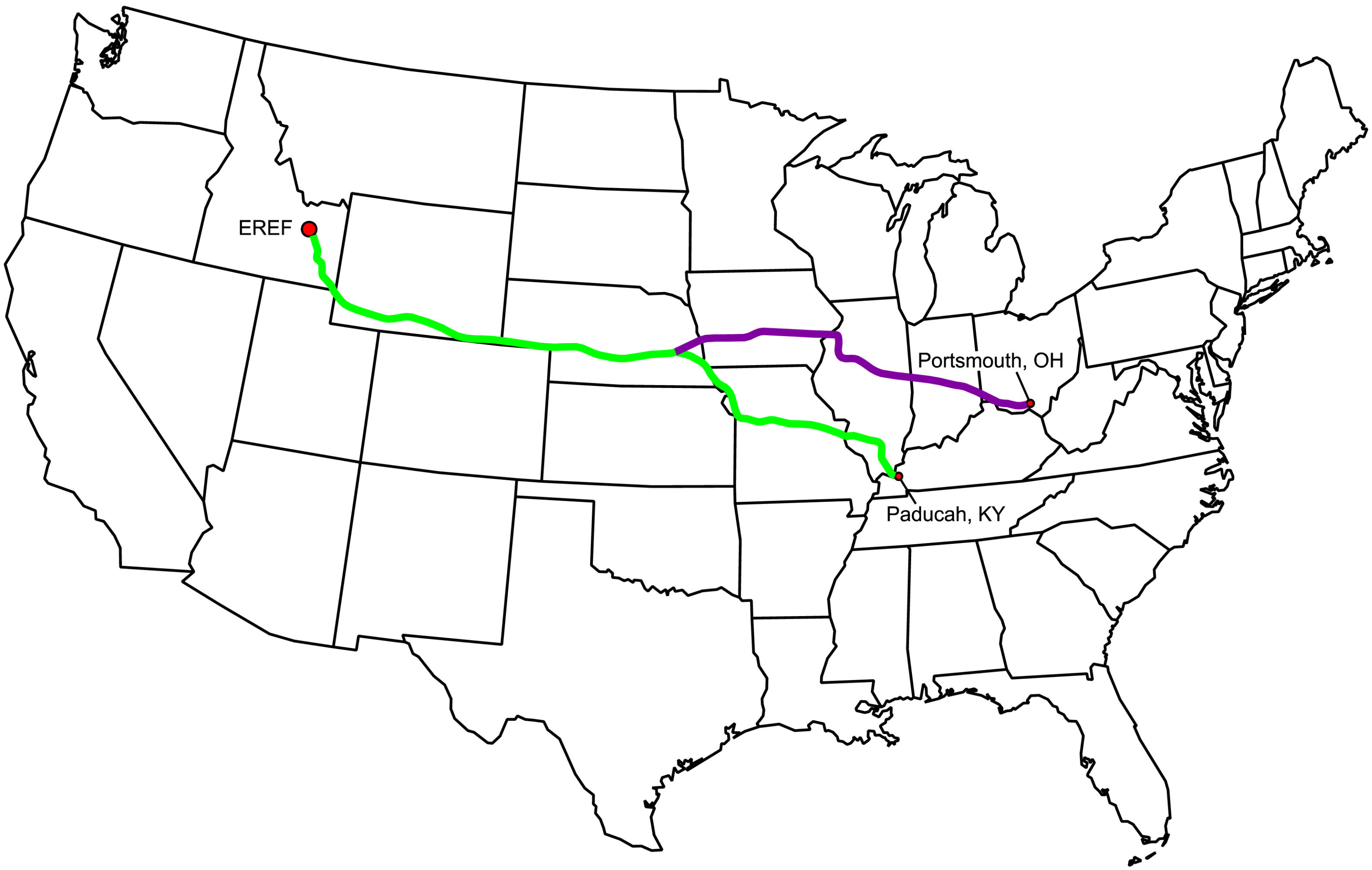

FIGURE 4.2-3 **Rev. 0**

Potential Depleted Uranium Tails Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

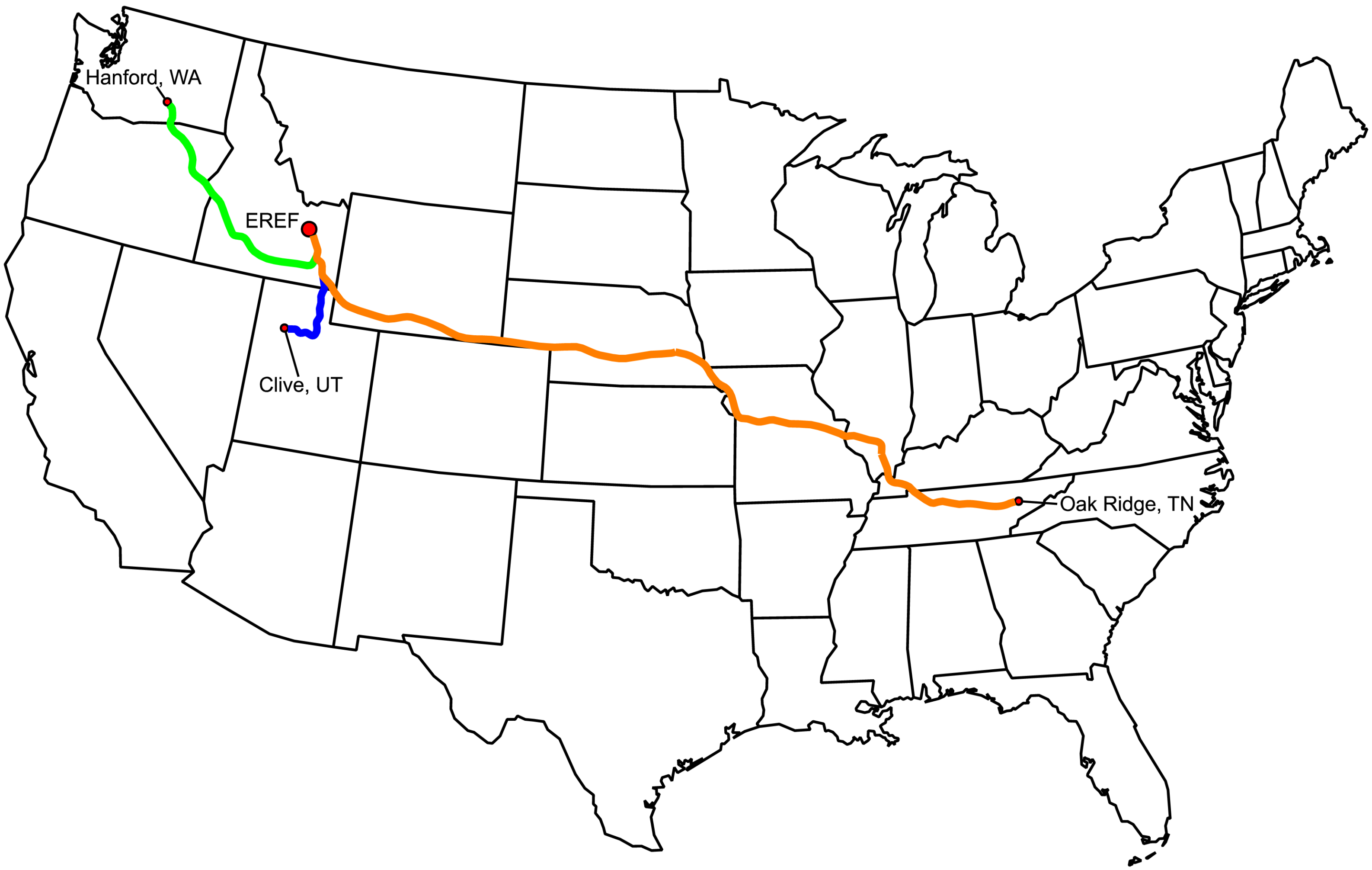

FIGURE 4.2-4 **Rev. 0**

Potential Radioactive Waste Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

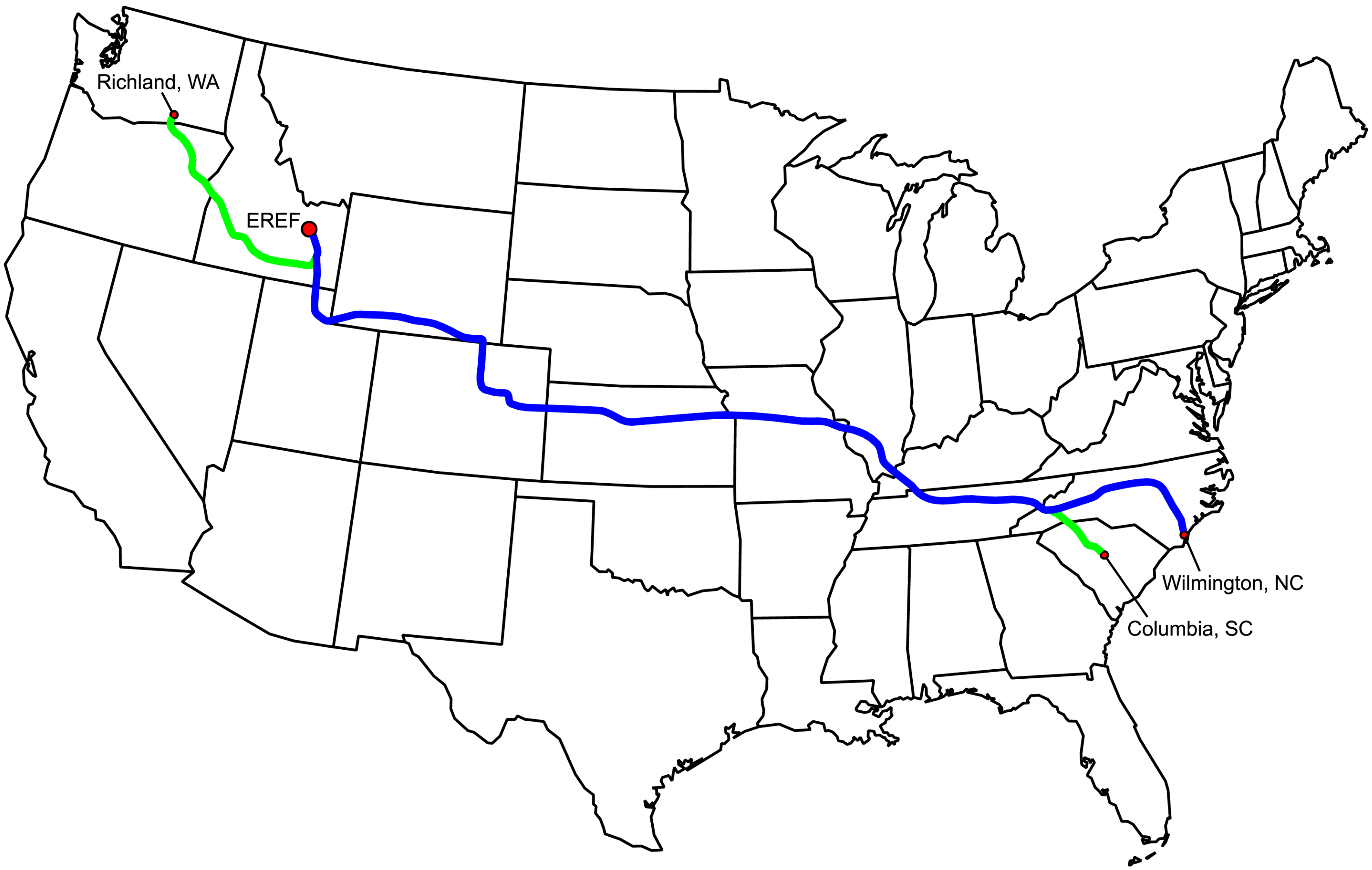

FIGURE 4.2-5 **Rev. 0**

Potential Empty Product Cylinder Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

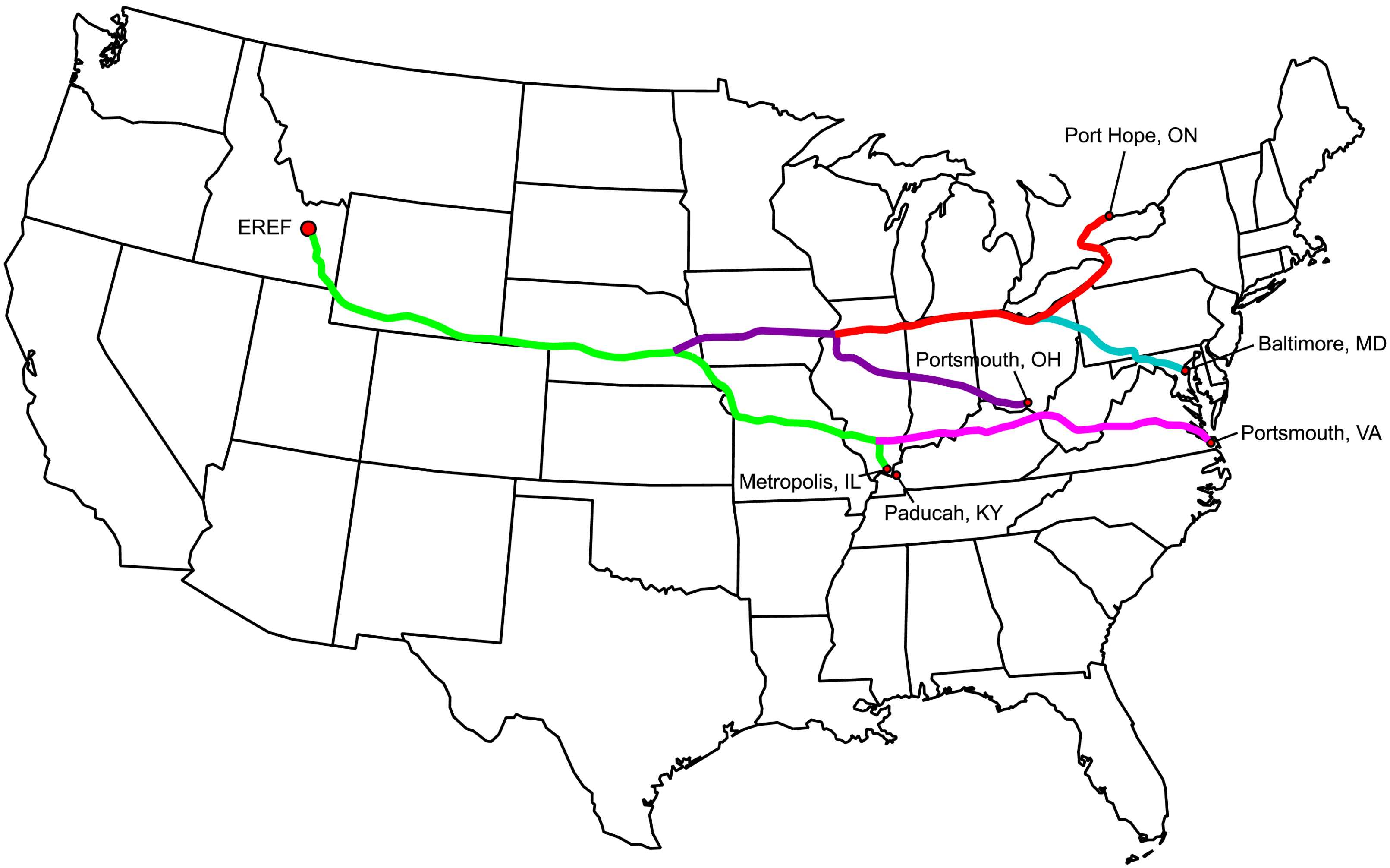

FIGURE 4.2-6 **Rev. 0**

Potential Empty Depleted Uranium Cylinder Transportation Routes

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

4.3 GEOLOGY AND SOILS IMPACTS

This section provides a description of the impacts to geology and soils that can be expected from the construction, operation, and decommissioning of the proposed Eagle Rock Enrichment Facility (EREF). A complete description of the geology and soils at the proposed site is provided in ER Section 3.3, Geology and Soils. A brief description of the geology and soils follows to provide context for the impacts discussion.

The surface area of the proposed site is comprised mostly of relatively flat semi-arid steppe covered by eolian soils of variable thickness that incompletely cover broad areas of bedrock outcrop. The outcrops cover about 14% of the total area of the proposed site and exist in the form of low irregular ridges, small areas of thin soils mixed with blocky rubble, and as erosional surfaces in intermittent stream drainages (see Figures 3.3-8, Areas of Exposed Basaltic Lava Flows and 3.3-9, Topography, Roads and Drainage). The outcrops at the proposed site are comprised of 100% basaltic lava flows that originated from nearby vent and fissure systems. The lava flows show a range of morphologies indicative of eruption, flow, and cooling. In outcrop and drill cores (obtained during the investigation of the EREF site), these morphologies include jointing in approximate columnar patterns, extensive vertical, less extensive horizontal jointing, and open cavities and rubble at the flow surfaces and margins. Drill cores also indicate that for thicker lava flows, the highly vesicular, pervasively fractured lava associated with flow margins grades into finely vesicular to non-vesicular (massive) lava of the flow interior. Within the massive flow interiors, the frequency and aperture of fractures are decreased and permeability zones observed in core and geophysical logs consisted of widely spaced, subhorizontal fractures and thin subhorizontal vesicular zones. Most of the exposed fractures and cavities show evidence of infilling by wind and water carried silt and clay, reducing the potential for infiltration of surface water into the subsurface. The remaining 86% of the area is covered with thin soils of predominantly eolian origin. Soil thicknesses on the proposed site range from 0 to 6.2 m (20.5 ft). Many of the areas with thickest soils, gentle slopes, and a minimum of rock outcrop are currently used for irrigated crops. Laboratory analyses of soil samples collected during geotechnical investigation of the EREF site indicate that soils at depths of five feet or greater consist of 84% to 98% clay sized particles. The characteristics of the soil and bedrock at the EREF site are variable with respect to the potential for infiltration of precipitation. Although precipitation may readily infiltrate into the soil and bedrock exposed at the land surface, intervening lower permeability clay rich zones and massive basalt flow interiors that may retard vertical infiltration of precipitation also occur beneath the site.

There are few established surface drainages at the proposed site primarily due to the low annual precipitation rate and high evapotranspiration rate. The high potential for infiltration into surficial materials, relatively young geological age of the terrain, and smoothing of terrain in crop areas also influence the surface drainage morphology. A few small intermittent stream drainages exist in the southeastern corner of the site. A more significant intermittent drainage exists in the southwestern corner of the proposed site and runs from the south-central area of the proposed site southward toward U.S. Highway 20 (see Figure 3.3-8, Topography, Roads and Drainage). U.S. Highway 20 has a culvert to convey water from this drainage to the south away from the roadway.

Elevations over the entire area of the proposed site range from approximately 1,556 m (5,106 ft) near U.S. Highway 20 to about 1,600 m (5,250 ft) in a small area at the eastern edge of the property. Within the footprint of the proposed facility, elevations range from approximately 1,573 m (5,161 ft) in the vicinity of the stormwater basins to 1,588 m (5,210 ft). There is no risk of landslides at the proposed site due to the low slopes, thin soils, and low rate of precipitation.

The proposed facility will be located on flat terrain, requiring cut and fill of significant areas to bring ground level to a final grade of 1,573 to 1,585 m (5,161 to 5,200 ft). The excavation of a detention basin will also produce fill material. The material excavated will be a combination of soil and basaltic bedrock. It is planned that the volume of material excavated from the higher portions of the site will be fully utilized for fill at the lower areas of the site, with a total of about 778,700 m^3 (1,018,500 yd^3) cut and used as fill. The modification of the site to a finished grade of 1,573 to 1,585 m (5,161 to 5,200 ft) will cause about 59 ha (145 acres) of the site to be raised with soil fill and 88 ha (218 acres) to be excavated down to that elevation. There are no current plans to dispose of excavated materials off site. Because of the agricultural history of the site, the resulting terrain change for the site from gently sloping to flat topography as a result of construction of the proposed facility is expected to cause a small environmental impact to the site geology or soils.

The entire area of the facility is underlain by competent bedrock of basaltic lava that is not expected to subside due to construction of buildings and related infrastructure. The possible exception to this generalization is a low potential for the occurrence of lava tubes in the subsurface that could be subject to collapse due to increased loads resulting from facility construction. Lava tubes have been observed at other locations on the Eastern Snake River Plain (ESRP) and are locally a major mode of lava flow movement across the landscape. Generally, however, lava tubes collapse after a volcanic event terminates because they are no longer supported by the flowing lava. Based on these observations, the likelihood of subsurface lava tubes within the facility footprint is expected to be small but should be considered during detailed subsurface investigations associated with facility construction.

Short-term increases in soil erosion and dust generation in the areas in and adjacent to the proposed facility footprint and roads may occur during construction due to earth-moving activities, clearing of vegetation, and compaction of soils. However, rainfall in the region is limited and erosional impacts due to site clearing and grading will be mitigated by utilization of construction and erosion control best management practices (BMPs). (See ER Section 4.1, Land Use Impacts, for a discussion of construction BMPs.) Disturbed soils would be stabilized as part of construction work. Earth berms, dikes, and sediment fences will be utilized as necessary during all phases of construction to limit runoff. These measures will prevent the local surface drainages from being affected substantially by construction activities. Much of the excavated areas would be covered by structures or paved, limiting the creation of new dust sources. Watering will be used to control potentially fugitive construction dust. Water conservation will be considered when deciding how often dust suppression sprays would be applied. ER Section 4.4.7, Control of Impacts for Water Quality, contains a discussion of water conservation measures. Because site preparation and construction result in only short-term effects to the geology and soils, the impacts will be small.

The operation phase of the proposed facility will not involve additional disruption of the local bedrock and therefore, is expected to have no impact on the site geology beyond that caused by excavation activities during construction. Thus, the impact to geology and soils due to operation will be small. Also, during operation of the proposed facility, BMPs will be used to manage stormwater runoff from paved and compacted surfaces to drainage ditches and basins. Process waste water will be contained within enclosed systems treated and evaporated; process waste waster and will not be disposed to the subsurface bedrock or local soils. These various measures will minimize impacts to geology and soils from the proposed facility.

A portion of the proposed site located primarily in the northeastern corner is currently used for irrigated crops. The remainder of the proposed site is currently used for seasonal cattle grazing. These areas of cropland and grazing will be taken out of service during construction and operation of the proposed facility. However, it is not expected that agrarian areas surrounding the proposed site will be affected; and it is anticipated that they will continue to be used for irrigated cropland and grazing.

Decommissioning activities will be staged during facility operations to reduce impacts. The retention and detention basins, and building pads will be restored to natural ground contours using local fill to the extent possible and revegetated. These activities will allow the area to be released for unrestricted use after decommissioning has been completed.

The volcanic and seismic hazards associated with the EREF site are summarized in Sections 3.3.3, Site-Specific Volcanic Hazard Analysis and 3.3.7, Seismic Hazard Assessment of this report, and detailed evaluations of these hazards are presented in Appendices D and F. The baseline geology and soil features at the site are products of the natural environment of the ESRP and agricultural development in the area.

The EREF site is located within the Axial Volcanic Zone, between the Circular Butte – Kettle Butte and Lava Ridge – Hell's Half Acre volcanic rift zones, and north of the Hell's Half Acre lava field. The most recent volcanic activity in the area was at Hell's Half Acre approximately 5,400 years ago. The land surface was formed in response to inundation of the area by basalt lava flows from nearby eruptive centers, subsequent deposition of wind blown fine sediment, and physical and chemical weathering of the lava flows and soils. No evidence of volcanic rift zones, volcanic vents, or dike-induced fissures and faults have been observed in the outcrops or core samples from the EREF site. However, the area has been repeatedly inundated by basaltic lava flows erupted from nearby volcanic centers during approximately the last 750,000 years. The volcanic hazards analysis included in Appendix D indicates the estimated mean annual probability (preferred value) of lava inundation at the proposed site is 5×10^{-6}. The estimated upper and lower bounds of the annual probability distribution span two orders of magnitude, from 10^{-5} to 10^{-7}, respectively. Because they have a more frequent recurrence interval and affect larger areas than local silicic volcanism, basalt lava flows are considered to pose the most significant volcanic hazard to facilities. Other hazards associated with basaltic volcanism, with or without lava effusion, include: release of corrosive gas from eruptive fissures or lava tubes, which would mainly affect areas within a few hundred meters (feet) of active vents; coarse tephra deposition within a few hundred meters (feet) of active vents; surface fissuring and minor faulting above ascending dikes, within narrow zones up to about 10 km (6 mi) long; and small- to moderate-magnitude earthquakes induced by the ascending dikes (Hackett, 1996; Hackett, 2002). Due to the low probability of a local volcanic event affecting the planned EREF area, it is unlikely that construction, operation, or decommissioning activities and/or structures will be affected.

The northwest-trending volcanic rift zones in the ESRP are generally parallel to several of the long axes of fault bounded mountain ranges of the adjacent Basin and Range Provence. Both the mountain ranges and the volcanic rift zones are extensional tectonic features that developed in response to the same extensional, regional-stress field. However, in contrast to the range front faults, the volcanic rift zones are the result of ascent and eruption of basaltic dikes. The emplacement of magma as dikes within the rift structures is considered to be the mechanism of crustal extension within the ESRP volcanic province (Parsons, 1991).

The results of a probabilistic seismic hazard assessment (PSHA) including peak ground acceleration (PGA) estimates and estimated contributions to total hazard from regional seismic sources are presented in Appendix F. The predominant source of ground motion hazard is seismic activity located within the ESRP. Impacts from regional Quaternary Faults are considered minor compared to ground motion impacts attributed to seismic activity that may occur within the ESRP. The reason for the negligible ground motion impacts from the Basin and Range faults is the high rate of attenuation of ground vibrations generated by slip on normal faults. The central location of the EREF site within the ESRP relative to the adjacent Basin and Range faulted areas contributes to the minimized impact of seismic activity in the tectonically active Basin and Range zones.

On a local scale, dike emplacement and inflation are important controls on extension in the ESRP (Parsons, 1998). Study of historical seismicity observed during dike intrusion events beneath volcanic rift zones in analog regions (Iceland, Hawaii, etc.), and the published results of numerical and physical modeling of the dike intrusion process indicate that only small to moderate earthquakes (magnitude 3 - 5.5) are associated with dike intrusion (Parsons, 1998; Hackett, 1994; Hackett, 1996).

4.3.1 Potential Mitigation Measures

Mitigation measures will be in place to minimize the impact to geology and soil resources. These include the following items:

- The use of BMPs to reduce soil erosion (e.g., earth berms, dikes, and sediment fences).
- Prompt revegetation or covering of bare areas with natural materials will be used to mitigate erosional impacts due to construction activities.
- Watering will be used to control potentially fugitive construction dust.
- Standard drilling and blasting techniques, if required, will be used to minimize impact to bedrock, reducing the potential for over-excavation thereby minimizing damage to the surrounding rock, and protecting adjacent surfaces that are intended to remain intact.
- Soil stockpiles generated during construction will be placed in a manner to reduce erosion.
- Excavated materials will be reused whenever possible.

4.3.2 Cumulative Impacts to Geologic Resources

The cumulative impacts to the geologic resources of the proposed construction and operation of the EREF will be similar to the direct and indirect impacts of the project and those associated with the current land use. No federal, state, or private development plans are known within 16 km (10 mi) of the proposed site. Current land use, primarily agriculture and grazing, will continue to have similar impacts on wildlife and habitat on surrounding properties. Construction of the proposed EREF will result in limited soil erosion, which will be minimized using BMPs. Therefore, cumulative impacts will be small.

4.3.3 Comparative Geology and Soils Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The geology and soils impacts will be the same since three enrichment plants will be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The geology and soils impacts will be the same if the increased centrifuge plant is located on previously undisturbed land; otherwise, the impact will be less if the increased plant is located on previously disturbed land.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The geology and soils impacts will be the same if the increased centrifuge plant is located on previously undisturbed land; otherwise, the impact will be less if the increased plant is located on previously disturbed land.

4.4 WATER RESOURCES IMPACTS

The water resources at the proposed Eagle Rock Enrichment Facility (EREF) site are discussed in Section 3.4, Water Resources. ER Section 3.4.1, Surface Hydrology, indicates that there are no permanent surface water features and although intermittent stream drainages exist, they have not been observed to carry water. ER Section 3.4.15, Groundwater Characteristics, indicates that groundwater exists at the site in quantity and is of high quality in this portion of the Eastern Snake River Plain (ESRP). The depth to groundwater in wells on the proposed EREF site ranges between 201.5 m (661.1 ft) and 220.0 m (721.9 ft) below the ground surface, depending on location. The ESRP Aquifer extends over much of southeastern Idaho and is a major water source for drinking and irrigation water in the region. The area of the site has a semi-arid climate with low precipitation rates and high evapotranspiration rates. Soils are thin and the vertical conductivity of the underlying bedrock is high. Although minimal, there is the potential for impacts to groundwater. Impacts to surface water are expected to be minimal to nonexistent. The pathways for planned and potential releases are discussed below.

Permits related to water that may be applicable to site construction and EREF operation are described in ER Section 1.3, Applicable Regulatory Requirements, Permits and Required Consultation. These permits address various potential discharges to water and prescribe mitigation needed to maintain state water quality standards and avoid degradation to water resources at or near the site. These permits include:

- *A National Pollutant Discharge Elimination System (NPDES) General Permit for Industrial Stormwater:* The NPDES General Permit for Industrial Stormwater regulates point source discharges of stormwater runoff from industrial and commercial facilities to waters of the United States. In Idaho, the NPDES permit program is administered by the EPA, Region 10 (IDEQ, 2008a). AES will file a Notice of Intent (NOI) for coverage under the Multi-Section General Permit with the EPA, Washington, D.C., at least 60 days prior to the initiation of EREF operations.
- *NPDES General Permit for Construction Stormwater:* The construction of the proposed EREF will involve the disturbance of 240 ha (592 acres). Because this disturbance area is more than 0.4 ha (1 acre), a NPDES Construction General Permit from the EPA Region 10 and an oversight review by the Idaho Department of Environmental Quality (IDEQ) are required. AES will develop a Storm Water Pollution Prevention Plan (SWPPP) and file a NOI with the EPA, Washington, D.C., at least 60 days prior to the commencement of construction activities. (IDEQ, 2008a)
- *NPDES Individual Permit for Point Sources.* The Clean Water Act (CWA) authorizes the EPA to regulate point sources that discharge pollutants into surface waters of the United States through the NPDES permit program. In Idaho, the NPDES permit program is administered by the EPA Region 10. An applicant may apply for either an individual or a general NPDES permit. An individual permit is specifically tailored to an individual facility, and a general permit covers multiple facilities with a specific category, such as stormwater discharges (IDEQ, 2008c). Because the EREF will discharge treated domestic sanitary wastewaters to a lined retention basin, an Individual NPDES permit will not be required as there will be no discharge of wastewaters to surface or groundwaters.
- *Section 401 Certification:* Under Section 401 of the federal Clean Water Act, states can review and approve, condition, or deny all federal permits or licenses that might result in a discharge to State waters, including wetlands (IDEQ, 2008b). The purpose of this review is to ensure that the given project conforms to applicable state water criteria. By letter dated October 10, 2008, the USACE notified AES of its determination that there are no

Department of the Army (DA) jurisdictional waters at the EREF site and for this reason the project does not require a 404 permit (USACE, 2008). As a result, a Section 401 certification is not required.

The EREF site design addresses the following:

- General construction activities
- Domestic Sanitary Sewage Treatment Plant design and construction
- Discharge of stormwater and treated domestic sanitary effluents to site detention and retention basins during operations.

Construction of the EREF will pose a short-term risk to water resources due to transport in stormwater runoff of constituents, such as sediment, oil and grease, fuels, and chemical constituents derived from wash-off of concrete, fill materials, and construction materials. The off-site transport of these types of potential contaminants will be controlled by employing best management practices (BMPs) during construction, including control and mitigation of hazardous materials and fuels. The BMPs will be designed to reduce the probability of hazardous material spills and stormwater runoff from contacting potential contaminant sources related to construction activities. The BMPs will also be used for dust control associated with excavation and fill operations during construction. See Section 4.1, Land Use Impacts, for more information on construction BMPs.

During operation of the proposed EREF, domestic sanitary wastewater and stormwater runoff will be controlled by routing to the detention and retention basins. These basins are described in Section 3.4.1.1, Facility Withdrawals and/or Discharges to Hydrologic Systems, and include the following:

- Site Stormwater Detention Basin
- Cylinder Storage Pads Stormwater Retention Basin

The locations of these basins are shown in Figure 4.4-1, Facility Layout with Stormwater Detention/Retention Basins.

The Site Stormwater Detention Basin will collect stormwater runoff from parking lots, roofs, roads, and diversions from unaltered areas around the site. The detention basin is designed to contain runoff for a volume equal to the 24-hour, 100-year return frequency rain storm of 5.70 cm (2.24 in) rainfall. The storage capacity available for maintaining a freeboard of 0.6 m (2.0 ft) is approximately 32,835 m^3 (27 acre-ft). For a highly unlikely storm scenario maintaining a freeboard of 0.3 m (1.0 ft), the basin will have approximately 49,600 m^3 (40 acre-ft) of storage capacity. The area served by the detention basin is about 134 ha (332 acres).

Water quality of the Site Stormwater Detention Basin will be typical of runoff from building roofs and paved areas from any industrial facility and natural runoff from diversions in unaltered areas of the site. Except for small amounts of oil and grease typically found in runoff from paved roadways and parking areas, the runoff is not expected to contain other chemical contaminants. The detention basin will not be lined so that the collected runoff is allowed to infiltrate as well as evaporate.

The Site Stormwater Detention Basin will be designed with an outlet structure for overflow. It is possible that overflow from the basin will occur during a rainfall event larger than the design basis. Overflow of the basin is an unlikely event, but if it does occur, then the local downgradient terrain will serve as the receiving area for the excess runoff. The additional impact to the surrounding land above what would occur during such a flood is expected to be small. Therefore, the potential overflow of the Site Stormwater Detention Basin during an event beyond its design capacity is expected to have a small impact to surrounding land. The Site Stormwater Detention Basin will also receive runoff from a portion of the site stormwater diversions. The purpose of the diversions is to safely divert surface runoff away from EREF structures during extreme precipitation events. Retention or attenuation of flows in the diversions is not expected.

The Cylinder Storage Pads Stormwater Retention Basin will be utilized for the collection and containment of treated domestic sanitary effluents from the Domestic Sanitary Sewage Treatment Plant and stormwater runoff from the Cylinder Storage Pads. The Cylinder Storage Pads Stormwater Retention Basin will be lined to prevent infiltration and open to the air to allow evaporation. There will be no direct discharge to waters of the U.S. or to groundwater. The retention basin will not have an outfall. Sanitary effluent discharges to the retention basin will be approximately 14,600 m^3/yr (3,860,000 gal/yr).

Stormwater runoff from the Cylinder Storage Pads, where full tails, full feed, full product and empty cylinders are stored, will also be directed to the Cylinder Storage Pads Stormwater Retention Basin. The area served for stormwater retention by the basin is 12.7 ha (31.4 acres), the total area of the Cylinder Storage Pads. The retention basin is designed to contain a volume of approximately 110,087 m^3 (89 acre-ft) maintaining a freeboard of 0.9 m (3.0 ft). Under highly unlikely events, the volume of the basin will contain approximately 113,888 m^3 (92 acre-ft), maintaining a freeboard of 0.3 m (1.0 ft). As designed, the retention basin can contain runoff for a volume equal to twice that for the 24-hour, 100-year return frequency rain storm, a 5.70-cm (2.24-in) rainfall plus allowances for daily treated domestic sanitary effluent discharges.

Although a highly unlikely occurrence, the stored cylinders represent a potential source of low-level radioactivity that could enter stormwater runoff. The engineering of cylinder storage systems (high-grade sealed cylinders described in ER Section 2.1.2, Proposed Action) with the collection of stormwater to the lined basin and environmental monitoring of the Cylinder Storage Pads Stormwater Retention Basin (described in ER Section 6.2, Physicochemical Monitoring), combine to make the potential for contamination release through this system extremely low. An assessment was made by AES that assumed a conservative contamination level on cylinder surfaces and 100% washoff to the Cylinder Storage Pads Stormwater Retention Basin from a single storm event. Results show that the levels of radioactivity discharged to the basin will be below the regulatory unrestricted release criteria.

For an average annual rainfall at the site of 25.4 cm/yr (10.0 in/yr), the potential stormwater runoff volumes reaching the basins are approximately 79,155 m^3/yr (20,910,000 gal/yr) for the Site Stormwater Detention Basin and 32,400 m^3/yr (8,560,000 gal/yr) for the Cylinder Storage Pads Stormwater Retention Basin. The potential stormwater runoff volume for the balance of the property is 3,938,350 m^3/yr (1,040,400,000 gal/yr). This is the pure volume of the mean precipitation falling (before evapotranspiration and infiltration) upon the remaining undeveloped area. Considering the size of the property at approximately 1,700 ha (4,200 acres) compared to the developed central footprint area of 147 ha (363 acres), about 9% of the property, the attenuation of the increase of runoff by the detention and retention basins, the placement of the developed area being a considerable distance to the property lines, and the semi-arid climate, it is unlikely that there will be an increase of stormwater runoff to adjacent properties.

4.4.1 Receiving Waters

The proposed EREF will not discharge any process effluents from plant operations onto the site or into surface waters. Daily treated domestic sanitary effluent will be discharged from the

Domestic Sanitary Sewage Treatment Plant to the Cylinder Storage Pads Stormwater Retention Basin. Stormwater runoff from most of the developed portions of the site will be collected in the Site Stormwater Detention Basin with the exception of the Cylinder Storage Pads. Stormwater runoff from the Cylinder Storage Pads will be directed to the Cylinder Storage Pads Stormwater Retention Basin.

Discharge from the Site Stormwater Detention Basin will occur by evaporation and infiltration into the ground. Discharge from the Cylinder Storage Pads Stormwater Retention Basin will occur by evaporation only. The detention and retention basins are designed to provide a means of controlling discharges of runoff for approximately 134 ha (332 acres) of pavement, parking lots, and roofs of the EREF structures plus an additional 12.7 ha (31.4 acres) of the Cylinder Storage Pads. Combined, these areas represent about 147 ha (363 acres) of the approximate 1,700 ha (4,200 acres) total EREF site area.

Due to high evapotranspiration rates for the area, it is not anticipated that runoff derived from the proposed EREF will reach receiving waters. The soils in the site area are thin, and the vertical conductivity of the bedrock is high. Therefore, it is likely that a portion of the stormwater collected in the detention basin will infiltrate into the subsurface and eventually reach groundwater. The Site Stormwater Detention Basin is designed to have an outlet structure for overflow, if needed, such as for a storm event exceeding the design basis. The local terrain serves as the receiving area in the rare event that there is enough stormwater to cause release from the outlet of the detention basin. Under normal weather conditions, evapotranspiration will likely consume the majority of water released from the outlet, and a fraction will be expected to infiltrate into the subsurface. The infiltrating water is expected to have a chemical composition typical of runoff from paved roadways, roofs, parking areas, and natural runoff. The basin will be included in the site environmental monitoring program as described in Section 6.1, Radiological Monitoring, and ER Section 6.2, Physiochemical Monitoring.

As discussed in ER Section 3.4.15, Groundwater Characteristics, water that reaches the basalt bedrock will likely infiltrate and flow vertically downward until reaching a low permeability layer, such as the sedimentary interbeds. Once encountering a low permeability layer, the water could become temporarily perched and/or flow laterally until the low permeability layer pinches out or contacts a higher permeability zone. At this point the water will continue to migrate vertically until reaching the next low permeability layer. The water will migrate from the ground surface downward in a step-wise manner until reaching the saturated groundwater zone. Some vaporization of the moisture may occur in the thick vadose zone causing additional diffusion of the wetting front in its downward migration to the aquifer. Further transport will be a function of the transmissivity and flow direction of the groundwater in the aquifer.

The Cylinder Storage Pads Stormwater Retention Basin, which will serve the paved outdoor cylinder storage areas, will be single-lined to prevent infiltration and designed to retain a volume that is slightly more than twice that for the 24-hour, 100-year storm plus an allowance for treated domestic sanitary wastewater. The configuration of the retention basin will allow for radiological testing of water and sediment (see ER Section 4.4.2, Impacts on Surface Water and Groundwater Quality). The retention basin will not have an outlet. The only discharge allowed from the Cylinder Storage Pads Stormwater Retention Basin will be through evaporation. If applicable, residual solids, after evaporation of water, will be removed through approved procedures.

The Cylinder Storage Pads will be constructed of reinforced concrete with a minimal number of construction joints, and pad joints will be plugged with joint sealer and water stops as a leak prevention measure. The ground surfaces around the Cylinder Storage Pads will be contoured to prevent rainfall in the area surrounding the pads from entering the pad drainage system.

4.4.2 Impacts on Surface Water and Groundwater Quality

Groundwater of good quality and quantity exists at the proposed EREF site, but there are no natural surface water bodies. During construction of the proposed EREF, surface water runoff will be controlled in accordance with the NPDES Construction General Permit (CGP). Therefore, no significant impacts are expected for either surface water bodies or groundwater as a result of construction activities.

During operation, stormwater runoff from the developed portions of the site, such as parking lots, roads, and roofs, will be collected in the Site Stormwater Detention Basin as described above in ER Section 4.4.1, Receiving Waters, and shown in Figure 4.4-1, Facility Layout with Stormwater Detention/Retention Basins. No wastes from facility operational systems will be discharged to the detention basin. Therefore, the water from the detention basin is not expected to have any impact on water quality in the downgradient groundwater system. Water collected in the detention basin will be routinely monitored for chemical composition to detect the presence of any contaminants. ER Section 6.2, Physiochemical Monitoring, provides the details of the monitoring plan for the detention basin. In addition, stormwater discharges during plant operation will be controlled by a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will identify potential sources of pollution that may reasonably be expected to affect the quality of stormwater discharge from the site, describe the practices used to reduce pollutants in stormwater, and define compliance with the terms and conditions of the CGP.

During operation of the proposed EREF, the Cylinder Storage Pads Stormwater Retention Basin will collect runoff water from the Cylinder Storage Pads. Wastewater associated with the Domestic Sanitary Sewage Treatment Plant will also be directed to this retention basin as described in ER Section 3.4.1.1, Facility Withdrawals and/or Discharges to Hydrologic Systems. The capacity of the retention basin is designed to be sufficient for containment of the volume of runoff predicted for slightly more than twice the 100-year, 24-hour frequency precipitation event plus an allowance for treated domestic sanitary effluent.

Runoff from the Cylinder Storage Pads has the extremely remote potential to contain low-level radioactivity from cylinder surfaces or leaks. However, an assessment of a potential release of radioactive constituents from the Cylinder Storage Pads from a single precipitation event based on conservative assumptions about contamination levels on cylinder surfaces and 100% washoff showed that the level of radioactivity in such a discharge to the basin will be below the regulatory criteria.

To prevent potential losses of runoff from the Cylinder Storage Pads to the environment, the drainage system from the pads to the retention basin for surface water runoff will include pre-cast catch basins and concrete trench drains, and piping will have sealed joints to preclude leakage. The retention basin will be lined with a single layer of impervious synthetic fabric with ample soil cover over the liner to prevent surface damage and degradation by ultraviolet radiation. The liner will prevent infiltration of water, thereby averting potential impacts to the groundwater system.

In summary, runoff controls incorporated into the facility design and treatment of sanitary waste effluents, are expected to prevent impacts to surface water and groundwater.

4.4.3 Hydrological System Alterations

Excavation and placement of fill for construction of the proposed EREF will result in a final site grade between 1,573 m (5,160 ft) and 1,585 m (5,200 ft). An approximate total of 778,700 m^3 (1,018,500 yd^3) of cut material from the site will be used as fill. Approximately 59 ha (145 acres) of the site will be raised with soil fill and 88 ha (218 acres) will be excavated down to that elevation. This earthwork will not require alteration or filling of surface water features on the site.

No alterations to groundwater systems will occur due to facility construction. The construction will involve the excavation and placement of fills at the surface, but these activities are not expected to affect the groundwater system, which is located at depths from 201.5 m (661.1 ft) and 220.0 m (721.9 ft) below ground surface. Runoff controls will be in place both during construction as part of BMPs and during operation to prevent uncontrolled releases of water. These control systems are described above in ER Sections 4.4, Water Resources Impacts, and 4.4.1, Receiving Waters. The potential for water or other liquids from spills or pipeline leaks to introduce sufficient amounts of liquid to saturate the top soil and bedrock surfaces to cause significant migration of contaminants downward to the groundwater system, is considered unlikely.

4.4.4 Hydrological System Impacts

The proposed EREF will obtain its water supply from on-site wells. Rates of water usage consumption are summarized in Table 3.4-2, Anticipated Normal Plant Water Consumption and Table 3.4-3, Anticipated Peak Plant Water Consumption. The ESRP Aquifer that underlies the proposed EREF is extremely productive (Garabedian, 1992). For example, typical well yields for most seasonally pumped agricultural wells in the ESRP Aquifer range from 3.4 m^3/min (900.0 gal/min) to 12.5 m^3/min (3,300.0 gal/min) and experience less than 6.1 m (20.0 ft) of drawdown (Garabedian, 1992). In comparison, the normal and peak potable water requirements for operation of the EREF are expected to be approximately 0.04 m^3/min (9.44 gal/min) and 2.6 m^3/min (689.0 gal/min), respectively. In consideration of the productivity of the ESRP Aquifer and high rates of normal water usage for irrigation, the amounts of water used at the proposed EREF are not expected to cause significant impacts to the site hydrologic systems.

Control of surface water runoff will be required for the EREF construction activities and will be covered by the NPDES Construction General Permit. As a result, no significant impacts are expected to either surface or groundwater bodies. Control of impacts from construction runoff is discussed below in ER Section 4.4.7, Control of Impacts to Water Quality.

The volume of water discharged into the ground from the Site Stormwater Detention Basin is expected to be minimal, as evapotranspiration is expected to be the dominant natural influence on standing water.

4.4.5 Ground and Surface Water Use

The proposed EREF will obtain its water supply from on-site wells. Anticipated normal plant water consumption and peak plant water requirements are provided in ER Table 3.4-2, Anticipated Normal Plant Water Consumption, and ER Table 3.4-3, Anticipated Peak Plant Water Consumption, respectively. No surface water sources will be used and there will be no liquid effluent discharges from plant operations. Treated sanitary effluents and stormwater runoff will be to engineered retention and detention basins.

The use of groundwater will be covered by a 1961 water right appropriation that will be transferred to the property for use as industrial water. The water transfer will occur concurrently with the purchase of the property by AES and will change the original water use from agriculture to industrial use. The primary point of diversion is expected to be from the existing agricultural well, Lava Well 3, near the center of Section 13, or a replacement well. The water will be assigned to other points of diversion to allow for the use of water from another well if the primary well should happen to fail. The original 1961 appropriation will decrease to approximately 1,713 m^3/d (452,500 gal/d) for industrial use and 147 m^3/d (38,800 gal/d) for seasonal irrigation use. The predicted daily water consumption of the EREF is anticipated to be approximately 51.5 m^3/d (13,600.0 gal/d) and the peak water consumption rate is anticipated to 43 L/s (689.0 gal/min). The normal annual water usage rate for the EREF will be 18,790,000 L/yr (4,970,000 gal/yr), which is a very small fraction (i.e., about 3%) of the water appropriation value of 625,000,000 L/yr (165,000,000 gal/yr) for industrial use. The peak water usage is developed based on the assumption that all water users are operating simultaneously. Furthermore, the peak water usage assumes that each water user is operating at maximum demand. This combination of assumptions is very unlikely to occur during the lifetime of the EREF. Nevertheless, the peak water usage is used to size the piping system and pumps. Given that the normal annual water usage rate for the EREF is a very small fraction of the appropriation value, momentary usages of water beyond the expected normal water usage rate is expected to be well within the water appropriation value for the EREF.

The closest and largest municipalities that rely on the ESRP Aquifer for drinking water are Idaho Falls in Bonneville County and Pocatello in Bannock County. Idaho Falls is upgradient of the proposed site according to regional hydrologic maps (Ackerman, 2006) and Pocatello is on the opposite side of the Snake River from the proposed EREF. Therefore, any groundwater consumption at the proposed EREF will not impact groundwater availability for these municipalities.

For both peak and normal usage rates, the needs of the proposed EREF facility should be readily met by the on-site groundwater pumping wells. The impacts to water resources on site and in the vicinity of the proposed EREF are expected to be negligible.

4.4.6 Identification of Impacted Ground and Surface Water Users

The locations of known groundwater users within a 1.6-km (1.0-mi) radius of the site boundary are shown on Figure 4.4-2, Water Wells in the Vicinity of the EREF. These locations were obtained from the Idaho Department of Water Resources (IDWR, 2008c). There are two irrigation (agricultural) wells located within the site boundaries. These wells are part of the water right appropriation described in ER Section 4.4.5, Ground and Surface Water Use. There is also one domestic well located near the southeast corner of the site. This domestic well is located approximately 1.21 km (0.75 mi) from the site boundary and is cross-gradient to the groundwater flowpath beneath the proposed facility footprint. The well is labeled as a domestic well by the IDWR, but there are no structures near the well. This domestic well is used to irrigate several crop fields. There are also three IDWR observation wells shown on Figure 4.4-2, Water Wells in the Vicinity of the EREF, approximately 3.2 km (2.0 mi) from the site boundary; two of the wells are hydrologically upgradient of the proposed EREF site and one is downgradient. The water right appropriation associated with the EREF property transfer defines the amount of water allowed for use and is less than the current irrigation appropriation. As a result, the impact of groundwater withdrawals during operation of the EREF is expected to be less than current impacts from irrigation practices.

There are no permanent surface water bodies on the site or within 1.6 km (1.0 mile), and no surface water users in the vicinity of the EREF. Therefore, there will be no impacts to surface water users.

4.4.7 Control of Impacts to Water Quality

Site runoff water quality impacts will be controlled during construction by compliance with NPDES Construction General Permit requirements, and BMPs will be described in a site SWPPP.

Wastes generated during site construction will be varied, depending on the stage of construction. Any hazardous wastes from construction activities will be handled and disposed of in accordance with applicable state and federal regulations. These regulations include proper labeling, recycling, controlling and protecting storage, and shipping off site to approved disposal sites. Sanitary wastes generated at the site will be handled by portable systems until the Domestic Sanitary Sewage Treatment Plant is available for use.

The need to level the site for construction will require some soil excavation as well as fills. Native soils will be used for fill. Therefore, fill placed on the site will provide the same characteristics as the existing natural soils and runoff from altered soil areas will have the same chemical characteristics as natural soils on the site.

During operation, the EREF's stormwater runoff detention and retention system will provide a means to allow controlled releases of site runoff only from the Site Stormwater Detention Basin in the event of a major precipitation event exceeding the 24-hr, 100-yr design criteria. Stormwater discharge will be periodically monitored in accordance with state and/or federal permits. A Spill Prevention, Control, and Countermeasure (SPCC) plan will be implemented for the facility to identify potential spill substances, sources, and responsibilities and perform any mitigations that are necessary. This plan is described in ER Section 4.1, Land Use Impacts. A SWPPP will also be implemented for the EREF so that runoff released to the environment will be of suitable quality.

Water discharged from the EREF Domestic Sanitary Sewage Treatment Plant will only consist of treated sanitary effluents; no facility process related effluents will be introduced into the Domestic Sanitary Sewage Treatment Plant. The Liquid Effluent Collection and Treatment System for the EREF will provide a means to control liquid process wastes within the plant. The system provides for the collection and treatment of liquid process wastes to remove contaminants by filtration and precipitation prior to being sent to an evaporator for vaporization; there will be no liquid effluent discharges from plant operations. Refer to ER Section 3.12, Waste Management, for further information on this system.

The Cylinder Storage Pads Stormwater Retention Basin will be lined to prevent infiltration. The basin will be designed to retain a volume slightly more than twice that for the 24-hour, 100-year frequency storm plus an allowance for treated domestic sanitary effluent. This retention basin has no flow outlet so that the only means for water loss is by evaporation. The retention basin will also be designed for sampling and radiological testing of the contained water and sediment.

The Site Stormwater Detention Basin is designed with an outlet structure for overflow. It is possible that overflow from the basin could occur during a rainfall event larger than the design basis. Overflow of the basin is an unlikely event, but if it does occur, then the local downgradient terrain will serve as the receiving area for the excess runoff. The additional impact to the surrounding land over what would occur during such a flood alone is expected to be small. The Site Stormwater Detention Basin will also receive runoff from a portion of the site stormwater diversions. The purpose of the diversions is to safely divert surface runoff away from the EREF structures during extreme precipitation events. Retention or attenuation of flows in the diversions is not expected. Since there are no modifications or attenuation of flows, there are no adverse impacts and no mitigative measures will be required.

4.4.7.1 Mitigations

Mitigation measures will be in place to minimize potential impacts on water resources during construction and operation. These include employing BMPs and the control of hazardous materials and fuels. In addition, the following controls will also be implemented:

- Construction equipment will be in good repair without visible leaks of oil, grease, or hydraulic fluids.
- The control and mitigation of spills during construction will be in conformance with the SPCC plan.
- Use of the BMPs will control stormwater runoff to prevent releases to nearby areas to the extent possible. See ER Section 4.1.1, Construction Impacts, for descriptions of construction BMPs.
- BMPs will also be used for dust control associated with excavation and fill operations during construction. Water conservation will be considered when deciding how often dust suppression sprays will be applied.
- Silt fencing and/or sediment traps will be used.
- External vehicle washing will use only water (no detergents).
- Stone construction pads will be placed at entrance/exits if unpaved construction access adjoins a state road.
- All temporary construction and permanent basins will be arranged to provide for the prompt, systematic sampling of runoff in the event of any special needs.
- Water quality impacts will be controlled during construction by compliance with the NPDES – Construction General Permit requirements and by applying BMPs as detailed in the site SWPPP.
- A SPCC plan will be implemented for the facility to identify potential spill substances, sources and responsibilities.
- All above-ground diesel storage tanks will be bermed or self contained.
- Any hazardous materials will be handled by approved methods and shipped off site to approved disposal sites. Sanitary wastes generated during site construction will be handled by portable systems until the Domestic Sanitary Sewage Treatment Plant is available for site use. An adequate number of these portable systems will be provided.
- The Liquid Effluent Collection and Treatment System will use evaporators, eliminating the need to discharge treated process water to an on-site basin.
- Control of surface water runoff will be required for activities covered by the NPDES Construction General Permit.

The proposed EREF is designed to minimize the use of water resources as shown by the following measures:

- The use of low-water consumption landscaping versus conventional landscaping reduces water usage.
- The installation of low flow toilets, sinks, and showers reduces water usage when compared to standard flow fixtures.

- Localized floor washing using mops and self-contained cleaning machines reduces water usage compared to conventional washing with a hose twice a week.
- Closed-loop cooling systems have been incorporated to reduce water usage.
- Cooling towers will not be used resulting in the use of less water since evaporative losses and cooling tower blowdown are eliminated.

4.4.8 Identification of Predicted Cumulative Effects on Water Resources

The cumulative impact to water resources is limited to those resulting from construction and operation of the EREF, and the existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF.

The proposed EREF will not extract groundwater from the site in excess of its water right appropriation. Stormwater runoff from the Cylinder Storage Pads and treated sanitary effluents will be discharged to a lined, engineered basin; there will be no liquid effluent discharges from plant operations. As a result, no significant effects on natural water systems are anticipated and the cumulative impact to the water resources will be small.

4.4.9 Comparative Water Resources Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The water resources impacts will be the same assuming similar water requirements for Silex technology as for GCPs.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The water resources impacts will be greater since NEF uses more water than EREF due to the differences in cooling system design and expansion concentrates water usage at one location.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The water resources impacts will be greater since expansion concentrates water usage at one location.

FIGURES

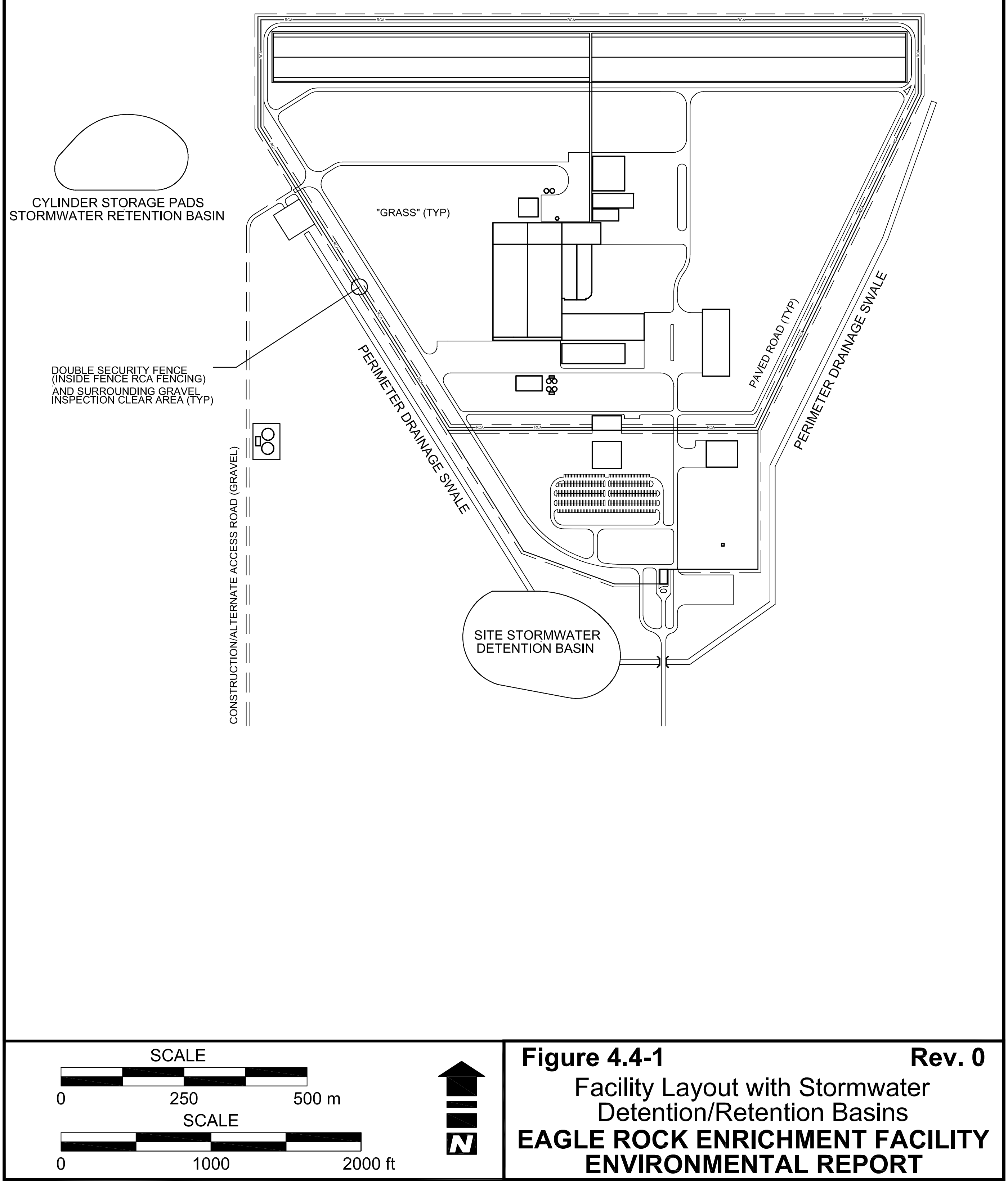

Figure 4.4-1 **Rev. 0**

Facility Layout with Stormwater Detention/Retention Basins

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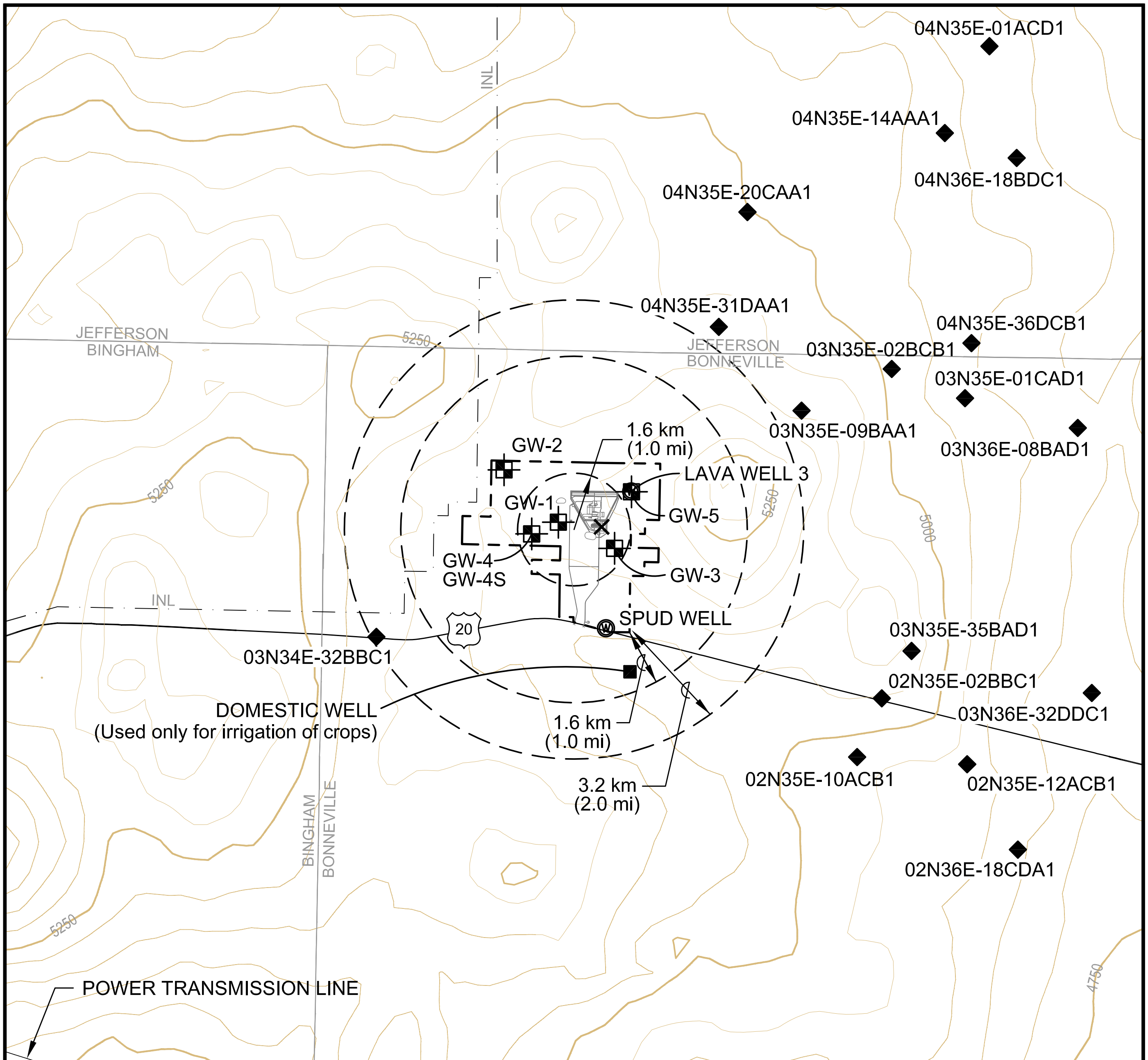

LEGEND:

5200	APPROXIMATE EXISTING GROUND SURFACE CONTOUR AND ELEVATION, ft
	SITE BOUNDARY
	IDAHO NATIONAL LABORATORY (INL) BOUNDARY
	MONITORING WELL
	EXISTING AGRICULTURAL WELL
	METEOROLOGICAL STATION
	IDWR OBSERVATION WELLS
	DOMESTIC WELL

NOTE:

1. GROUND SURFACE CONTOUR ELEVATIONS ARE SHOWN IN FEET. METRIC CONVERSION IS 1 m = 3.281 ft.
2. MONITORING WELL GW-5 IS 14.7 m (48.2 ft) SOUTHEAST OF LAVA WELL 3.
3. OBSERVATION WELLS OBTAINED FROM (IDWR, 2008b).

SCALE: 0 — 4 — 8 km

SCALE: 0 — 2 — 4 mi

N

Figure 4.4-2 **Rev. 0**

Water Wells in the Vicinity of the EREF

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

4.5 ECOLOGICAL RESOURCES IMPACTS

This section discusses the potential impacts of site preparation, construction, and operation of the proposed Eagle Rock Enrichment Facility (EREF) site on ecological resources.

4.5.1 Maps

Construction and operation of the proposed plant will result in changes to the ecological resources on the proposed property. Figure 4.5-1, EREF Footprint Relative to Vegetation, shows the location of the proposed EREF in relation to vegetation types.

4.5.2 Proposed Schedule of Activities

Construction for the proposed EREF will be initiated in 2011 and continue through 2018. Operations will begin in 2014 and continue until 2036. Decommissioning and decontamination will be initiated in 2032 and be completed in 2041. Refer to Section 1.2.4, Schedule on Major Steps Associated with the Proposed Action, for a complete schedule of all major steps in the proposed action.

4.5.3 Area of Disturbance

The total area of land to be directly disturbed by construction and operation of the facilities will be approximately 240 ha (592 ac). This area includes two access roads, parking area, and lay-down areas. Figure 2.1-2, Site Area and Facility Layout Map, shows the locations of proposed buildings. All of the disturbed lands ultimately will be used for buildings, support structures, parking, or landscaped areas. There are no areas that will be used on a short-term basis.

The proposed EREF will disturb about 75 ha (185 ac) of sagebrush steppe, 55 ha (136 ac) of seeded crested wheatgrass (non-irrigated seeded pasture), and 109 ha (268 ac) of irrigated crops will be eliminated (See Figure 4.5-1, EREF Footprint Relative to Vegetation). The total area of the proposed site represents about 4.3% of the land area within a radius of 8 km (5mi) from the site boundary (see Figure 3.1-4). The proposed EREF will result in a loss of about 0.3% of the sagebrush steppe vegetation, 1.4% of seeded crested wheatgrass, and 1.6% of agricultural lands within this area. No aquatic habitat, wetlands, riparian areas, or wet meadows will be affected because these habitats are not found on the proposed site.

The majority of the proposed site is suitable for use by wildlife, providing potential habitat for an assortment of birds, mammals, and reptiles (See Section 3.5.2, General Ecological Conditions of the Site). The sagebrush steppe is the most valuable and used by the greatest number and diversity of wildlife compared to the seeded crested wheatgrass and irrigated crop vegetation types.

4.5.4 Activities Expected to Impact Communities or Habitats

A variety of potential impacts will result from construction and operation of the proposed EREF. Sources of impact during construction will include loss of habitat, soil erosion, dust emissions, noise, night lighting, tall structures (e.g., construction cranes, powerline poles, and powerlines), presence of workers, traffic, and stormwater discharge ponds. Sources of impact during operations will be similar to those during construction; with the exception that dust and soil erosion will be negligible and a lined catch basin will contain treated domestic sanitary effluent.

Habitat loss (i.e., clearing of vegetation) from site preparation, construction, and operation of the proposed EREF will result in mobile animal species being displaced and loss of less mobile animals (e.g., small mammals). Mobile species moving through the area will likely avoid the disturbed area and facilities. Loss of the agriculture fields will result in some loss of a food source (e.g., grains) for mobile species. As discussed in Section 4.5.3, Area of Disturbance, the amount of habitat to be disturbed [240 ha (592 ac)] is a small percent of available habitat in the 8 km (5 mi) area). Therefore, impacts will be small.

Dust emissions during construction may reduce vegetation productivity in the immediate vicinity of the disturbed areas. Best management practices will be used to minimize dust. Therefore, impacts will be negligible to small.

- Noise from heavy equipment, traffic, and blasting during site preparation; from heavy equipment and traffic during construction; and from chillers, other equipment, and traffic during operations will result in reduced use of nearby onsite and offsite habitat for some species. Blasting and heavy equipment will have the largest noise footprints (see Section 4.7, Noise Impacts) and will result in the greatest reduction in habitat use by wildlife. Site preparation will be a short-term activity and precautions will be taken during land clearing activities to protect migratory birds during breeding or nesting season. Sound levels associated with blasting will be about 94 dBA at 15 m (50 ft) and about 60 to 65 dBA at the nearest site boundary to the footprint of the proposed plant. This level exceeds the limit that is considered acceptable based on the Housing and Urban Development (HUD) land use compatibility guideline of 60 dBA for farm land use (See Table 3.7-2, U.S. Department of Housing Urban Development Land Use Compatibility Guidelines). However, this sound level is within the guideline for industrial facilities of 70 dBA. Blasting will be limited and episodic. For comparison, thunder can generate sound levels of 120 dB.
- Equipment used during construction will generate noise levels as high as 95 dBA at 15 m (50 ft) and about 60 to 65 dBA at the nearest site boundary to the footprint of the proposed plant. This sound level exceeds the HUD land use compatibility guideline of 60 dBA for farm land use but is within the guideline for industrial facilities of 70 dBA. Construction sound levels will be within the HUD land use compatibility guidelines of 60 dBA for farm land use about 1 km (0.6 mi) from the site footprint, which is no more than 0.4 km (0.25 mi) from the boundary of the proposed site nearest to the proposed EREF footprint.

Noise from the plant during operations will be less than 15 dBA at the north boundary of the proposed site. This sound level is within the HUD land use compatibility guidelines of 60 dBA for farm land use.

The impacts to wildlife from noise during construction and operation of the proposed EREF likely will be small.

Night lighting will be used during operation of the proposed EREF. Lighting could reduce wildlife use of habitat adjacent to the facility. Bats could be attracted to the lights since insects, a food source for many bat species, are also attracted to the lights. Lighting will be limited to the plant and access roads. All lights will be pointed or aimed downward to minimize the distance that lights could be observed. Therefore, impacts likely will be small.

Cranes will be used during construction. The tallest plant structure will be about 20 m (65 ft) in height. Bird strikes are possible. However, the structure height is less than the 61 m (200 ft) threshold that requires notifying the FAA and installing lights for aviation safety (CFR, 2008pp); and no wires will be required to support the structure or cranes. In addition, the proposed site is not within a migration concentration area (e.g., near major water bodies or topographic features used for navigation). Therefore, bird strikes are much less likely to occur and the impacts will be small.

Presence of workers will result in avoidance of habitat immediately adjacent to construction and operation activities. Human presence will have the greatest impact during site preparation and construction, when workers are outside and using the most area within the proposed site. During operations worker presence will be lower (i.e., fewer workers, less amount of time outside) and animal populations will have adjusted during the first few years of plant construction. Presence of humans will be in part associated with noise impacts and the spatial extent of human activity will be limited to about 240 ha (592 ac); therefore, impacts will be small.

Traffic and use of onsite access roads can result in vehicle-wildlife collisions and fragmentation of seeded crested wheatgrass vegetation. Collisions will be minimized by maintaining reduced speeds for vehicles. Small mammals and birds will be the most affected by onsite traffic and roads, because few, if any, large mammals use this area on the property. However, the habitat value of this vegetation type potentially will improve with the removal of livestock grazing. The reduced grazing will result in increased vertical structure and a potential increase in plant diversity. This potential increase in plant community structure will offset potential loss from traffic although big game species (e.g., pronghorn) may begin to use the habitat if structure and diversity improves. Offsite traffic will increase along U.S. Highway 20 resulting in increased vehicle-wildlife collisions. The increased traffic volume over existing levels will range from about 28% during operations to about 71% during construction. Impacts from onsite and offsite traffic will be small.

- The retention and detention basins could be attractants to wildlife. The water quality of discharges to the basins will meet standards for stormwater and treated waste water. In addition, the retention and detention basins will be fenced to minimize the potential for wildlife to use the water. Impacts from retention and detention basins will be negligible to small.

4.5.5 Expected Impacts to Communities or Habitats

The communities and habitats on the proposed site are not unique or rare. No currently listed rare, threatened, or endangered species have been found or are known to occur on the proposed site. USFWS and IDFG identified that pronghorn (*Antilocapra americana*), greater sage grouse (*Centrocercus urophasianus*), and pygmy rabbit (*Brachylagus idahoensis*) were the three sensitive species of greatest interest to the agencies related to this project.

The proposed site is within BLM-designated crucial winter-spring pronghorn habitat. The sagebrush steppe habitat on the proposed site is adjacent and contiguous to habitat identified as key greater sage grouse habitat (ISGAC, 2006). The sagebrush steppe vegetation also represents potential habitat for pygmy rabbits. The sagebrush steppe habitat and the seeded crested wheatgrass vegetation provide nesting habitat for migratory birds, including various sparrow species, western meadowlark (*Sturnella neglecta*), sage thrasher (*Oreoscoptes montanus*), northern harrier (*Circus cyaneus*), short-eared owl (*Asio flammeus*), killdeer (*Charadrius vociferous*), and long-billed curlew (*Numenius americanus*), all of which were observed during site surveys. Impacts to these species will be similar to the impacts discussed in Section 4.5.4, Activities Expected to Impact Communities or Habitats. Specific potential impacts to these species are discussed below. See Section 4.5.10, Coordination with Federal and State Agencies, regarding regulatory compliance and protection of these species.

The construction and operation of the proposed EREF will result in the loss of about 75 ha (185 ac) of sagebrush steppe which is used by pronghorn. This is a small percent of this crucial winter-spring range. AREVA will improve the existing boundary fence to ensure pronghorn access to the remaining habitat on the proposed site. Removal of livestock will likely improve cover and vegetation diversity of the remaining sagebrush steppe and seeded crested wheatgrass vegetation types. This improvement may increase the carrying capacity and use of the remaining acres for pronghorn use.

Impacts to greater sage grouse will be similar to those for general wildlife relying on the sagebrush steppe habitat. About 75 ha (185 ac) of sagebrush steppe habitat that could be used for nesting, roosting, and brood rearing will be lost. Greater sage grouse are birds that require large expanses of habitat. Home ranges for non-migratory greater sage grouse have been reported to vary between 11 to 31 km^2 (4-12 mi^2) (Crawford, 2004) (Utah DNR, 2002). This is equivalent to approximately 1,100 ha (2,718 ac) to 3,100 ha (7,660 ac). The median distance traversed by birds from nests to summer/fall range has been reported to be 20.9 km (13 mi) (Fischer, 1993) while hens in Idaho nest an average of 3-5 km (2-3 mi) from their lek of capture but may move more than 8 km (5 mi) to nest (Connelly, 2004). Because greater sage grouse require large areas, the proposed site, which is 1,700 ha (4,200 ac) in size, likely supports only a few birds. The area of sagebrush steppe directly affected by land clearing is about 75 ha (185 ac) which is less than 10% of the median home range for a bird.

Portions of the remaining habitat will be avoided or used less frequently due to noise, human presence, and night lighting. Greater sage grouse mortality may increase if raptors use the remaining habitat more heavily due to increased numbers of perch sites. Removal of grazing may improve the remaining sagebrush steppe vegetation and may increase greater sage grouse use of this vegetation along the western portions of the proposed site. Noise during construction may affect the lek activity and decrease numbers of birds at this lek during breeding season. Maximum construction noise levels will be about 35 dBA at the nearest known lek, which is within ambient noise levels measured in June 2008. This lek is between 6.4 and 8 km (4 and 5 mi) from the proposed site. Therefore, breeding success at this lek may be affected. All other known leks are over 8 km (5 mi) from the proposed EREF site and will not be affected. Therefore, impacts to greater sage grouse from the proposed EREF will be small.

Impacts to the pygmy rabbit may be similar to those for general wildlife relying on the sagebrush steppe habitat. About 75 ha (185 ac) of sagebrush steppe habitat will be lost. Pygmy rabbits and sign were not observed during June and October 2008 surveys. Pygmy rabbits and sign were not observed during surveys conducted on two areas on the INL within 3.2 km (2 mi) of the proposed site and on several other INL areas within 8 km (5 mi) of the proposed EREF site. However, rabbits have been observed during surveys on the INL about 8.7 km (5.4 mi) from the proposed site. If pygmy rabbits are present, portions of the remaining habitat will be avoided or used less frequently due to noise and human presence. Pygmy rabbit mortality may increase if raptors use the remaining habitat more heavily due to increased numbers of perch sites. Conversely, removal of grazing may improve the remaining sagebrush steppe vegetation and increase pygmy rabbit use along the western portions of the proposed site.

- Impacts to migratory birds will include loss of breeding, nesting habitat, roosting, rearing, and feeding habitat. All three vegetation types totaling 240 ha (592 ac) provide some habitat for selected species of migratory birds. Therefore, the loss of habitat will result in birds relocating to adjacent habitat. None of the habitat is unique and remaining habitat may improve as grazing is eliminated, thereby, potentially offsetting some of the impacts. In addition, precautions will be taken when conducting site preparation activities (e.g., land clearing) during nesting season to further minimize impacts to migratory birds.

4.5.6 Tolerances or Susceptibilities of Important Biota to Pollutants

- Species that are highly mobile are not susceptible to localized physical and chemical pollutants as are other less mobile species such as invertebrates and aquatic species. The facility will have very low air emissions (see Section 4.6, Air Quality Impacts) and limited water discharges (see Section 4.4, Water Resources Impacts). Treated domestic sanitary effluent and storm water runoff from chemical processing areas will be collected in a lined retention basin. Stormwater runoff from roads, parking lots, and roofs will be collected in a detention basin. The retention and detention basins will be fenced, therefore limiting access to wildlife. There will be no impacts to aquatic systems because there are no existing aquatic resources on the proposed site, and the plant will not discharge water to any drainages.

4.5.7 Maintenance Practices

Maintenance practices such as the use of chemical herbicides and removal of detention basin residues will be employed during plant operation. No herbicides will be used during construction, but may be used during operations in limited amounts along the access roads, plant area, and security fence surrounding the plant. Herbicides will be used according to government regulations and manufacturer's instructions to control unwanted noxious vegetation during operation of the plant. Any eroded areas that may develop will be repaired and stabilized and sediment will be collected in a stormwater detention basin.

4.5.7.1 Special Maintenance Practices

No unique habitats (e.g., marshes, natural areas, bogs) have been identified within the 1,700-ha (4,200-ac) proposed site. Similarly, no special maintenance practices will be required to construct or operate the proposed EREF. Therefore, no special maintenance practices will be used.

4.5.8 Construction Practices

Standard land clearing methods, primarily the use of heavy equipment, will be used during the construction phase of the proposed EREF site. Erosion and runoff control methods, both temporary and permanent, will follow Best Management Practices (BMPs). These practices include minimizing the construction footprint to the extent possible, limiting site slopes to a horizontal to vertical ratio of four to one or less, using temporary sedimentation detention basins, protecting adjacent undisturbed areas with silt fencing and straw bales as appropriate, using crushed stone on top of disturbed soil in areas of concentrated runoff, and other site stabilization practices. When required, water will be applied to control dust in construction areas. Water conservation will be considered when deciding how often dust suppression sprays will be applied. See ER Section 4.4.7 for water conservation measures.

4.5.9 Practices and Procedures to Minimize Adverse Impacts

Several practices and procedures have been designed to minimize adverse impacts to the ecological resources of the proposed site. These practices and procedures include the use of BMP's recommended by various state and federal management agencies (refer to Section 4.5.8, Construction Practices), minimizing the construction footprint to the extent possible, avoiding all direct discharge (including stormwater) to any waters of the United States (i.e., the use of temporary detention ponds), and site stabilization practices to reduce the potential for erosion and sedimentation. The use of native plant species in disturbed area revegetation will enhance and maximize the opportunity for native wildlife habitat to be re-established at the site. In addition, AREVA has identified the following additional mitigations to reduce impacts to ecological resources:

- Dust suppression methods will be used to minimize dust emissions.
- Fence the stormwater discharge retention and detention basins to limit access by wildlife.
- Improve the existing boundary fence by using smooth wire on the bottom wire and maintaining a minimum distance of about 40 cm (16 in) between the bottom wire and the ground.
- Continue seasonal monitoring of habitat to confirm habitat use by sensitive species.
- Exercise precautions during site preparation (e.g. land clearing) activities to protect migratory birds during nesting season.
- The use of low maintenance landscaping in and around the stormwater detention basin.
- The management of unused open areas (i.e. leave undisturbed), including areas of native grasses and shrubs for the benefit of wildlife.
- Eliminate livestock grazing on the property, when the plant becomes operational.
- Re-seed cropland areas on the property with native species, when the plant becomes operational.

4.5.10 Coordination with Federal and State Agencies

Currently, no listed rare, threatened, or endangered species or habitats are known to occur on the proposed site. However, the sagebrush community isolated to the northwestern one-third of the proposed site has the potential to provide habitat for the pygmy rabbit and is used by the greater sage grouse. In January 2008, the USFWS initiated a status review for the pygmy rabbit (USFWS, 2008d) and in February 2008 for the greater sage grouse (USFWS, 2008e) (USFWS, 2008f) to determine if listing of either species is warranted. In addition, multiple agencies, including IDFG, published an updated sage grouse conservation plan (ISGAC, 2006). The life history and habitat requirements for both species are discussed in Section 3.5.3, Description of Important Wildlife and Plant Species. By letter dated June 30, 2008, the USFWS notified AES of its determination that Endangered Species Act consultation is not needed.

AREVA met with the Idaho Department of Fish and Game (IDFG) and the U.S. Fish and Wildlife Service (USFWS). AREVA, IDFG, and USFWS agreed to continue discussions as the proposed project planning evolves and, as appropriate, develop mitigations to minimize impacts to ecological resources. Section 4.5.9, Practices and Procedures to Minimize Adverse Impacts, provides the current mitigations identified by AREVA. AREVA, if needed, will obtain a permit(s) from USFWS for taking of migratory birds. In addition, AREVA will continue to work with USFWS and IDFG if either the greater sage grouse or pygmy rabbit are listed as threatened or endangered.

4.5.11 Cumulative Impacts

The cumulative impacts to the ecological resources is limited to those resulting from construction and operation of the EREF and existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. Continued land use, primarily agriculture and grazing, will continue to have similar impacts on wildlife and habitat. Wildfire threats will remain. In the larger region, reduction of sagebrush steppe habitat likely will continue from developments and conversion of sagebrush steppe to crop land. Federal, state, and private activities and coordination may reduce habitat losses in the future. Construction and operation of the proposed EREF will contribute to the direct loss of about 75 ha (185 ac) of sagebrush steppe in the region. This loss will be at the edge of contiguous habitat and will represent less than 1% of the sagebrush steppe habitat within 8 km (5 mi) of the proposed site. Therefore, cumulative impacts will be small.

4.5.12 Comparative Ecological Resource Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The ecological resource impacts would be the same since three enrichment plants would be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The ecological resource impacts would be the same or greater since there is additional concentration of activity at a single location.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The ecological resource impacts would be the same or greater since there is additional concentration of activity at a single location.

FIGURES

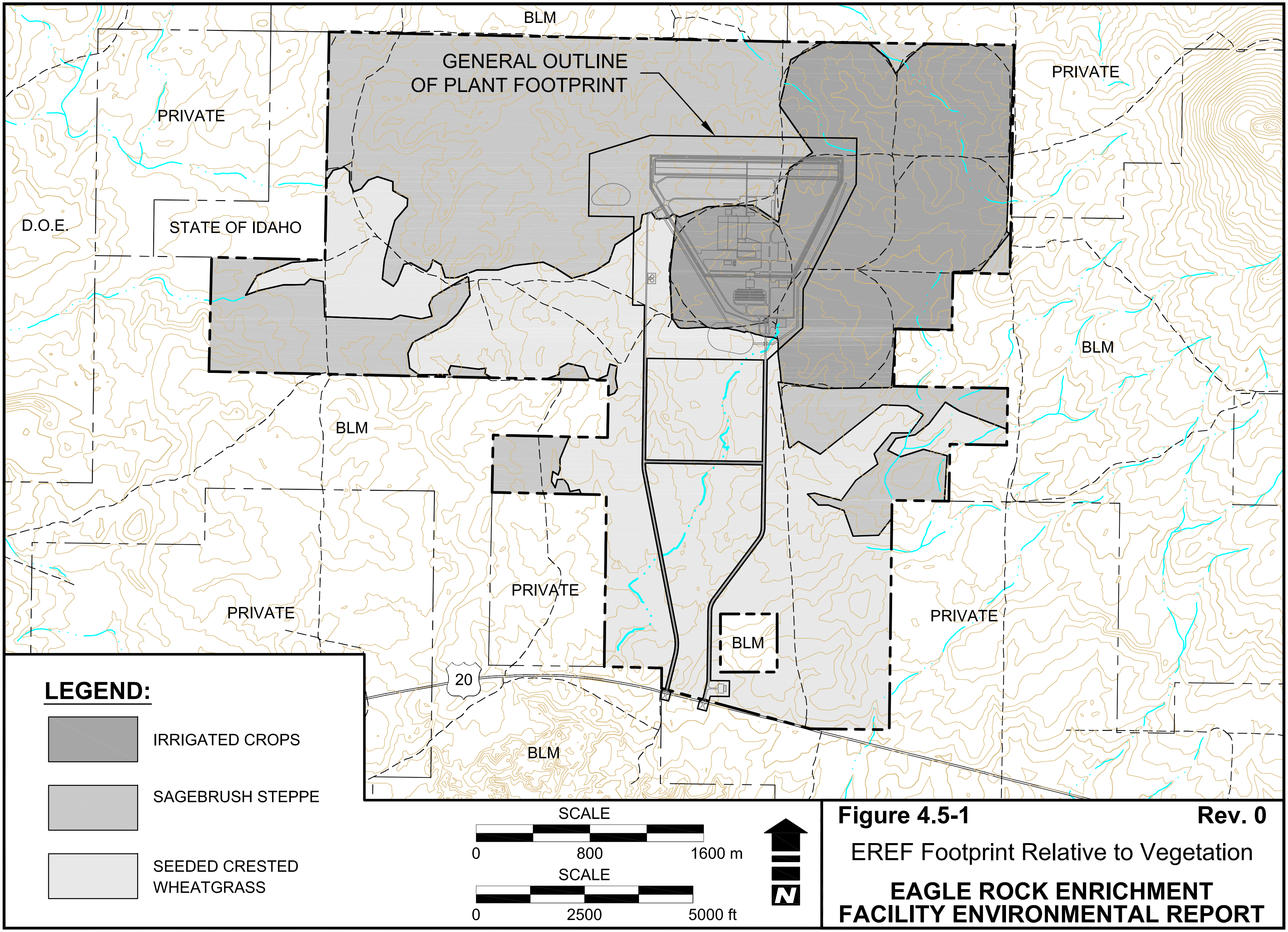

Figure 4.5-1 **Rev. 0**

EREF Footprint Relative to Vegetation

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

4.6 AIR QUALITY IMPACTS

This section describes the air quality impacts of the proposed action (construction, operation, and decommissioning of the Eagle Rock Enrichment Facility (EREF)).

4.6.1 Air Quality Impacts from Construction

Air quality impacts from site preparation for the EREF were evaluated using emission factors and air quality dispersion modeling. Emission rates of criteria pollutants were estimated for exhaust emissions from construction vehicles and for fugitive dust using emission factors provided in the United States Environmental Protection Agency's (EPA) AP-42, Compilation of Air Pollutant Emission Factors (EPA, 2008f). The total emission rates were used to scale the output from the American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD), based upon a unit source term as input to the model, to estimate both short-term and annual average ambient air concentrations at the facility property boundary. AERMOD is a refined, steady-state, multi-source, Gaussian dispersion model that is EPA's preferred model for a wide range of regulatory applications in all types of terrain (EPA, 2008g). The air emissions calculations and air dispersion modeling are discussed in more detail in Appendix B.

Emission rates from vehicle exhaust and fugitive dust, as listed in Table 4.6-1, Peak Emission Rates, were estimated for a 10-hour workday assuming peak construction activity levels were maintained throughout the year. Fugitive dust will originate predominantly from vehicle traffic on unpaved surfaces, earth moving, excavating and bulldozing, and to a lesser extent from wind erosion. Fugitive dust emissions were estimated using an AP-42 emission factor for construction site preparation that was adjusted to account for dust suppression measures and the fractions of total suspended particulate that are expected to be in the particulate matter less than 10 microns (PM_{10}) and particulate matter less than 2.5 microns ($PM_{2.5}$) size ranges. It was assumed that no more than 75 ha (185 ac) of the construction site would be involved in construction work at any one time. The area limitation on construction activities is based on the need to maintain compliance with the 24-hour PM_{10} ambient air quality standard. A more detailed discussion of this issue and a possible remedy to increase the percentage of allowable disturbed area is presented later in this section.

Of the combustion sources, vehicle exhaust will be the dominant source. Fugitive volatile emissions will occur because vehicles will be refueled on-site. Estimated vehicles that will be operating on the site during construction will consist of two types: support vehicles and construction equipment. The support vehicles will include fifty pickup trucks, forty gators (gas-powered carts), three fuel trucks, four stakebody trucks and three mechanic's trucks. Emission factors in EPA's MOBILE6.2 emission estimation model (EPA, 2003) were used to estimate emissions of criteria pollutants and non-methane hydrocarbons for these vehicles. Use of MOBILE6.2 requires that mobile sources be categorized by vehicle size. The gators were assumed to be Light Duty Vehicles, the pickup trucks and the mechanic's trucks Category I Light Duty Trucks, the stakebody trucks Category II Light Duty Trucks and the fuel trucks were assumed to be Heavy Duty Trucks. Baseline emission factors for each of the vehicle categories were provided in MOBILE6.2 as a function of the calendar year. Emission factors used included vehicle model years for the last 25 years.

The construction equipment that will be operating on the site during peak construction consists of five bulldozers, four graders, five pans (diesel-powered fill transporters), twenty dump trucks, nine backhoes, eight loaders, six rollers, four water trucks, five telehandlers, 16 manlifts, nine track drills, three 25-ton cranes and four cranes at 250-ton or greater, three concrete pump trucks, nine concrete delivery trucks and one tractor. Emission factors, in units of grams per hour of operation, provided in MOBILE6.2 for diesel-powered construction equipment, were compiled. In calculating emissions, it was conservatively assumed that all equipment would be in continuous operation throughout the 10-hour workday.

Emissions were modeled in AERMOD as a uniform area source with emissions occurring 10 hours per day, 5 days per week, and 52 weeks per year (Note: Construction activities are planned to occur for 50 weeks per year; however, since it was impossible to determine which two weeks of the year to eliminate from the meteorological data base, the dispersion model was conservatively run for all 52 weeks of the year). The modeling analysis was performed using five years (1988-1992) of hourly surface meteorological data from the National Weather Service (NWS) station at Pocatello Municipal Airport in Pocatello, Idaho and concurrent upper air sounding data collected at the Boise International Airport in Boise, Idaho. The Pocatello Airport surface data for this period (EPA had filled in missing data) are readily available from EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) (EPA, 2008h) web site.

Pocatello Airport is located 77 kilometers (48 miles) south of the EREF and both sites are characterized by predominantly rural surroundings with no significant nearby terrain influences. Therefore, the surface data collected at Pocatello Airport was adequately representative to conduct the modeling analysis to evaluate maximum impacts at the EREF site. For the upper air data, Boise Airport was the closest available data and therefore was used in this analysis.

Sixty-two (62) property line receptors were selected for the refined modeling analysis to determine the maximum air quality impacts caused by construction site preparation activity.

In order to demonstrate that the construction site preparation activities comply with the applicable National Ambient Air Quality Standards (NAAQS) (CFR, 2008nn), maximum predicted air quality impacts for each pollutant must be added to representative background air quality concentrations that represent the contribution from all un-modeled emissions sources. Background concentrations must be obtained for each pollutant and each averaging period for which an NAAQS exists.

There is a network of air pollutant monitoring sites throughout the State of Idaho. The nearest monitoring sites to the EREF are located in Pocatello, Idaho, where multiple monitoring sites are in operation for most of the criteria pollutants. Because of the general proximity of the Pocatello monitors to the EREF site, the air quality data at these sites will be assumed to be representative of air quality at the EREF site. For criteria pollutants not monitored in Pocatello, the next closest monitoring location was selected. In order to determine background concentrations for the modeling analysis, monitoring data reports for the most recent two years (2006 and 2007) were obtained from EPA's AIRData web-site (EPA, 2008i).

Table 4.6-2, Background Air Quality Concentrations for AERMOD Modeling Analysis, summarizes the monitored concentration data that were used in the background analysis and presents the calculated background concentrations that were used in the AERMOD modeling analysis. Because the NAAQS typically allow for a single exceedance of a short-term (24-hour average or less) standard without causing a violation, the short-term background concentrations for carbon monoxide (CO) and sulfur dioxide (SO_2) are based on the second-highest concentration measured at each monitor during each year. The higher of the two second-highest values was selected as the background concentration. In addition, based on modeling guidelines, the 24-hour average background concentrations for PM_{10} are based on the third highest concentration measured over the two-year period and $PM_{2.5}$ are based on the 98^{th} percentile monitored concentration (i.e., 98 percent of the monitored concentrations are less than that value).

The results of the air quality impact analysis of the EREF construction site preparation activities are presented in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity. All predicted concentrations shown in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity, include the appropriate ambient background level noted in Table 4.6-2, Background Air Quality Concentrations for AERMOD Modeling Analysis. No NAAQS has been set for hydrocarbons; however, the total annual emissions of hydrocarbons predicted from the site (approximately 4,045 kg (4.5 tons)) are well below the level of 36,287 kg (40 tons) that defines a significant source of volatile organic compounds (40 CFR 52.21(b)(23)(i)) (CFR, 2008qq).

As shown in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity, the maximum predicted one-hour and eight-hour CO concentrations for the EREF construction site preparation were 4.6 ppm and 2.1 ppm, respectively. All CO concentrations were generated by vehicle exhaust from support vehicles and construction equipment utilized on-site. None of the modeled CO concentrations exceed the NAAQS noted in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity.

The maximum predicted annual nitrogen dioxide (NO_2) concentration was estimated to be 11.6 $\mu g/m^3$. As with CO concentrations, all NO_2 concentrations were generated from vehicle exhaust and do not exceed the NAAQS.

For SO_2 concentrations, the estimated maximum annual concentration was 15.7 $\mu g/m^3$, 63.4 $\mu g/m^3$ for the 24-hour averaging period, and 163.1 $\mu g/m^3$ for the 3-hour averaging period. SO_2 concentrations were generated by vehicle exhaust from construction equipment. None of the predicted SO_2 concentrations exceeded the NAAQS.

PM_{10} concentrations were mainly generated by fugitive dust caused by construction activity. To a lesser extent, vehicle exhaust from construction equipment contributed to the PM_{10} concentrations. As can be seen in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity, the maximum predicted annual PM_{10} concentration was 25.8 $\mu g/m^3$ while the 24-hour PM_{10} concentration was estimated to be 150 $\mu g/m^3$. The NAAQS for the annual averaging period was revoked in 2006 and therefore does not apply. The 24-hour PM_{10} concentration is at the NAAQS but does not exceed the limit noted in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity. This maximum 24-hour PM_{10} concentration is predicted to occur at a location on the property boundary that is closest to the southwest portion of the area of disturbance.

Predicted maximum $PM_{2.5}$ annual concentrations were estimated to be 7.1 $\mu g/m^3$ and the 24-hour concentration was 30 $\mu g/m^3$. These concentrations do not exceed the annual and 24-hour NAAQS shown in Table 4.6-3, Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity. Fugitive dust generated by construction activity and vehicle exhaust is a contributor to the $PM_{2.5}$ concentrations.

Other onsite air quality impacts will occur due to the construction work, such as portable generator exhaust, air compressor exhaust, welding torch fumes, and paint fumes. Since the EREF will be constructed using a phased construction plan, some of the facility will be operational while construction continues. As such, other air quality impacts will occur due to the operation of the standby diesel generators. Construction emission types, source locations, and emission quantities are presented in Table 4.6-4, Construction Emission Types.

During the three-year period of site preparation and major building construction, offsite air quality will be impacted by passenger vehicles with construction workers commuting to the site and trucks delivering construction materials and removing construction wastes. Emission rates from passenger vehicle exhaust were estimated for a 80 km (50 mi) roundtrip commute for 900 vehicles per workday. No credit was taken for the use of car pools. Emission rates from delivery trucks were estimated for a 402 km (250 mi) roundtrip for 30 vehicles per workday. It was assumed that there are 250 workdays per year (five-day work week and fifty-week work year). Emission factors are based on MOBILE6.2. The resulting emission factors, tons of daily emissions, number of vehicles and heavy duty engines are provided in Table 4.6-5, Offsite Vehicle Air Emissions During Construction.

The construction estimates for daily emissions are based on the average number of trucks per day. There will be peak days, such as when large concrete pours are executed, where there will be more than the average number of trucks per day. This peak daily value of truck trips is not available at this time. It is estimated, however, that the daily emission values presented in Table 4.6-5, Offsite Vehicle Air Emissions During Construction, that are based on the average number of trucks could be about an order of magnitude higher on the peak days.

The air quality impacts from construction activities will be small, because:

- Impacts from vehicular emissions are predicted to be well below NAAQS.
- Impacts from particulate matter emissions from fugitive dust are predicted to be below NAAQS.
- The extent of the maximum fugitive dust impacts is limited to a small area that is in close proximity to the property boundary.
- Mitigation measures will be implemented to ensure that fugitive dust emissions are controlled to the lowest levels practicable.

4.6.2 Air Quality Impacts from Operation

Onsite air quality will be impacted during operation due to the operation of the standby generators. Operation emission types, source locations, and emission quantities of the EREF standby diesel generators are presented in Table 4.6-6, Air Emissions During Operations.

During operation, offsite air quality will be impacted by passenger vehicles with EREF workers commuting to the site, delivery trucks, uranium hexafluoride (UF_6) cylinder shipment trucks, and waste removal trucks. Emission rates from passenger vehicle exhaust were estimated for a 80.5 km (50 mi) roundtrip commute for 420 vehicles per workday. No credit was taken for the use of car pools. Emission rates from trucks were estimated for an average distance of 31,348 km (19,483 mi) for 10 vehicles per workday. It was assumed that there are 250 workdays per year (five-day work week and fifty-week work year). Emission factors are based on MOBILE6.2. The resulting emission factors, tons of daily emissions, number of vehicles and heavy duty engines are provided in Table 4.6-7, Offsite Vehicle Air Emissions During Operations.

NUREG-1748 (NRC, 2003a) recommends that atmospheric dispersion factors (χ/Q's) be used to assess the environmental effects of normal plant operations and facility accidents. In the following subsections, information is presented about the gaseous effluents, the gaseous effluent control systems, and computer models and data used to calculate the atmospheric dispersion and deposition factors.

The air quality impacts from operation activities will be small, because:

- Emissions from the operation of two emergency generators will be small. These emission units are exempt from permitting requirements.
- Vehicular emissions are predicted to be extremely low in the vicinity of the site.
- Emissions of hazardous air pollutants are predicted to be insignificant and are well below permitting thresholds.

4.6.2.1 Description of Gaseous Effluents

Uranium hexafluoride (UF_6) will be the radioactive effluent for gaseous pathways. Average source term releases to the atmosphere are estimated to be 9.8 MBq (264 μCi) per year for the purposes of bounding routine operational impacts. European experience indicates that uranium discharges from gaseous effluent ventilation systems are less than 10 g (0.35 ounces) per year. Therefore, 9.8 MBq (264 μCi) is a very conservative estimate and is consistent with an NRC estimate (NRC, 1994) for a 1.5 million SWU plant that has been scaled for the 3.3 million SWU EREF.

Nonradioactive gaseous effluents include hydrogen fluoride (HF), ethanol and methylene chloride. HF releases are estimated to be 1.0 kg (2.2 lbs) each year. Approximately 40 L (10.6 gal) and 610 L (161 gal) of ethanol and methylene chloride, respectively, are estimated to be released each year. These values are based on European operational experience.

In addition, on-site diesel engines include two standby diesel generators for use as standby power sources, a security diesel generator, and a fire pump diesel. Their use will be administratively controlled (i.e., only run a limited number of hours per year to limit emissions) and are exempt from air permitting requirements of the state of Idaho (IDAPA, 2008i).

4.6.2.2 Description of Gaseous Effluent Ventilation Systems and Exhaust Filtration Systems

The principal functions of the gaseous effluent ventilation system (GEVS) is to protect both the operator during connection/disconnection of UF_6 process equipment, and the environment, by collecting and cleaning all potentially hazardous gases from the plant prior to release to the atmosphere. Releases to the atmosphere will be in compliance with regulatory limits.

The stream of air and water vapor drawn into the GEVS can have suspended within it UF_6, hydrogen fluoride (HF), oil and uranium particulates (mainly UO_2F_2). Online instrument measurements will provide a continuous indication to the operator of the quantity of radioactive material and HF in the emission stream. This will enable rapid corrective action to be taken in the event of any deviation from the normal operating conditions.

There are six Gaseous Effluent Ventilation Systems for the plant: (1) the Separations Building Modules (SBM) Safe-by-Design GEVS (one in each of the two modules), (2) the Separations Building Modules Local Extraction GEVS (one in each of the two modules), (3) the Technical Support Building (TSB) GEVS and (4) the Centrifuge Test and Post Mortem Facilities GEVS within the Centrifuge Assembly Building (CAB). In addition, the TSB, the Blending, Sampling & Preparation Building (BSPB), and the Centrifuge Test and Post Mortem Facilities have HVAC systems that function to maintain negative pressure and exhaust filtration for rooms served by these systems.

The SBM Safe-by-Design GEVS transports potentially contaminated gases to a set of redundant filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and fans. The cleaned gases are discharged via rooftop exhaust vents to the atmosphere. The SBM Local Extraction GEVS collects potentially contaminated gaseous effluent from local flexible hose connections that are used during cylinder connection and disconnection and maintenance activities. The TSB GEVS transports potentially contaminated gases to a set of redundant filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and fans. The Centrifuge Test and Post Mortem Facilities GEVS has one set of filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and a single fan. The TSB Contaminated Area HVAC system has two active sets of filters (roughing filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and fans. The Ventilated Room HVAC System in the BSPB and Centrifuge Test and Post Mortem Facilities Exhaust Filtration (HVAC) System each have one set of filters (roughing filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and one fan. The TSB GEVS and TSB Contaminated Area HVAC System exhaust vents are on the roof of the TSB. The Ventilated Room HVAC System exhaust point is on the roof of the BSPB. The Centrifuge Test and Post Mortem Facilities GEVS and Exhaust Filtration System exhaust vents are on the roof of the CAB.

Instrumentation is provided to detect and signal via alarm all non-routine process conditions so that the process can be returned to normal by operator actions. Trip actions from the same instrumentation automatically put the system into a safe condition.

4.6.2.3 Calculation of Atmospheric Dispersion and Deposition Factors

NUREG-1748 (NRC, 2003a) recommends that atmospheric dispersion factors (χ/Q's) be used to assess the environmental effects of normal plant operations and facility accidents. Although onsite meteorological data were not available for this analysis, five years (2003-2007) of meteorological data that meet the guidelines of Regulatory Guide 1.23, Revision 1 (NRC, 2007c) were obtained from the Air Resources Laboratory Field Research Division of the National Oceanic and Atmospheric Administration. The meteorological data used in the calculation of atmospheric dispersion and deposition factors were collected at a monitoring station known as EBR (now identified as MFC) located 18 km (11 mi) west of the EREF site. Both the EREF site and the meteorological monitoring station are located in the Eastern Snake River Plain of Idaho and have the same climate; as such, the meteorological data collected at EBR are representative of meteorological conditions at the EREF site. The meteorological data used in this analysis are discussed in greater detail in Section 3.6.

The computer program AEOLUS3, Revision 1, is intended to provide estimates of atmospheric dispersion and deposition of gaseous effluents in routine releases from nuclear facilities. AEOLUS3 implements the guidance in Regulatory Guide 1.111 (NRC, 1977c). AEOLUS3 is based on the theory that material released to the atmosphere will be normally distributed (Gaussian distribution) about the plume centerline. In predicting concentrations for longer time periods, the horizontal plume distribution is assumed to be evenly distributed within the directional sector, the so-called sector average model. A straight-line trajectory is assumed between the point of release and all receptors. Distances to the site boundary were determined using guidance from NRC Regulatory Guide 1.145 (NRC, 1983).

Maximum annual average atmospheric dispersion and deposition factors for the site boundary, and nearest gardens, meat animals, and businesses are presented in Table 4.6-8. Factors are not provided at the locations of nearest residents; instead, a resident is assumed to exist in the critical sectors at the site boundary (as designed in Table 4.6-8). The highest χ/Q was 4.424E-06 sec/m^3 on the site boundary at a distance of 1,008 m (3,307 ft) in the southwest sector. The highest deposition factor was 1.635E-08 1/m^2 on the site boundary at a distance of 1,101 m (3,614 ft) in the north-northeast sector. Tables 4.6-9 through 4.6-14 present atmospheric dispersion and deposition factors out to 80 km (50 mi).

4.6.3 Visibility Impacts

Visibility impacts from construction will be limited to fugitive dust emissions. Fugitive dust will originate predominantly from vehicle traffic on unpaved surfaces, earth moving, excavating and bulldozing, and to a lesser extent from wind erosion. There are no anticipated visibility impacts from operation of the EREF since there are no cooling towers that would produce visible plumes. Visibility impacts from decommissioning will be limited to fugitive dust. Fugitive dust will originate predominantly from building demolition, bulldozing, and vehicle traffic on unpaved surfaces.

4.6.4 Air Quality Impacts from Decommissioning

Air quality impacts will occur during the decommissioning work, such as fugitive dust, vehicle exhaust, portable generator exhaust, air compressor exhaust, cutting torch fumes, and solvent fumes. Decommissioning emission types, source locations, and emission quantities are presented in Table 4.6-15, Decommissioning Emission Types. Fugitive dust and vehicle exhaust during decommissioning are assumed to be bounded by the emissions during construction.

The air quality impacts from decommissioning activities will be small, because these impacts are similar to and bounded by the air quality impacts associated with the construction of the EREF. The construction impacts were determined to be small.

4.6.5 Mitigative Measures for Air Quality Impacts

Air concentrations of criteria pollutants for vehicle emissions and fugitive dust will be below the NAAQS. Particulate matter and visibility impacts from fugitive dust emissions will be minimized by watering of the site during the construction phase to suppress dust emissions. Water conservation will be considered when deciding how often dust suppression sprays will be applied.

Mitigative measures for all credible accident scenarios considered in the Safety Analysis Report (SAR) are summarized in ER Section 4.12, Public and Occupational Health Impacts and ER Chapter 5, Mitigation Measures.

Mitigation measures will be in place to minimize potential impact on air quality. These include the following items:

- The SBM Safe-by-Design GEVS and SBM Local Extraction GEVS are designed to collect and clean all potentially hazardous gases from the plant prior to release into the atmosphere. Instrumentation is provided to detect and signal via alarm all non-routine process conditions, including the presence of radionuclides or HF in the exhaust system that will trip the system to a safe condition in the event of effluent detection beyond routine operational limits.
- The TSB GEVS is designed to collect and clean all potentially hazardous gases from the serviced areas in the TSB prior to release into the atmosphere. Instrumentation is provided to detect and signal the Control Room via alarm all non-routine process conditions, including

the presence of radionuclides or HF in the exhaust stream. Operators will then take appropriate actions to mitigate the release.

- The Centrifuge Test and Post Mortem Facilities GEVS is designed to collect and clean all potentially hazardous gases from the serviced areas in the CAB prior to release into the atmosphere. Instrumentation is provided to detect and signal the Control Room via alarm all non-routine process conditions, including the presence of radionuclides or HF in the exhaust stream. Operators will then take appropriate actions to mitigate the release.
- The TSB Contaminated Area HVAC, the Ventilated Room HVAC System in the BSPB, and the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System are designed to collect and clean all potentially hazardous gases from the serviced areas prior to release into the atmosphere.
- Construction Best Management Practices will be applied to minimize fugitive dusts.
- Applying gravel to the unpaved surface of haul roads.
- Imposing speed limits on unpaved haul roads.
- Applying an environmentally safe chemical soil stabilizer or chemical dust suppressant to the surface of the unpaved haul roads.
- The use of water spray bars at drop and conveyor transfer points.
- Limiting the height and disturbances of stockpiles.
- Applying water to the surface of stockpiles.
- Air concentrations of the criteria pollutants resulting from vehicle emissions and fugitive dust during construction will be below NAAQS.

4.6.6 Comparative Air Quality Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The air quality impacts would be the same since three enrichment plants would be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The air quality impacts would be the same or greater since there is additional concentration of activity at a single location.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The air quality impacts would be the same or greater since there is additional concentration of activity at a single location.

4.6.7 Cumulative Air Quality Impacts

The cumulative impacts to the regional air quality is limited to those resulting from construction and operation of the EREF and existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF.

ER Section 3.6.3.9, Regional Emissions, provides an emissions inventory of other emission sources in the four-county region surrounding the EREF. The inventory consists of ten sources, eight of which are associated with activities at the INL. The other two sources are owned by Basic American Foods, Inc. Due to the relatively small quantity of emissions from these sources and their distance from the EREF site, it is unlikely that these sources, in combination with emissions from the EREF site, will result in significant cumulative impacts. Nevertheless, the air quality impact analysis described in ER Section 4.6.1, Air Quality Impacts from Construction, does incorporate background concentrations (see Table 4.6-2, Background Air Quality Concentrations for AERMOD Modeling Analysis) that are added to potential EREF impacts to simulate cumulative impacts. The cumulative impact to the regional air quality will be small.

TABLES

Table 4.6-1 Peak Emission Rates
(Page 1 of 1)

Pollutant	Total Work-Day Average Emissions g/s (lbs/hr)
Vehicle Emissions:	
Hydrocarbons	0.34 (2.67)
Carbon Monoxide	3.55 (28.19)
Nitrogen Oxides	1.30 (10.29)
Sulfur Oxides	0.10 (0.77)
Particulates[1]	0.02 (0.17)
Fugitive Emissions:	
PM_{10}	21.8 (172.7)
$PM_{2.5}$	3.3 (25.9)

Note:

[1]Conservatively assumed all vehicle particulate emissions were $PM_{2.5}$, which means $PM_{2.5}$=PM_{10}.

Table 4.6-2 Background Air Quality Concentrations for AERMOD Modeling Analysis (Page 1 of 1)

Pollutant	Averaging Period	Closest Selected Station	Ambient Background Concentration		Selected Background Concentration
			2006	2007	
Carbon Monoxide	1-Hour	Eastman Bldg/ 166 N. 9th St. Boise, Idaho Site ID 160010014	3.5 ppm	4.3 ppm	4.3 ppm
	8-Hour		2.1 ppm	1.6 ppm	2.1 ppm
Nitrogen Dioxide	Annual	N. of Lancaster Rd. Hayden, Idaho Site ID 16055003	11.3 µg/m^3	11.3 µg/m^3	11.3 µg/m^3
Sulfur Dioxide	3-Hour	Stp/Batiste & Chubbuck Rd. Pocatello, Idaho Site ID 160050004	159.7 µg/m^3	133.5 µg/m^3	159.7 µg/m^3
	24-Hour		62.8 µg/m^3	62.8 µg/m^3	62.8 µg/m^3
	Annual		13.1 µg/m^3	15.7 µg/m^3	15.7 µg/m^3
Particulates -PM_{10}	24-Hour	G&G/Corner of Garret & Gould Pocatello, Idaho Site ID 160050015	52 µg/m^3	45 µg/m^3	52 µg/m^3
	Annual		21 µg/m^3	22 µg/m^3	22 µg/m^3
Particulates -$PM_{2.5}$	24-Hour	G&G/Corner of Garret & Gould Pocatello, Idaho Site ID 160050015	21 µg/m^3	ND[1]	21 µg/m^3
	Annual		6.4 µg/m^3	ND[1]	6.4 µg/m^3

Note:

[1]ND means no data available.

Table 4.6-3 Results of Air Quality Impact AERMOD Dispersion Modeling for EREF Construction Site Preparation Activity

(Page 1 of 1)

Pollutant	Averaging Period	Standard	Modeled Maximum Concentration[1]	Units	Exceedance?
Carbon Monoxide (CO)	8-Hour	9 ppm	2.1	ppm	No
	1-Hour	35 ppm	4.6	ppm	No
Nitrogen Dioxide (NO_2)	Annual	100 $\mu g/m^3$	11.6	ug/m^3	No
Sulfur Dioxide (SO_2)	Annual	80 $\mu g/m^3$	15.7	ug/m^3	No
	24-Hour	365 $\mu g/m^3$	63.4	ug/m^3	No
	3-Hour	1300 $\mu g/m^3$	163.1	ug/m^3	No
Particulate Matter -PM_{10}	Annual	Revoked in 2006	25.8	ug/m^3	Not Applicable
	24-Hour	150 $\mu g/m^3$	150.0	ug/m^3	No
Particulate Matter -$PM_{2.5}$	Annual	15 $\mu g/m^3$	7.1	ug/m^3	No
	24-Hour	35 $\mu g/m^3$	30.0	ug/m^3	No

Note:

[1]Modeled Maximum Concentrations include an ambient background concentration (see Table 4.6-2).

Table 4.6-4 Construction Emission Types
(Page 1 of 1)

Emission Type	Source Location	Quantity
Fugitive Dust PM_{10} $PM_{2.5}$	Onsite	21.8 g/s (172.7 lb/hr) 3.3 g/s (25.9 lb/hr)
Vehicle Exhaust	Onsite	4,045 kg/yr (4.5 tons/yr)
Paint Fumes	Onsite buildings	NA[1]
Welding Torch Fumes	Onsite buildings	NA[1]
Solvent Fumes	Onsite buildings	NA[1]
Air Compressors	NA[1]	NA[1]
Portable Generators	NA[1]	NA[1]
Standby Diesel Generator Exhaust[2]	Mechanical Services Building	61 kg/yr (0.067 ton/yr) of PM_{10} 8,437 kg/yr (9.3 ton/yr) of NO_x 726 kg/yr (0.80 ton/yr) of CO 168 kg/yr (0.185 ton/yr) of VOC

Notes:

[1]Information is not available at this time.

[2]Other smaller diesel generators (security diesel generator, fire pump diesel) may also be used to provide backup power to some specific systems.

Table 4.6-5 Offsite Vehicle Air Emissions During Construction
(Page 1 of 1)

Estimated Vehicle Type	Emission Factor (g/mi)	Estimated Daily Number Of Vehicles	Estimated Daily Mileage km (mi)	Daily Work Day Emissions (g)
NONMETHANE HYDROCARBONS				
Light Duty Vehicles (Gasoline)	1.219	900	80 (50)	54,855
Heavy Duty Truck (Diesel)	0.506	30	402 (250)	3,795
Total				58,650
Daily Emissions				**5.9E-02 metric tons (6.5E-02 tons)**
CARBON MONOXIDE				
Light Duty Vehicles (Gasoline)	20.350	900	80 (50)	915,750
Heavy Duty Truck (Diesel)	2.560	30	402 (250)	19,200
Total				934,950
Daily Emissions				**9.3E-01 metric tons (1.0E+00 tons)**
NITROGEN OXIDES				
Light Duty Vehicles (Gasoline)	1.193	900	80 (50)	53,685
Heavy Duty Truck (Diesel)	10.292	30	402(250)	77,190
Total				130,875
Daily Emissions				**1.3E-01 metric tons (1.4E-01 tons)**

Table 4.6-6 Standby Diesel Generator Air Emissions During Operations
(Page 1 of 1)

Standby Diesel Generator Exhaust[1]	Mechanical Services Building	61 kg/yr (0.067 ton/yr) of PM_{10}
		8,437 kg/yr (9.3 ton/yr) of NO_x
		726 kg/yr (0.80 ton/yr) of CO
		168 kg/yr (0.185 ton/yr) of VOC

[1] Other smaller diesel generators (security diesel generator, fire pump diesel) may also be used to provide backup power to some specific systems.

Table 4.6-7 Offsite Vehicle Air Emissions During Operations
(Page 1 of 1)

Estimated Vehicle Type	Emission Factor (g/mi)	Estimated Daily Number Of Vehicles	Estimated Daily Mileage km (mi)	Daily Work Day Emissions (g)
NONMETHANE HYDROCARBONS				
Light Duty Vehicles (Gasoline)	1.219	420	80 (50)	25,599
Heavy Duty Truck (Diesel)	0.506	10	31,348 (19,483)	158,618
Total				184,217
Daily Emissions				**1.8E-01 metric tons (2.0E-01 tons)**
CARBON MONOXIDE				
Light Duty Vehicles (Gasoline)	20.350	420	80 (50)	427,350
Heavy Duty Truck (Diesel)	2.560	10	31,348 (19,483)	802,496
Total				1,229,846
Daily Emissions				**1.2 metric tons (1.4 tons)**
NITROGEN OXIDES				
Light Duty Vehicles (Gasoline)	1.193	420	80 (50)	25,053
Heavy Duty Truck (Diesel)	10.292	10	31,348 (19,483)	3,226,285
Total				3,251,338
Daily Emissions				**3.3 metric tons (3.6 tons)**

Table 4.6-8 Summary of Maximum Annual Average Atmospheric Dispersion and Deposition Factors

(Page 1 of 1)

Special Receptors	**Sector Average Concentration, Undepleted, Undecayed χ/Q Values**			**Sector Average D/Q Values**		
	χ /Q, (sec/m³)	**Sector**	**Distance from Source, m (ft)**	**D/Q, (1/m²)**	**Sector**	**Distance from Source, m (ft)**
Site Boundary	4.424E-06	SW	1,008 (3,307)	1.635E-08	NNE	1,101 (3,614)
Gardens	3.029E-07	SW	5,800 (19,029)	9.731E-10	NE	6,000 (19,685)
Meat Animals	2.833E-06	SSW	1,116 (3,661)	9.744E-09	SSW	1,116 (3,661)
Businesses	4.079E-07	SW	4,700 (15,420)	1.127E-09	S	2,834 (9,298)

Table 4.6-9 Sector Average Concentration, Undepleted, Undecayed χ/Q Values (sec/m³) for Grid Receptors

(Page 1 of 2)

	200m (0.12 mi)	400m (0.24 mi)	600m (0.37 mi)	805m (0.5 mi)	1000m (0.62 mi)	1200m (0.75 mi)	1400m (0.86 mi)	1610 m (1 mi)
N	5.954E-05	2.135E-05	1.127E-05	6.962E-06	4.802E-06	3.528E-06	2.740E-06	2.192E-06
NNE	5.659E-05	2.019E-05	1.052E-05	6.457E-06	4.451E-06	3.264E-06	2.530E-06	2.019E-06
NE	4.384E-05	1.563E-05	8.022E-06	4.888E-06	3.365E-06	2.462E-06	1.903E-06	1.516E-06
ENE	2.441E-05	8.703E-06	4.441E-06	2.699E-06	1.858E-06	1.359E-06	1.050E-06	8.349E-07
E	1.296E-05	4.615E-06	2.353E-06	1.430E-06	9.837E-07	7.190E-07	5.552E-07	4.416E-07
ESE	1.292E-05	4.590E-06	2.340E-06	1.422E-06	9.788E-07	7.154E-07	5.524E-07	4.394E-07
SE	1.413E-05	5.021E-06	2.560E-06	1.556E-06	1.071E-06	7.829E-07	6.046E-07	4.810E-07
SSE	1.996E-05	7.085E-06	3.630E-06	2.211E-06	1.524E-06	1.115E-06	8.615E-07	6.859E-07
S	2.831E-05	9.988E-06	5.134E-06	3.133E-06	2.160E-06	1.580E-06	1.222E-06	9.735E-07
SSW	4.451E-05	1.581E-05	8.132E-06	4.964E-06	3.422E-06	2.505E-06	1.938E-06	1.544E-06
SW	5.690E-05	2.025E-05	1.058E-05	6.505E-06	4.485E-06	3.290E-06	2.551E-06	2.037E-06
WSW	5.670E-05	2.038E-05	1.083E-05	6.713E-06	4.630E-06	3.406E-06	2.648E-06	2.121E-06
W	3.624E-05	1.309E-05	6.986E-06	4.337E-06	2.990E-06	2.202E-06	1.713E-06	1.373E-06
WNW	1.947E-05	6.988E-06	3.704E-06	2.292E-06	1.581E-06	1.163E-06	9.037E-07	7.234E-07
NW	1.978E-05	7.097E-06	3.760E-06	2.326E-06	1.605E-06	1.180E-06	9.169E-07	7.339E-07
NNW	4.809E-05	1.730E-05	9.188E-06	5.691E-06	3.926E-06	2.888E-06	2.245E-06	1.797E-06
	1800m (1.12 mi)	**2000m (1.24 mi)**	**2200m (1.37 mi)**	**2415m (1.5 mi)**	**2600m (1.62 mi)**	**2800m (1.75 mi)**	**3000m (1.86 mi)**	**3220 m (2 mi)**
N	1.839E-06	1.562E-06	1.350E-06	1.173E-06	1.050E-06	9.405E-07	8.496E-07	7.664E-07
NNE	1.690E-06	1.433E-06	1.237E-06	1.072E-06	9.587E-07	8.575E-07	7.735E-07	6.967E-07
NE	1.266E-06	1.071E-06	9.220E-07	7.976E-07	7.117E-07	6.354E-07	5.721E-07	5.143E-07
ENE	6.967E-07	5.888E-07	5.064E-07	4.376E-07	3.902E-07	3.480E-07	3.131E-07	2.812E-07
E	3.685E-07	3.115E-07	2.679E-07	2.315E-07	2.065E-07	1.842E-07	1.657E-07	1.489E-07
ESE	3.666E-07	3.098E-07	2.665E-07	2.303E-07	2.054E-07	1.832E-07	1.648E-07	1.481E-07
SE	4.014E-07	3.392E-07	2.918E-07	2.522E-07	2.249E-07	2.006E-07	1.805E-07	1.622E-07
SSE	5.728E-07	4.844E-07	4.170E-07	3.607E-07	3.218E-07	2.873E-07	2.586E-07	2.325E-07
S	8.134E-07	6.884E-07	5.930E-07	5.132E-07	4.581E-07	4.091E-07	3.685E-07	3.314E-07
SSW	1.290E-06	1.092E-06	9.410E-07	8.145E-07	7.272E-07	6.495E-07	5.850E-07	5.262E-07
SW	1.707E-06	1.448E-06	1.250E-06	1.084E-06	9.699E-07	8.680E-07	7.833E-07	7.059E-07
WSW	1.781E-06	1.514E-06	1.310E-06	1.139E-06	1.020E-06	9.149E-07	8.270E-07	7.467E-07
W	1.153E-06	9.808E-07	8.490E-07	7.384E-07	6.619E-07	5.936E-07	5.368E-07	4.848E-07
WNW	6.071E-07	5.160E-07	4.463E-07	3.878E-07	3.474E-07	3.114E-07	2.814E-07	2.540E-07
NW	6.158E-07	5.234E-07	4.526E-07	3.933E-07	3.523E-07	3.157E-07	2.853E-07	2.575E-07
NNW	1.509E-06	1.283E-06	1.110E-06	9.645E-07	8.642E-07	7.746E-07	7.002E-07	6.320E-07

Table 4.6-9 Sector Average Concentration, Undepleted, Undecayed χ/Q Values (sec/m^3) for Grid Receptors

(Page 2 of 2)

	4025 m (2.5 mi)	4830 m (3 mi)	5630 m (3.5 mi)	6440 m (4 mi)	7240 m (4.5 mi)	8050 m (5 mi)	12070 m (7.5 mi)	16.1 km (10 mi)
N	5.554E-07	4.288E-07	3.456E-07	2.873E-07	2.444E-07	2.117E-07	1.229E-07	8.411E-08
NNE	5.024E-07	3.863E-07	3.102E-07	2.571E-07	2.181E-07	1.885E-07	1.084E-07	7.374E-08
NE	3.686E-07	2.819E-07	2.254E-07	1.860E-07	1.573E-07	1.355E-07	7.702E-08	5.196E-08
ENE	2.010E-07	1.533E-07	1.223E-07	1.007E-07	8.500E-08	7.312E-08	4.131E-08	2.774E-08
E	1.064E-07	8.120E-08	6.479E-08	5.338E-08	4.506E-08	3.877E-08	2.192E-08	1.473E-08
ESE	1.058E-07	8.075E-08	6.442E-08	5.307E-08	4.479E-08	3.853E-08	2.178E-08	1.462E-08
SE	1.159E-07	8.845E-08	7.057E-08	5.814E-08	4.907E-08	4.222E-08	2.386E-08	1.602E-08
SSE	1.665E-07	1.273E-07	1.017E-07	8.388E-08	7.087E-08	6.103E-08	3.460E-08	2.329E-08
S	2.378E-07	1.821E-07	1.457E-07	1.203E-07	1.018E-07	8.771E-08	4.992E-08	3.370E-08
SSW	3.776E-07	2.892E-07	2.314E-07	1.911E-07	1.617E-07	1.394E-07	7.935E-08	5.358E-08
SW	5.098E-07	3.925E-07	3.156E-07	2.618E-07	2.223E-07	1.922E-07	1.109E-07	7.557E-08
WSW	5.424E-07	4.197E-07	3.389E-07	2.821E-07	2.403E-07	2.085E-07	1.216E-07	8.350E-08
W	3.526E-07	2.731E-07	2.207E-07	1.839E-07	1.567E-07	1.360E-07	7.951E-08	5.471E-08
WNW	1.843E-07	1.425E-07	1.150E-07	9.564E-08	8.143E-08	7.059E-08	4.107E-08	2.817E-08
NW	1.868E-07	1.444E-07	1.165E-07	9.686E-08	8.245E-08	7.146E-08	4.156E-08	2.849E-08
NNW	4.589E-07	3.550E-07	2.865E-07	2.385E-07	2.031E-07	1.761E-07	1.026E-07	7.042E-08

	24.1 km (15 mi)	32.2 km (20 mi)	40.2 km (25 mi)	48.3 km (30 mi)	56.3 km (35 mi)	64.4 km (40 mi)	72.4 km (45 mi)	80.5 km (50 mi)
N	4.974E-08	3.445E-08	2.598E-08	2.066E-08	1.704E-08	1.443E-08	1.247E-08	1.095E-08
NNE	4.323E-08	2.977E-08	2.235E-08	1.771E-08	1.457E-08	1.231E-08	1.061E-08	9.298E-09
NE	3.014E-08	2.061E-08	1.539E-08	1.215E-08	9.955E-09	8.385E-09	7.211E-09	6.304E-09
ENE	1.599E-08	1.089E-08	8.103E-09	6.377E-09	5.213E-09	4.382E-09	3.762E-09	3.284E-09
E	8.498E-09	5.790E-09	4.312E-09	3.394E-09	2.776E-09	2.334E-09	2.004E-09	1.749E-09
ESE	8.429E-09	5.739E-09	4.271E-09	3.361E-09	2.747E-09	2.309E-09	1.982E-09	1.729E-09
SE	9.233E-09	6.285E-09	4.677E-09	3.680E-09	3.008E-09	2.528E-09	2.169E-09	1.893E-09
SSE	1.346E-08	9.183E-09	6.843E-09	5.390E-09	4.410E-09	3.709E-09	3.186E-09	2.782E-09
S	1.955E-08	1.337E-08	9.978E-09	7.871E-09	6.448E-09	5.429E-09	4.667E-09	4.079E-09
SSW	3.110E-08	2.127E-08	1.588E-08	1.253E-08	1.027E-08	8.648E-09	7.437E-09	6.501E-09
SW	4.443E-08	3.065E-08	2.305E-08	1.829E-08	1.505E-08	1.273E-08	1.098E-08	9.632E-09
WSW	4.960E-08	3.446E-08	2.605E-08	2.076E-08	1.715E-08	1.455E-08	1.259E-08	1.106E-08
W	3.257E-08	2.267E-08	1.716E-08	1.369E-08	1.132E-08	9.606E-09	8.317E-09	7.315E-09
WNW	1.670E-08	1.158E-08	8.745E-09	6.962E-09	5.747E-09	4.871E-09	4.212E-09	3.700E-09
NW	1.687E-08	1.170E-08	8.829E-09	7.026E-09	5.799E-09	4.914E-09	4.248E-09	3.731E-09
NNW	4.179E-08	2.901E-08	2.192E-08	1.746E-08	1.442E-08	1.223E-08	1.058E-08	9.293E-09

Table 4.6-10 Sector Average Concentration, Undepleted, Undecayed χ/Q Values (sec/m^3) for Special Receptors

(Page 1 of 1)

	Site Boundary	Gardens	Meat Animals	Businesses
N	4.072E-06	0.000E+00	0.000E+00	0.000E+00
NNE	3.771E-06	1.748E-07	0.000E+00	0.000E+00
NE	2.454E-06	2.058E-07	0.000E+00	0.000E+00
ENE	1.397E-06	1.115E-07	1.203E-06	0.000E+00
E	1.035E-06	5.911E-08	7.001E-07	0.000E+00
ESE	1.216E-06	5.876E-08	0.000E+00	0.000E+00
SE	1.331E-06	1.314E-07	1.071E-06	0.000E+00
SSE	1.289E-06	2.723E-07	3.387E-07	0.000E+00
S	1.077E-06	0.000E+00	3.577E-07	4.017E-07
SSW	3.375E-06	0.000E+00	2.833E-06	0.000E+00
SW	4.424E-06	3.029E-07	0.000E+00	4.079E-07
WSW	3.972E-06	0.000E+00	1.026E-06	0.000E+00
W	9.959E-07	0.000E+00	8.252E-07	0.000E+00
WNW	7.526E-07	0.000E+00	0.000E+00	0.000E+00
NW	1.176E-06	0.000E+00	0.000E+00	0.000E+00
NNW	3.331E-06	0.000E+00	0.000E+00	0.000E+00

Table 4.6-11 Sector Average Concentration, Depleted, Decayed χ/Q Values (sec/m^3) for Grid Receptors

(Page 1 of 2)

	200m (0.12 mi)	400m (0.24 mi)	600m (0.37 mi)	805m (0.5 mi)	1000m (0.62 mi)	1200m (0.75 mi)	1400m (0.86 mi)	1610 m (1 mi)
N	5.768E-05	2.020E-05	1.046E-05	6.354E-06	4.322E-06	3.143E-06	2.418E-06	1.917E-06
NNE	5.482E-05	1.911E-05	9.764E-06	5.894E-06	4.006E-06	2.908E-06	2.233E-06	1.766E-06
NE	4.248E-05	1.479E-05	7.447E-06	4.462E-06	3.029E-06	2.193E-06	1.680E-06	1.326E-06
ENE	2.365E-05	8.237E-06	4.122E-06	2.464E-06	1.673E-06	1.211E-06	9.264E-07	7.302E-07
E	1.256E-05	4.368E-06	2.184E-06	1.305E-06	8.852E-07	6.404E-07	4.899E-07	3.861E-07
ESE	1.251E-05	4.343E-06	2.172E-06	1.298E-06	8.808E-07	6.371E-07	4.874E-07	3.841E-07
SE	1.369E-05	4.751E-06	2.376E-06	1.420E-06	9.638E-07	6.972E-07	5.335E-07	4.205E-07
SSE	1.934E-05	6.705E-06	3.369E-06	2.018E-06	1.371E-06	9.927E-07	7.602E-07	5.997E-07
S	2.742E-05	9.453E-06	4.765E-06	2.859E-06	1.944E-06	1.408E-06	1.078E-06	8.512E-07
SSW	4.312E-05	1.496E-05	7.548E-06	4.531E-06	3.079E-06	2.231E-06	1.710E-06	1.350E-06
SW	5.512E-05	1.917E-05	9.822E-06	5.937E-06	4.036E-06	2.930E-06	2.251E-06	1.782E-06
WSW	5.493E-05	1.928E-05	1.006E-05	6.127E-06	4.167E-06	3.034E-06	2.337E-06	1.855E-06
W	3.510E-05	1.238E-05	6.484E-06	3.958E-06	2.691E-06	1.961E-06	1.511E-06	1.200E-06
WNW	1.886E-05	6.612E-06	3.438E-06	2.092E-06	1.423E-06	1.035E-06	7.972E-07	6.323E-07
NW	1.916E-05	6.716E-06	3.489E-06	2.123E-06	1.444E-06	1.051E-06	8.089E-07	6.416E-07
NNW	4.659E-05	1.637E-05	8.529E-06	5.195E-06	3.533E-06	2.572E-06	1.981E-06	1.572E-06
	1800m (1.12 mi)	**2000m (1.24 mi)**	**2200m (1.37 mi)**	**2415m (1.5 mi)**	**2600m (1.62 mi)**	**2800m (1.75 mi)**	**3000m (1.86 mi)**	**3220 m (2 mi)**
N	1.595E-06	1.344E-06	1.154E-06	9.943E-07	8.847E-07	7.874E-07	7.068E-07	6.334E-07
NNE	1.467E-06	1.234E-06	1.057E-06	9.095E-07	8.081E-07	7.181E-07	6.436E-07	5.759E-07
NE	1.099E-06	9.221E-07	7.881E-07	6.765E-07	6.000E-07	5.321E-07	4.761E-07	4.252E-07
ENE	6.045E-07	5.069E-07	4.328E-07	3.711E-07	3.289E-07	2.914E-07	2.605E-07	2.325E-07
E	3.197E-07	2.681E-07	2.289E-07	1.963E-07	1.739E-07	1.541E-07	1.378E-07	1.230E-07
ESE	3.180E-07	2.666E-07	2.276E-07	1.952E-07	1.730E-07	1.533E-07	1.370E-07	1.223E-07
SE	3.482E-07	2.920E-07	2.493E-07	2.138E-07	1.895E-07	1.679E-07	1.501E-07	1.339E-07
SSE	4.968E-07	4.169E-07	3.563E-07	3.058E-07	2.711E-07	2.404E-07	2.151E-07	1.920E-07
S	7.056E-07	5.925E-07	5.066E-07	4.351E-07	3.860E-07	3.424E-07	3.065E-07	2.738E-07
SSW	1.120E-06	9.403E-07	8.040E-07	6.906E-07	6.127E-07	5.437E-07	4.867E-07	4.348E-07
SW	1.481E-06	1.246E-06	1.068E-06	9.195E-07	8.173E-07	7.266E-07	6.516E-07	5.833E-07
WSW	1.545E-06	1.303E-06	1.119E-06	9.656E-07	8.599E-07	7.658E-07	6.880E-07	6.170E-07
W	1.000E-06	8.441E-07	7.252E-07	6.259E-07	5.576E-07	4.968E-07	4.464E-07	4.005E-07
WNW	5.264E-07	4.440E-07	3.811E-07	3.287E-07	2.926E-07	2.605E-07	2.339E-07	2.097E-07
NW	5.341E-07	4.504E-07	3.866E-07	3.333E-07	2.967E-07	2.641E-07	2.372E-07	2.126E-07
NNW	1.309E-06	1.104E-06	9.482E-07	8.180E-07	7.283E-07	6.486E-07	5.825E-07	5.224E-07

Table 4.6-11 Sector Average Concentration, Depleted, Decayed χ/Q Values (sec/m^3) for Grid Receptors

(Page 2 of 2)

	4025 m (2.5 mi)	4830 m (3 mi)	5630 m (3.5 mi)	6440 m (4 mi)	7240 m (4.5 mi)	8050 m (5 mi)	12070 m (7.5 mi)	16.1 km (10 mi)
N	4.488E-07	3.396E-07	2.687E-07	2.196E-07	1.839E-07	1.570E-07	8.596E-08	5.594E-08
NNE	4.061E-07	3.061E-07	2.414E-07	1.967E-07	1.643E-07	1.399E-07	7.593E-08	4.911E-08
NE	2.980E-07	2.234E-07	1.754E-07	1.423E-07	1.185E-07	1.006E-07	5.398E-08	3.463E-08
ENE	1.624E-07	1.214E-07	9.511E-08	7.703E-08	6.400E-08	5.425E-08	2.891E-08	1.846E-08
E	8.593E-08	6.427E-08	5.035E-08	4.078E-08	3.389E-08	2.873E-08	1.532E-08	9.778E-09
ESE	8.544E-08	6.389E-08	5.004E-08	4.053E-08	3.367E-08	2.854E-08	1.520E-08	9.699E-09
SE	9.360E-08	7.000E-08	5.483E-08	4.441E-08	3.690E-08	3.127E-08	1.666E-08	1.063E-08
SSE	1.345E-07	1.007E-07	7.901E-08	6.408E-08	5.330E-08	4.522E-08	2.417E-08	1.546E-08
S	1.921E-07	1.441E-07	1.132E-07	9.193E-08	7.655E-08	6.501E-08	3.489E-08	2.238E-08
SSW	3.051E-07	2.290E-07	1.799E-07	1.461E-07	1.217E-07	1.033E-07	5.550E-08	3.562E-08
SW	4.119E-07	3.108E-07	2.454E-07	2.001E-07	1.673E-07	1.426E-07	7.756E-08	5.025E-08
WSW	4.382E-07	3.323E-07	2.635E-07	2.157E-07	1.809E-07	1.546E-07	8.503E-08	5.551E-08
W	2.848E-07	2.161E-07	1.715E-07	1.405E-07	1.179E-07	1.008E-07	5.553E-08	3.630E-08
WNW	1.488E-07	1.127E-07	8.925E-08	7.299E-08	6.116E-08	5.224E-08	2.864E-08	1.865E-08
NW	1.508E-07	1.142E-07	9.043E-08	7.395E-08	6.195E-08	5.290E-08	2.899E-08	1.887E-08
NNW	3.709E-07	2.812E-07	2.228E-07	1.824E-07	1.529E-07	1.307E-07	7.182E-08	4.687E-08
	24.1 km (15 mi)	**32.2 km (20 mi)**	**40.2 km (25 mi)**	**48.3 km (30 mi)**	**56.3 km (35 mi)**	**64.4 km (40 mi)**	**72.4 km (45 mi)**	**80.5 km (50 mi)**
N	3.046E-08	1.971E-08	1.401E-08	1.057E-08	8.303E-09	6.721E-09	5.565E-09	4.691E-09
NNE	2.653E-08	1.709E-08	1.210E-08	9.101E-09	7.134E-09	5.763E-09	4.765E-09	4.012E-09
NE	1.852E-08	1.185E-08	8.348E-09	6.254E-09	4.886E-09	3.937E-09	3.247E-09	2.728E-09
ENE	9.797E-09	6.235E-09	4.375E-09	3.266E-09	2.543E-09	2.043E-09	1.681E-09	1.409E-09
E	5.189E-09	3.300E-09	2.314E-09	1.726E-09	1.343E-09	1.077E-09	8.854E-10	7.413E-10
ESE	5.141E-09	3.266E-09	2.288E-09	1.705E-09	1.325E-09	1.063E-09	8.727E-10	7.301E-10
SE	5.634E-09	3.579E-09	2.507E-09	1.868E-09	1.453E-09	1.165E-09	9.567E-10	8.006E-10
SSE	8.222E-09	5.235E-09	3.674E-09	2.741E-09	2.134E-09	1.713E-09	1.409E-09	1.180E-09
S	1.195E-08	7.626E-09	5.363E-09	4.009E-09	3.125E-09	2.513E-09	2.068E-09	1.734E-09
SSW	1.903E-08	1.216E-08	8.556E-09	6.400E-09	4.993E-09	4.017E-09	3.309E-09	2.776E-09
SW	2.720E-08	1.753E-08	1.243E-08	9.349E-09	7.329E-09	5.921E-09	4.895E-09	4.120E-09
WSW	3.036E-08	1.971E-08	1.404E-08	1.061E-08	8.348E-09	6.765E-09	5.608E-09	4.732E-09
W	1.988E-08	1.291E-08	9.204E-09	6.955E-09	5.471E-09	4.433E-09	3.674E-09	3.099E-09
WNW	1.016E-08	6.570E-09	4.666E-09	3.515E-09	2.757E-09	2.228E-09	1.842E-09	1.550E-09
NW	1.028E-08	6.645E-09	4.719E-09	3.555E-09	2.789E-09	2.254E-09	1.864E-09	1.569E-09
NNW	2.563E-08	1.663E-08	1.185E-08	8.956E-09	7.048E-09	5.713E-09	4.737E-09	3.999E-09

Table 4.6-12 Sector Average Concentration, Depleted, Decayed χ/Q Values (sec/m^3) for Special Receptors

(Page 1 of 1)

	Site Boundary	Gardens	Meat Animals	Businesses
N	3.645E-06	0.000E+00	0.000E+00	0.000E+00
NNE	3.375E-06	1.287E-07	0.000E+00	0.000E+00
NE	2.186E-06	1.589E-07	0.000E+00	0.000E+00
ENE	1.245E-06	8.608E-08	1.067E-06	0.000E+00
E	9.334E-07	4.557E-08	6.230E-07	0.000E+00
ESE	1.104E-06	4.529E-08	0.000E+00	0.000E+00
SE	1.208E-06	1.070E-07	9.638E-07	0.000E+00
SSE	1.154E-06	2.271E-07	2.862E-07	0.000E+00
S	9.459E-07	0.000E+00	2.969E-07	3.358E-07
SSW	3.035E-06	0.000E+00	2.534E-06	0.000E+00
SW	3.978E-06	2.346E-07	0.000E+00	3.240E-07
WSW	3.557E-06	0.000E+00	8.645E-07	0.000E+00
W	8.578E-07	0.000E+00	7.038E-07	0.000E+00
WNW	6.590E-07	0.000E+00	0.000E+00	0.000E+00
NW	1.047E-06	0.000E+00	0.000E+00	0.000E+00
NNW	2.981E-06	0.000E+00	0.000E+00	0.000E+00

Table 4.6-13 Sector Average D/Q Values (1/m^2) for Grid Receptors (Page 1 of 2)

	200m (0.12 mi)	400m (0.24 mi)	600m (0.37 mi)	805m (0.5 mi)	1000m (0.62 mi)	1200m (0.75 mi)	1400m (0.86 mi)	1610 m (1 mi)
N	1.518E-07	5.585E-08	2.996E-08	1.876E-08	1.316E-08	9.743E-09	7.511E-09	5.928E-09
NNE	2.193E-07	8.106E-08	4.352E-08	2.726E-08	1.913E-08	1.417E-08	1.092E-08	8.622E-09
NE	2.427E-07	9.009E-08	4.841E-08	3.034E-08	2.130E-08	1.577E-08	1.216E-08	9.605E-09
ENE	1.114E-07	4.121E-08	2.212E-08	1.385E-08	9.721E-09	7.197E-09	5.548E-09	4.379E-09
E	3.804E-08	1.410E-08	7.573E-09	4.744E-09	3.330E-09	2.466E-09	1.901E-09	1.501E-09
ESE	3.361E-08	1.243E-08	6.673E-09	4.179E-09	2.933E-09	2.171E-09	1.674E-09	1.321E-09
SE	3.699E-08	1.368E-08	7.346E-09	4.602E-09	3.230E-09	2.392E-09	1.844E-09	1.456E-09
SSE	4.992E-08	1.838E-08	9.862E-09	6.175E-09	4.333E-09	3.208E-09	2.473E-09	1.952E-09
S	7.580E-08	2.799E-08	1.503E-08	9.413E-09	6.607E-09	4.892E-09	3.772E-09	2.978E-09
SSW	1.333E-07	4.926E-08	2.646E-08	1.659E-08	1.165E-08	8.627E-09	6.654E-09	5.255E-09
SW	1.440E-07	5.329E-08	2.864E-08	1.795E-08	1.261E-08	9.341E-09	7.205E-09	5.690E-09
WSW	1.031E-07	3.786E-08	2.031E-08	1.272E-08	8.926E-09	6.608E-09	5.095E-09	4.022E-09
W	5.364E-08	1.970E-08	1.056E-08	6.614E-09	4.641E-09	3.435E-09	2.648E-09	2.090E-09
WNW	2.704E-08	9.933E-09	5.328E-09	3.336E-09	2.341E-09	1.733E-09	1.336E-09	1.054E-09
NW	3.067E-08	1.125E-08	6.032E-09	3.777E-09	2.650E-09	1.961E-09	1.512E-09	1.193E-09
NNW	1.095E-07	4.012E-08	2.150E-08	1.346E-08	9.438E-09	6.985E-09	5.383E-09	4.248E-09
	1800m (1.12 mi)	**2000m (1.24 mi)**	**2200m (1.37 mi)**	**2415m (1.5 mi)**	**2600m (1.62 mi)**	**2800m (1.75 mi)**	**3000m (1.86 mi)**	**3220 m (2 mi)**
N	4.898E-09	4.090E-09	3.472E-09	2.957E-09	2.602E-09	2.288E-09	2.030E-09	1.795E-09
NNE	7.125E-09	5.950E-09	5.052E-09	4.302E-09	3.787E-09	3.331E-09	2.954E-09	2.614E-09
NE	7.938E-09	6.630E-09	5.630E-09	4.795E-09	4.221E-09	3.713E-09	3.294E-09	2.914E-09
ENE	3.619E-09	3.022E-09	2.565E-09	2.184E-09	1.923E-09	1.691E-09	1.500E-09	1.327E-09
E	1.240E-09	1.036E-09	8.795E-10	7.490E-10	6.593E-10	5.798E-10	5.144E-10	4.550E-10
ESE	1.092E-09	9.118E-10	7.741E-10	6.592E-10	5.802E-10	5.103E-10	4.526E-10	4.004E-10
SE	1.203E-09	1.005E-09	8.530E-10	7.264E-10	6.394E-10	5.623E-10	4.988E-10	4.413E-10
SSE	1.613E-09	1.346E-09	1.143E-09	9.732E-10	8.566E-10	7.533E-10	6.681E-10	5.910E-10
S	2.461E-09	2.055E-09	1.745E-09	1.486E-09	1.308E-09	1.150E-09	1.021E-09	9.028E-10
SSW	4.343E-09	3.628E-09	3.081E-09	2.624E-09	2.310E-09	2.032E-09	1.803E-09	1.595E-09
SW	4.704E-09	3.929E-09	3.337E-09	2.842E-09	2.503E-09	2.201E-09	1.953E-09	1.728E-09
WSW	3.323E-09	2.775E-09	2.356E-09	2.006E-09	1.766E-09	1.553E-09	1.377E-09	1.218E-09
W	1.727E-09	1.442E-09	1.224E-09	1.042E-09	9.174E-10	8.067E-10	7.155E-10	6.329E-10
WNW	8.713E-10	7.275E-10	6.176E-10	5.259E-10	4.628E-10	4.070E-10	3.610E-10	3.193E-10
NW	9.858E-10	8.230E-10	6.986E-10	5.948E-10	5.235E-10	4.604E-10	4.083E-10	3.611E-10
NNW	3.509E-09	2.930E-09	2.487E-09	2.117E-09	1.863E-09	1.638E-09	1.453E-09	1.285E-09

Table 4.6-13 Sector Average D/Q Values (1/m^2) for Grid Receptors (Page 2 of 2)

	4025 m (2.5 mi)	4830 m (3 mi)	5630 m (3.5 mi)	6440 m (4 mi)	7240 m (4.5 mi)	8050 m (5 mi)	12070 m (7.5 mi)	16.1 km (10 mi)
N	1.214E-09	8.803E-10	6.695E-10	5.275E-10	4.269E-10	3.531E-10	1.728E-10	1.082E-10
NNE	1.768E-09	1.282E-09	9.755E-10	7.687E-10	6.222E-10	5.146E-10	2.519E-10	1.579E-10
NE	1.973E-09	1.431E-09	1.089E-09	8.582E-10	6.946E-10	5.745E-10	2.813E-10	1.763E-10
ENE	8.976E-10	6.507E-10	4.949E-10	3.900E-10	3.157E-10	2.611E-10	1.278E-10	8.008E-11
E	3.079E-10	2.232E-10	1.698E-10	1.338E-10	1.083E-10	8.955E-11	4.380E-11	2.743E-11
ESE	2.708E-10	1.963E-10	1.493E-10	1.176E-10	9.520E-11	7.872E-11	3.850E-11	2.411E-11
SE	2.986E-10	2.165E-10	1.646E-10	1.297E-10	1.050E-10	8.681E-11	4.246E-11	2.658E-11
SSE	3.997E-10	2.897E-10	2.203E-10	1.736E-10	1.405E-10	1.161E-10	5.680E-11	3.557E-11
S	6.108E-10	4.429E-10	3.369E-10	2.655E-10	2.149E-10	1.777E-10	8.691E-11	5.443E-11
SSW	1.080E-09	7.832E-10	5.960E-10	4.698E-10	3.802E-10	3.144E-10	1.538E-10	9.635E-11
SW	1.170E-09	8.488E-10	6.459E-10	5.092E-10	4.121E-10	3.408E-10	1.667E-10	1.044E-10
WSW	8.242E-10	5.975E-10	4.544E-10	3.581E-10	2.898E-10	2.396E-10	1.172E-10	7.339E-11
W	4.280E-10	3.102E-10	2.359E-10	1.858E-10	1.504E-10	1.243E-10	6.080E-11	3.806E-11
WNW	2.160E-10	1.565E-10	1.190E-10	9.376E-11	7.587E-11	6.273E-11	3.066E-11	1.919E-11
NW	2.442E-10	1.770E-10	1.346E-10	1.060E-10	8.579E-11	7.093E-11	3.468E-11	2.171E-11
NNW	8.690E-10	6.297E-10	4.788E-10	3.772E-10	3.053E-10	2.524E-10	1.235E-10	7.738E-11
	24.1 km (15 mi)	**32.2 km (20 mi)**	**40.2 km (25 mi)**	**48.3 km (30 mi)**	**56.3 km (35 mi)**	**64.4 km (40 mi)**	**72.4 km (45 mi)**	**80.5 km (50 mi)**
N	5.455E-11	3.292E-11	2.201E-11	1.573E-11	1.177E-11	9.128E-12	7.271E-12	5.918E-12
NNE	7.962E-11	4.808E-11	3.216E-11	2.300E-11	1.723E-11	1.337E-11	1.065E-11	8.677E-12
NE	8.896E-11	5.374E-11	3.597E-11	2.572E-11	1.928E-11	1.496E-11	1.193E-11	9.721E-12
ENE	4.038E-11	2.438E-11	1.631E-11	1.166E-11	8.735E-12	6.775E-12	5.400E-12	4.397E-12
E	1.382E-11	8.331E-12	5.566E-12	3.974E-12	2.973E-12	2.303E-12	1.833E-12	1.491E-12
ESE	1.214E-11	7.315E-12	4.885E-12	3.486E-12	2.607E-12	2.019E-12	1.606E-12	1.306E-12
SE	1.338E-11	8.066E-12	5.386E-12	3.844E-12	2.875E-12	2.226E-12	1.771E-12	1.440E-12
SSE	1.791E-11	1.079E-11	7.208E-12	5.145E-12	3.848E-12	2.980E-12	2.371E-12	1.927E-12
S	2.741E-11	1.653E-11	1.104E-11	7.885E-12	5.899E-12	4.570E-12	3.638E-12	2.958E-12
SSW	4.854E-11	2.928E-11	1.957E-11	1.398E-11	1.046E-11	8.108E-12	6.456E-12	5.252E-12
SW	5.261E-11	3.174E-11	2.121E-11	1.515E-11	1.134E-11	8.785E-12	6.995E-12	5.690E-12
WSW	3.695E-11	2.228E-11	1.488E-11	1.062E-11	7.947E-12	6.155E-12	4.898E-12	3.983E-12
W	1.915E-11	1.154E-11	7.701E-12	5.493E-12	4.106E-12	3.178E-12	2.527E-12	2.054E-12
WNW	9.650E-12	5.811E-12	3.876E-12	2.763E-12	2.065E-12	1.597E-12	1.269E-12	1.031E-12
NW	1.092E-11	6.581E-12	4.392E-12	3.133E-12	2.342E-12	1.812E-12	1.441E-12	1.171E-12
NNW	3.899E-11	2.353E-11	1.573E-11	1.123E-11	8.410E-12	6.519E-12	5.192E-12	4.225E-12

Table 4.6-14 Sector Average D/Q Values ($1/m^2$) for Special Receptors
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	Site Boundary	Gardens	Meat Animals	Businesses
N	1.125E-08	0.000E+00	0.000E+00	0.000E+00
NNE	1.635E-08	4.661E-10	0.000E+00	0.000E+00
NE	1.572E-08	9.731E-10	0.000E+00	0.000E+00
ENE	7.395E-09	4.423E-10	6.371E-09	0.000E+00
E	3.489E-09	1.518E-10	2.401E-09	0.000E+00
ESE	3.604E-09	1.334E-10	0.000E+00	0.000E+00
SE	3.968E-09	3.459E-10	3.230E-09	0.000E+00
SSE	3.704E-09	7.087E-10	9.073E-10	0.000E+00
S	3.311E-09	0.000E+00	9.860E-10	1.127E-09
SSW	1.155E-08	0.000E+00	9.744E-09	0.000E+00
SW	1.251E-08	6.132E-10	0.000E+00	8.901E-10
WSW	7.714E-09	0.000E+00	1.776E-09	0.000E+00
W	1.467E-09	0.000E+00	1.185E-09	0.000E+00
WNW	1.100E-09	0.000E+00	0.000E+00	0.000E+00
NW	1.955E-09	0.000E+00	0.000E+00	0.000E+00
NNW	8.066E-09	0.000E+00	0.000E+00	0.000E+00

Table 4.6-15 Decommissioning Emission Types
(Page 1 of 1)

Emission Type[1]	Source Location	Quantity
Fugitive Dust PM_{10} $PM_{2.5}$	Onsite	 21.8 g/s (172.7 lb/hr) 3.3 g/s (25.9 lb/hr)
Vehicle Exhaust	Onsite	4,045 kg/yr (4.5 tons/yr)
Portable Generator Exhaust	Onsite buildings	NA[2]
Cutting Torch Fumes	Onsite buildings	NA[2]
Solvent Fumes	NA[2]	NA[2]
Standby Diesel Generator Exhaust[3]	Mechanical Services Building	61 kg/yr (0.067 ton/yr) of PM_{10} 8,437 kg/yr (9.3 ton/yr) of NO_x 726 kg/yr (0.80ton/yr) of CO 168 kg/yr (0.185ton/yr) of VOC
Air Compressors	Onsite buildings	NA[2]

Notes:

[1]Fugitive dust and vehicle exhaust during decommissioning are assumed to be bounded by the emissions during construction.

[2]Information is not available at this time.

[3]Other smaller diesel generators (security diesel generator, fire pump diesel) may also be used to provide backup power to some specific systems.

4.7 NOISE IMPACTS

Noise is defined as "unwanted sound." At high levels noise can damage hearing, cause sleep deprivation, interfere with communication, and disrupt concentration. Even at low levels, noise can be a source of irritation, annoyance, and disturbance to people and communities when it significantly exceeds normal background sound levels. In the context of protecting the public health and welfare, noise implies adverse effects on people and the environment. A quantifiable demonstration of the range of noise levels and how humans subjectively perceive noise is presented in Figure 3.7-2, Sound Level Range Examples.

4.7.1 Predicted Noise Levels

4.7.1.1 Construction Impacts

Eagle Rock Enrichment Facility (EREF) construction activities primarily would occur in an area centrally located on the proposed site (EREF footprint). Construction of the highway entrances, visitor center and portions of the access roads would be located at the southern boundary of the site near U.S. Highway 20. As shown on Figure 2.1-2, Site Area and Facility Layout Map 1.6 Kilometer (1 Mile) Radius, the closest site boundary (north) from the proposed EREF footprint would be about 825 m (2,707 ft). The proposed EREF footprint would be about 3,060 m (10,039 ft) north of U.S. Highway 20.

The construction of the proposed EREF would require equipment for excavation, such as pile drivers, backhoes, graders, front-end loaders, bulldozers, and dump trucks. Excavation would also require blasting (and the associated warning alarms). Equipment needed for construction and material handling would include cranes, cherry pickers, water trucks, concrete delivery trucks, concrete pump trucks, stake body trucks, compressors, generators, and pumps. Noise generated from these types of equipment, blasting, and alarms would range from 80 to 95 dBA at approximately 15 m (50 ft) (FHWA, 2006). Most of the construction activities would occur during weekday, daylight hours; however, construction may continue during nights and weekends, when necessary to maintain the construction schedule.

4.7.1.1.1 Eagle Rock Enrichment Facility Footprint

Noise levels up to 60 dBA are considered “clearly acceptable” under the U.S. Department of Housing and Urban Development (HUD) Land Use Compatibility Guideline for residential, livestock, and farming land uses (HUD, 1985). Similarly, noise levels under 55 dBA would not exceed the U.S. Environmental Protection Agency- (EPA-) defined goal of 55 dBA for Day-Night Average Sound Level (L_{dn}) for outdoor spaces (EPA, 1974). Noise levels from construction of the EREF would range from 80 to 95 DBA at approximately 15 m (50 ft). These noise levels would diminish to about 46 to 61 dBA at the nearest site boundary to the proposed EREF footprint (about 825 m (2,707 ft)). Maximum noise levels from construction of the proposed access roads will be about 89 dBA at the nearest site boundary about 37 m (120 ft) west of the proposed access roads. These noise levels will occur only during construction of the access road.

Maximum construction noise levels of about 95 dBA would diminish to about 61 dBA at the nearest site boundary. These levels are considered “clearly acceptable” for industrial facilities and only one dBA above the level considered “clearly acceptable” for farm, livestock, and residential land uses under the HUD Guideline (HUD, 1985). However, maximum construction noise would exceed the EPA-defined goal of 55 dBA for L_{dn} for outdoor spaces (EPA, 1974). Therefore, noise during construction of the proposed EREF footprint would be audible on adjacent properties, primarily north, east, southeast, and southwest of the proposed EREF footprint. While construction would continue for about seven years, the impacts would be small since nearby land use is limited to grazing; the nearest residence is approximately 7.7 km (4.8 mi) east of the proposed site; and noise levels would be within the sound levels identified by HUD as "clearly acceptable" or "normally acceptable."

As discussed in Section 3.7, the Wasden Complex, a group of important archaeological sites, is about 1.0 km (0.6 mi) from the boundary of the proposed EREF site. It is about 2.3 km (1.4 mi) to the nearest portion of the proposed EREF footprint. Noise levels during construction would diminish from about 80 to 95 dBA in the proposed EREF footprint to about 37 to 52 dBA at the Wasden Complex. This noise level would be less than the 60 dBA, which is considered "clearly acceptable" under the HUD Land Use Compatibility Guideline for residential, livestock, and farming land uses (HUD, 1985) and less than the EPA-defined goal of 55 dBA for Day-Night Average Sound Level (L_{dn}) for outdoor spaces (EPA, 1974). Therefore, the proposed EREF would have a small impact on the Wasden Complex.

4.7.1.1.2 Highway Entrances, Access Roads, and Visitor Center

Noise levels during construction of the highway entrances, access roads, and visitor center would range from 80 to 95 dBA. One highway entrance and access road would be immediately adjacent to the Hell's Half Acre Wilderness Study Area (WSA). However the nearest point of the Bureau of Land Management (BLM) hiking trail associated with the WSA is about 0.5 km (0.3 mi) further southwest. The other highway entrance, access road and visitor center would be about 200 m (656 ft) from the WSA. Construction noise would diminish from about 80 to 95 dBA to 56 to 71 dBA at 200 m (656 ft) from the construction area and to about 51 to 66 dBA at the nearest BLM hiking trail point. These noise levels are considered "clearly acceptable" (< 60 dBA) or "normally acceptable" (60 to 75 dBA) for livestock and farming land uses (HUD, 1985). The BLM trailhead on the WSA is about 860 m (2821 ft) from the nearest highway entrance construction area and noise levels would diminish to about 44 to 59 dBA. These noise levels are considered "clearly acceptable" for residential, livestock, and farming land uses (HUD, 1985). Therefore, construction noise would be audible on portions of the WSA during construction of portions of the access roads, U.S. Highway 20 entrances, and the visitor center. Construction noise levels may be an irritation to some visitors. Construction near the WSA would be completed within 12 months, and therefore sound impacts would be temporary. Since there is already substantial traffic using U.S. Highway 20, the temporarily increased noise level impacts would be small from construction of the visitor center, highway entrances, and access roads.

Noise from construction traffic along U.S. Highway 20 would be similar as existing highway noise levels because construction activities largely would be during weekday daylight hours. Existing noise levels were recorded at the proposed site at 57 dBA 15 m (50 ft) from U.S. Highway 20, during peak commute times. This noise level likely would be similar during construction when construction traffic is included.

4.7.1.2 Operational Impacts

The development of the proposed facility would generally increase noise levels, although the amount of the increase would depend on many factors, including the number of employees and the amount of increased vehicular traffic. Vehicular traffic would be increased on U.S. Highway 20 during operations, but due to the considerable vehicle traffic already present, maximum noise levels would not increase; however, the duration of these maximum noise levels would increase because of the increased duration of the peak commute.

An operational noise survey was performed at the Almelo Enrichment Plant in Almelo, Netherlands, at the border of the site boundary during a 24-hour period. The Almelo Enrichment Plant design is comparable to the design of the proposed facility. The noise results obtained during the survey ranged from 30 to 47 dBA, with an average of 39.7 dBA. The main sources of operational noise were from the cascade halls, the cooling fans, and the cooling towers. The minimum distance from the cascade halls to the site boundary was about 80 m (262 ft), while the cooling towers and cooling fans were about 120 m (394 ft) from the site boundary.

The Almelo Enrichment Plant site is much smaller compared to the proposed EREF site. Sound levels recorded at the Almelo Enrichment Plant boundary would represent a conservative upper noise levels for the proposed EREF. The estimated maximum noise levels during normal operations of the proposed EREF would be less than 47 dBA (recorded at the Almelo boundary) at the nearest boundary to the proposed EREF footprint. Therefore, the proposed EREF would be in compliance with the HUD guidelines of 60 dBA for residential use and the EPA criteria of 55 dBA. Although the noise from the plant and the additional traffic would generally be noticeable, the operational noise from the plant is not expected to have a significant impact on adjacent properties. The noise levels at the WSA (about 2.4 km (1.5 mi)) would be substantially lower due to noise attenuation over distances and would be near ambient and masked by noise from U.S. Highway 20 traffic. Similarly, noise levels from proposed EREF operations would be only about 4 dBA at the Wasden Complex and therefore near ambient noise levels. The nearest residence would not hear the operations noise since it is approximately 7.7 km (4.8 mi) east of the proposed site.

Noise from traffic on U.S. Highway 20 that is from delivery and worker vehicles during the operation of the proposed EREF would be heard on U.S. Highway 20 and, therefore, at the WSA and residences along U.S. Highway 20. There is considerable existing traffic already present on U.S. Highway 20. Therefore, maximum noise levels would not increase, although the duration of noise that is associated with peak commute traffic would increase.

4.7.1.3 Decommissioning Impacts

Noise levels during decommissioning would be similar to those during construction at the EREF footprint. Noise levels during decommissioning would be no greater than those generated during construction, and would therefore range from 80 to 95 dBA. These noise levels would diminish to about 46 to 61 dBA at the nearest site boundary to the proposed EREF footprint (about 825 m (2,707 ft)). Noise levels up to 60 dBA are considered “clearly acceptable” under HUD Land Use Compatibility Guideline for residential, livestock, and farming land uses (HUD, 1985). Similarly, noise levels under 55 dBA would not exceed the EPA-defined goal of 55 dBA for Day-Night Average Sound Level (L_{dn}) for outdoor spaces (EPA, 1974).

Maximum decommissioning noise levels of about 95 dBA would diminish to about 61 dBA at the nearest site boundary. These levels are considered “clearly acceptable” for industrial facilities and only one dBA above the level considered “clearly acceptable” for farm, livestock, and residential land uses under the HUD Guideline (HUD, 1985). However, maximum decommissioning noise would exceed the EPA-defined goal of 55 dBA for L_{dn} for outdoor spaces (EPA, 1974). Therefore, noise during decommissioning of the proposed EREF footprint would be audible on adjacent properties, primarily north, east, southeast, and southwest of the proposed EREF footprint. While decommissioning would continue for about nine years, the impacts would be small since land use is limited to grazing; the nearest residence is approximately 7.7 km (4.8 mi) east of the proposed site; and noise levels would be within the sound levels identified by HUD as “clearly acceptable” or “normally acceptable.”

4.7.2 Noise Sources

Noise point sources for the proposed facility during operation would include cascade halls, coolers, rooftop fans, air conditioners, transformers, and traffic from delivery trucks, employee vehicles, and site vehicles. Noise line sources for the plant during operation would consist only of vehicular traffic entering and leaving the site. Ambient background noise sources in the area include vehicular traffic along U.S. Highway 20, nearby farming operations, and wind gusts.

4.7.3 Noise Level Standards

HUD guidelines, as detailed in Table 3.7-2, U.S. Department of Housing Urban Development Land Use Compatibility Guidelines, set the acceptable Day-Night Average Sound Level (L_{dn}) for areas of industrial, manufacturing, and utilities at 70 to 80 dBA as “normally acceptable.” Additionally, under these guidelines, construction and operation of the facility would not result in a change to sound levels to the closest residence and would not exceed 65 dBA (HUD, 1985). The EPA has set a goal of 55 dBA for L_{dn} in outdoor spaces, as detailed in the EPA Levels Document (EPA, 1974). Background measurements were consistent with the guidance provided in American Society of Testing and Materials (ASTM) Standard Guide E1686-03 (ASTM, 2003).

As indicated in Section 4.7.1, Predicted Noise Levels, the calculated construction noise levels at the nearest boundary of the proposed site from the construction areas would be at levels defined as “clearly acceptable” or “normally acceptable” by HUD (HUD, 1985) but would exceed the EPA goal of 55 dBA (EPA, 1974). Operational noise levels would be below both the HUD and EPA guidelines. There are no Bonneville County or state environmental noise ordinances or regulations applicable to the proposed EREF. Sound levels during construction and operation of the proposed EREF would not be harmful to the public's life and health nor a disturbance of public peace and welfare.

4.7.4 Potential Impacts to Sensitive Receptors

Potential impacts to local schools, churches, hospitals, and residences would be small. The nearest home is located approximately 7.7 km (4.8 mi) east of the proposed site. The nearest school, hospital, church, and other sensitive noise receptors are located in Idaho Falls. Therefore, noise from construction, operations, decontamination, and decommissioning would not affect these receptors. Homes located along U.S. Highway 20 would be affected by the vehicle noise, but due to existing heavy tractor-trailer vehicle traffic, the change should be minimal.

As discussed in Section 4.5.5, Expected to Impacts to Communities or Habitats, habitat adjacent to the proposed facility would be avoided or used less frequently due to noise, human presence, and night lighting. Noise during construction may affect the ability of female sage grouse near the proposed EREF site to hear male sage grouse at leks during breeding season. Maximum construction noise levels would be about 35 dBA at the nearest known lek, which is similar to ambient noise levels measured in June 2008. This lek is within 6.4 km (4 mi) from the proposed site. Therefore, breeding success at this lek may be affected because female sage grouse close to the proposed EREF may not consistently hear male sage grouse on the lek. However, all other known leks are over 16 km (10 mi) from the proposed EREF site and would not be affected. Therefore, impacts to greater sage grouse from the proposed EREF would be small.

4.7.5 Mitigation

Mitigation of operational noise sources would occur primarily from the plant design, as cooling systems, valves, transformers, pumps, generators, and other facility equipment would generally be located inside plant structures. The buildings themselves would absorb the majority of the noise generated within. Natural land contours, vegetation (such as scrub brush), and site buildings and structures would mitigate noise from equipment located outside of the site structures. Distance from the noise source is also a key factor in the control of noise levels to area receptors. It is generally true that the sound pressure level from an outdoor noise source decreases 6 dB per doubling of distance. Thus, a noise that measures 80 dBA at 15 m (50 ft) away from the source would measure 74 dB at 30.5 m (100 ft), 68 dB at 61 m (200 ft), and 62 dB at 122 m (400 ft). As noted above, the nearest home is located approximately 7.7 km (4.8 mi) east of the proposed site; and the WSA is located immediately south of the proposed site. Both the residence and the WSA are near U.S. Highway 20. To minimize noise impacts to the residence, most use of U.S. Highway 20 would be restricted after twilight through early morning hours. Similarly, heavy truck and earth moving equipment usage during construction of the access roads and highway entrances would be restricted after twilight through early morning hours to minimize noise impacts to the WSA. All noise suppression systems on construction vehicles would be kept in proper operation

4.7.6 Cumulative Impacts

Cumulative noise sources would include the proposed EREF, existing traffic along U.S. Highway 20, farm and ranch operations, infrequent small aircraft; and environmental noise (e.g., wind, thunder). AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF. Expected noise levels would mostly affect a 1.6-km (1-mi) radius. Much of the area within that radius is on the proposed EREF site. Offsite property is primarily grazing and agriculture land with the exception of portions of the WSA. Cumulative impacts from all noise sources at the EREF footprint would generally remain at or below HUD guidelines of 60 dBA Ldn (HUD, 1985), during construction and decommissioning, and below 60 dBA L_{dn} (HUD, 1985) and the EPA guidelines of 55 dBA L_{dn} (EPA, 1974) during operations.

The affected portion of the WSA is also near U.S. Highway 20 and would receive cumulative noise impacts from the highway and construction of the proposed EREF. Maximum cumulative noise levels near the WSA during construction of the highway entrances and visitor center would be in excess of 70 dBA but less than 75 dBA. The cumulative effects would be relatively temporary because construction of the highway entrances, visitor center and access roads would be completed within 12 months. Residences closest to the site boundary would also experience noise from traffic along U.S. Highway 20. The primary sources of cumulative noise would be from existing traffic (e.g., Idaho National Laboratory commuters). Overall noise levels are not likely to increase; however, the duration of peak noise levels associated with commuting may increase. Therefore, cumulative noise impacts from the EREF will be small.

4.7.7 Comparative Noise Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The noise impacts would be the same since three enrichment plants would be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The noise impacts would be the same or greater since there is additional concentration of activity at a single location.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The noise impacts would be the same or greater since there is additional concentration of activity at a single location.

4.8 HISTORIC AND CULTURAL RESOURCE IMPACTS

4.8.1 Direct Impacts

A pedestrian cultural resource survey of the 381-hectare (941-acre) parcel of land where the proposed Eagle Rock Enrichment Facility (EREF) is to be located (WCRM, 2008). The survey resulted in the recording of 11 sites and 17 isolated occurrences (finds); there are three prehistoric, four historic, and four multi-component sites. The Idaho State Historic Preservation Officer (SHPO) determined that further investigation was needed to assess the National Register of Historic Places (NRHP) eligibility for the prehistoric components of three sites (MW002, MW012, and MW015). The historic component of one site (MW004) is recommended as eligible. Seven sites (MW003, MW006, MW007, MW009, MW011, MW013, and MW014) are recommended not eligible for inclusion in the NRHP. Subsurface evaluative testing was conducted from October 1 through October 4, 2008 on sites MW002, MW012, and MW015. The prehistoric components of these sites include a lithic scatter (MW002), a lithic scatter with an associated rock feature (MW012), and a prehistoric artifact in association with a rock feature (MW015). The results of the testing program found that the prehistoric components of each of these three sites will not yield further significant data; they have been recommended as not eligible. The historic component of the site (MW004) recommended as eligible consists of a historic homestead complex and a possible ranching field camp; this site will provide information regarding the historic ranching practices in the area. The isolates include lithic flakes, stone tool fragments, rock features, cans, galvanized tubs, a lard pail, agricultural machinery/implements, board fragments and wire nails. None of the isolated occurrences are recommended as eligible for inclusion in the NRHP. Any site recommended as eligible for inclusion in the NRHP will be avoided, or a mitigation plan will be developed and implemented if required. (See ER Section 4.8.6, Minimizing Adverse Impacts.)

Based on recommendations from the Idaho State Historic Preservation Office (SHPO) and standard practice, AREVA Enrichment Services (AES) has not identified the locations of the sites on a map so that the sites would not be disturbed by curiosity seekers or vandals.

4.8.2 Indirect Impacts

Based on the survey results as stated in ER Section 4.8.1, one potentially eligible site (MW004) is known to exist within the survey Area of Potential Effect (APE) of the proposed EREF. If it is officially determined eligible, this site will be treated/mitigated to minimize the potential for indirect impacts. AES has knowledge of one act of unauthorized collection on a cultural site west of the EREF site. AES will provide the Idaho SHPO with the survey results in 2009 in lieu of providing the locations in the ER to further preclude the potential for vandalism. (See Section 4.8.6 on mitigative actions.)

4.8.3 Agency Consultation

Consultation has been initiated with all appropriate state agencies. In addition, AES has consulted by letter with the Shoshone Bannock Tribe. Consultation letters are included in ER Appendix A.

At the request of the Idaho State SHPO, a visualization assessment of the Wasden Complex viewshed, relative to the EREF, was performed. The Wasden Complex represents a group of potential Paleo-Indian historical sites of significance. Results of the visualization assessment indicate that the impact on sightlines from the Wasden Complex is expected to be small due to an intervening ridgeline that obscures all but the very tops of the EREF buildings.

4.8.4 Historic Preservation

Site MW004, located within the APE, is recommended eligible for inclusion in to the NRHP. This site will either be avoided or a mitigation plan will be developed and implemented. No further action is required with regard to sites that are officially determined to be not eligible for inclusion in the NRHP. The results of the survey will be submitted to the Idaho SHPO in 2009 for determination of eligibility. Based on the Idaho SHPO determination, AES will implement, if necessary, appropriate measures. Idaho implementation of the Federal National Historic Preservation Act in contained in Idaho State Statute Title 67, Chapter 41, State Historical Society (Idaho Statutes, 2008a) (See Section 4.8.6 on mitigative actions.)

4.8.5 Potential for Human Remains

Procedures to deal with unexpected discoveries will be prepared by AES in consultation with the Idaho SHPO. The procedures will provide the processes for dealing with discoveries of human remains or previously unidentified archeological materials. Although there is a low potential for human remains to be present on the EREF site, previous work in the region indicates that burials can occur in any location or setting. Should an inadvertent discovery of such remains be made during construction, AES, in accordance with Idaho State Law Section 27-501 through 27-504 (Idaho Statutes, 2008c), would stop construction activities immediately in the area of the discovery and notify the Director of the Idaho State Historical Society. The Director of the Idaho State Historical Society would determine the appropriate measures to identify, evaluate, and treat these discoveries. If the remains are potentially from Native American sites, AES would, in addition to the above actions, contact the federal agency that has primary management authority and the appropriate Native American tribe. AES would also make a reasonable effort to protect the items discovered before resuming the construction activities in the vicinity of the discovery. The construction activity would resume only after the appropriate consultations and notifications have occurred and guidance received.

4.8.6 Minimizing Adverse Impacts

Mitigation measures will be in place to minimize any potential impact on historical and cultural resources. In the event that any inadvertent discovery of human remains or other items of archeological significance is made during construction, the facility will cease construction activities in the area around the discovery and notify the State Historic Preservation Officer (SHPO) to make the determination of appropriate measures to identify, evaluate, and treat these discoveries.

Mitigation of the impact to historical and cultural sites within the EREF project boundary can take a variety of forms. Avoidance and data collection are the two most common forms of mitigation recommended for sites considered eligible for inclusion in the National Register of Historic Places (NRHP) (USC, 2008i). Significance criteria (a-d) serve as the basis for a determination that a site is eligible for inclusion in the NRHP. When possible, avoidance is the preferred alternative because the site is preserved in place and mitigation costs are minimized. When avoidance is not possible, data collection becomes the preferred alternative.

Data collection can take place after sites recommended eligible in the field have been officially determined eligible by the SHPO and a treatment plan has been submitted and approved. The plan describes the expected data content of the sites and the methodology for collection, analysis and reporting. For the EREF, one site, MW004, has been recommended eligible for inclusion in the NRHP under criteria a and d. A treatment/mitigation plan for MW004 will be developed by AES to recover significant information.

Procedures to deal with unexpected discoveries will be developed in a plan prepared by AES. The plan will set forth the process for dealing with discoveries of human remains or previously unidentified archaeological materials that are discovered during ground disturbing activities and will establish procedures for the evaluation and treatment of these resources.

Materials that may be recovered for analysis during discovery or data recovery activities include artifacts and samples (e.g., bone, charcoal, sediments). Certain types of samples, such as radiocarbon samples, are usually submitted to outside analytical laboratories. All resources within the EREF are located on private land.

Given the small number of archaeological sites and isolated occurrences located within the EREF and AES's ability to avoid or mitigate impacts to those sites, the EREF would not have a significant impact on archaeological and cultural resources.

4.8.7 Cumulative Impacts

The cumulative impacts to historic and cultural resources will be limited to those resulting from construction and operation of the EREF and existing development on surrounding properties, because AES does not know of any other Federal, State, or private development plans within 16 km (10 mi) of the EREF.

There are a small number of archaeological sites located in the area associated with the EREF. The cumulative impacts to cultural resources will be small.

4.8.8 Comparative Historic and Cultural Resource Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The historical and cultural impacts would be the same since three enrichment plants would be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The historical and cultural impacts would be the same or less since some land on the expanded site may already have been disturbed.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The historical and cultural impacts would be the same or less since some land on the expanded site may already have been disturbed.

4.9 VISUAL/SCENIC RESOURCES IMPACT

4.9.1 Photos

The proposed Eagle Rock Enrichment Facility (EREF) site has limited development (refer to Section 3.9.2, Site Photographs). The few structures on the property include an irrigation well, six pivot irrigation systems, livestock handling pens, and barbed wire fences. In addition, there are two potato sheds and four grain bins on the property adjacent to U.S. Highway 20.

4.9.2 Aesthetic and Scenic Quality Rating

The Bureau of Land Management (BLM) visual resource inventory process provides a means for determining visual values (BLM, 1984a). The inventory consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones. Based on these three factors, lands are placed into one of four visual resource inventory classes. These inventory classes represent the relative value of the visual resources as follows: Classes I and II are considered to have the highest value, Class III represents a moderate value, and Class IV is of least value. The inventory classes provide the basis for considering visual values in the BLM resource management planning (RMP) process. Visual resource management (VRM) classes are established through the RMP process. Scenic quality is a measure of the visual appeal of a tract of land that is given an A, B or C rating (A-highest, C-lowest) based on the apparent scenic quality. The proposed EREF site received a "B" rating (see Table 3.9-1, Scenic Quality Inventory and Evaluation Chart). This class is of moderate value and allows for manipulation or disturbance. While the proposed site falls within an area identified by the BLM as VRM Class II, this designation is for BLM lands.

Private lands and INL lands within this Class II area have some development, including potato cellars, equipment barns, and industrial facilities. In addition, the county has zoned this area G-1 which allows for industrial development along with agriculture and grazing. Therefore, the site could be considered a VRM Class III or IV area.

The proposed EREF would disturb about 240 hectares (592 acres), which represents about 14% of the 1700 hectares (4200 acres) site. In addition, it would consist of structures no higher than 20 m (65 ft) and would be centrally located on the property. Therefore it would not dominate the landscape and would be within the objectives for Class III and IV. Both Classes allow for management activities that require modifications of the existing character of the landscape (BLM, 1984a) (BLM, 1984b) (BLM, 1986) (BLM, 2008b).

4.9.3 Significant Visual Impacts

Figure 4.9-1, Aerial View, is an artistic aerial view of the proposed EREF and surrounding area. The majority of the surrounding area is grazing land and seeded dryland pasture with limited development. Communication towers are located on Kettle Butte 1.6 km (1 mi) east of the proposed site and U.S. Highway 20 runs along the southern most boundary of the proposed site. There are potato storage facilities, stock handling areas, and irrigation systems within 3.2 km (2 mi) of the proposed site that can be seen from the proposed EREF footprint. A powerline runs from the east to a substation near the southeast boundary of the proposed site. In addition, the BLM Hell's Half Acre Wilderness Study Area (WSA) can be seen from the proposed EREF footprint; although no detail can be observed. No permanent structures are visible on the adjacent properties to the north or west.

4.9.3.1 Potential Impacts from Construction

Construction equipment would be out of character with the current uses and features of the site and surrounding properties. Construction of the access roads, U.S. Highway 20 entrances, and Visitors Center near U.S. Highway 20 would be most visible to the public including traffic along U.S. Highway 20 and visitors to the WSA. Construction near the WSA would be completed within 12 months and therefore sound impacts would be temporary.

Construction on the EREF footprint would be less visible but would continue for about seven years. Cranes would be visible from portions of U.S. Highway 20 and likely from locations on the WSA. However, U.S. Highway 20 and the closest portions of the WSA are at least 2.4 km (1.5 mi) away from the facility construction area. Therefore, detail of the cranes and other construction activity would not be observed. Construction on the EREF footprint would be visible from the nearest proposed site boundaries. It is unlikely that even the construction cranes would be easily observable on the west boundary of the property due to topography and distance. Construction of much of the site would be visible from adjacent properties north, east, southeast, and southwest of the proposed EREF footprint. These properties are open lands and used for grazing. While construction would continue for about seven years, the impacts would be small since land use is limited primarily to grazing and few visitors. The impact to views from the WSA likely would be small due to the distance to the proposed EREF and the size of the proposed EREF in comparison to the entire viewshed from the WSA.

None of the construction activities or proposed EREF structures would require removal of natural topographic elevations that would serve to partially screen the proposed EREF. Any changes in topography to construct the access roads would be minimal. Natural landscaping with indigenous vegetation is planned to provide additional screening measures that would improve aesthetics.

Noise and dust would be generated during construction. Construction of the access roads, U.S. Highway 20 entrances, and Visitors Center near U.S. Highway 20 would create temporary changes to the audible, atmospheric, and visual, elements at the northern portion of the WSA, which is south of the proposed site. Similarly, construction of the EREF main facility would create temporary changes to the audible, atmospheric, and visual, elements of properties to the north, east, and southwest of the facility. Normal noise levels during construction would be about 85 dBA at 15 m (50 ft) from the noise source. These noise levels would diminish to about 50 dBA at the nearest site boundary (see ER Section 4.7.1, Predicted Noise Levels). These levels are considered “clearly acceptable” under the U.S. Department of Housing and Urban Development Land Use Compatibility Guideline (HUD, 1985) and do not exceed the EPA-defined goal of 55 dBA for Ldn for outdoor spaces (EPA, 1973). Maximum construction noise levels of about 95 to 101 dBA at 15 m (50 ft) would occur intermittently during construction. These noise levels would diminish to about 60 to 65 dBA at the nearest site boundary (see ER Section 4.7.1, Predicted Noise Levels). These levels are considered “normally acceptable” under the HUD Guideline (HUD, 1985), but exceed the EPA-defined goal of 55 dBA for Ldn for outdoor spaces (EPA, 1973).

Construction noise would be audible on portions of the WSA, south of U.S. Highway 20, during construction of the access roads, U.S. Highway 20 entrances, and Visitors Center. Construction near the WSA would be completed within 12 months and therefore sound impacts would be temporary. The impacts would be small since the construction near the WSA would be relatively short-term and most visitors to the WSA would be further than 2 km (1.2 mi) away from the nearest construction area.

Noise during construction of the proposed EREF, centrally located on the proposed site, would be audible on adjacent properties, primarily north, east, southeast, and southwest of the proposed EREF footprint. These properties are open lands and used for grazing. While construction would continue for about seven years, the impacts would be small since land use is limited to grazing and noise levels would be within the sound levels identified by HUD as “clearly acceptable” or “normally acceptable.”

Dust would be generated during construction. Dust suppression Best Management Practices (BMPs) would be used to minimize dust and disturbed areas would be stabilized as soon as practicable. Therefore, the visual impacts due to the construction of the EREF would be small.

4.9.3.2 Potential Impacts from Operations

The proposed EREF would be out of character with current uses and features because the proposed site and surrounding area is primarily used for farming, crop harvesting operations, and grazing. The size and industrial nature of this proposed facility would be new to the immediate area. However, similar sized industrial facilities (e.g., Materials and Fuels Complex) are located approximately 16 km (10 mi) west of the proposed site on the Idaho National Laboratory (INL).

The proposed EREF would create limited visual intrusions and would partially obstruct views of the nearby landscape. None of the proposed structures would be taller than 20 m (65 ft). Most of the impact would be on views from private and BLM lands southwest, east, and southeast of the proposed footprint. These lands are used for grazing and important visual features for offsite observers such as mountains and buttes are in the far distance. Therefore the viewing locations do not represent high quality view areas.

Due to the relative flatness of the site and surrounding vicinity, portions of the proposed EREF structures would likely be observable from U.S. Highway 20 and the WSA. This would include taller facility buildings such as the Centrifuge Assembly Building and Separation Buildings. U.S. Highway 20 and the WSA are about 2.4 km (1.5 mi) at the nearest point to the proposed EREF footprint. In addition, the trailhead on the WSA is about 3.9 km (2.4 mi) from the proposed footprint. Therefore, details of the structures would be difficult to observe. In addition, the buildings would be painted neutral colors and landscaping is planned to provide aesthetically pleasing screening measures that would add to the aesthetics.

Lighting would be limited to the EREF, U.S. Highway 20 entrances, and access roads. Lighting would be minimized and based on security and safety requirements. In addition, lighting would be directional to limit visibility.

None of the proposed EREF structures will require removal of natural topographic elevations that would serve to partially screen the proposed EREF.

Maximum noise levels during normal operations would be less than 50 dBA within 15 m (50 ft) of any sound source. The noise levels would be reduced to less than 20 dBA at the nearest site boundaries.

No dust would be generated during operation of the facility. Accordingly, the visual impacts due to the operation of the EREF would be small.

4.9.3.3 Potential Impacts from Decommissioning Activities

Impacts to visual resources during decommissioning activities would be similar to those generated during construction. Accordingly, the visual impacts due to decommissioning of the EREF would be small.

4.9.4 Altered Historical, Archaeological, or Cultural Properties

Based on discussions with the county historian, local Indian tribe and the State Historical Preservation Office (SHPO) and, as stated in ER Section 3.8, Historic and Cultural Resources, all cultural or archaeological sites that were identified during the Cultural Resources Inventory within the proposed EREF footprint will be either avoided or mitigated, as necessary to protect the resource. The results of the Cultural Resources Inventory will be submitted to the SHPO in 2009 for a determination of eligibility. Based on the SHPO determination, AREVA Enrichment Services, LLC. (AES) will implement, if required, appropriate measures. As a result, historical, archaeological or cultural resources will be identified and protected. These sites were unknown prior to the survey, are small, and are on private land. In addition, these sites cannot be seen from public lands. AES has also assessed the potential visual impact of the EREF on the Wasden Complex viewshed and has provided the assessment to the SHPO. AES is currently working with the SHPO to address their concern. Therefore, AES finds that the visual impacts from the proposed EREF would be small.

4.9.5 Visual Compatibility and Compliance

As noted in Section 3.9.9, Regulatory Information, discussions were held between AREVA and Bonneville County officials, to coordinate and discuss local area community planning issues. No county zoning, land use planning or associated review process requirements were identified. All applicable local ordinances and regulations will be followed during the construction and operation of the proposed EREF. In addition, development of the site will meet federal and state requirements for nuclear and radioactive material sites regarding design, siting, construction materials, and monitoring.

4.9.6 Potential Mitigation Measures

Mitigation measures will be in place to minimize the impact to visual and scenic resources. These include the following items:

- The use of accepted natural, low-water consumption landscaping techniques to limit any potential visual impacts. These techniques will incorporate, but not be limited to, the use of native landscape plantings and crushed stone pavements on difficult to reclaim areas.
- Aesthetically pleasing screening measures such as berms and earthen barriers, natural stone, and other physical means may be used to soften the buildings.
- Prompt revegetation or covering of bare areas with natural materials will be used to mitigate visual impacts due to construction activities.
- Use of neutral colors for structures.
- Limiting lighting to meet security requirements and focusing lighting toward the ground to reduce night lighting in the surrounding area.

4.9.7 Cumulative Impacts to Visual/Scenic Quality

The cumulative impacts to the visual/scenic quality of the proposed EREF site were assessed by examining the proposed actions associated with construction of the proposed EREF and the development of surrounding properties. AES does not know of any other Federal, State, or private development plans within 16 ki (10 mi) of the EREF.

Proposed EREF site development potentially impacting the visual/scenic quality of the proposed site includes:

- Several buildings surrounded by chain link fencing;
- Large storage areas for feed, product and depleted uranium cylinders;
- Storm water detention basins;
- Equipment storage areas;
- Electrical substation and supply power lines;
- Facility access and security roads; and
- Barbed wire fencing along property perimeters

Existing off site development on surrounding properties impacting the visual/scenic quality of the site and vicinity includes continuing use of:

- Farm buildings (e.g., potato sheds, equipment sheds);
- Center pivot irrigation systems;
- Dirt and gravel covered roadways;
- Power poles, a small substation, and a high-voltage utility line; and
- U.S. Highway 20

By considering both proposed onsite and nearby existing developments, modification to the proposed site would result in small visual impacts. Therefore, cumulative impacts will be small on the visual/scenic quality of the proposed site.

4.9.8 Comparative Visual/Scenic Resources Impacts of the No Action Alternative

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The visual/scenic resources impacts would be the same since three enrichment plants would be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The visual/scenic resources impacts would be the same or less because although only two plants are constructed, the size of one plant would be larger.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The visual/scenic resources impacts would be the same or less because although only two plants are constructed, the size of one plant would be larger.

FIGURES

FIGURE 4.9-1 **Rev. 0**

Aerial View

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

4.10 SOCIOECONOMIC IMPACTS

This section describes the socioeconomic impacts to the community surrounding the Eagle Rock Enrichment Facility (EREF), including impacts from the influx of the construction and operational workforces to schools, housing, and social services. Transportation impacts are described in Section 4.2, Transportation Impacts.

4.10.1 Facility Construction

4.10.1.1 Jobs, Income, and Worker Population

Construction of the EREF site is scheduled for the beginning of 2011, with construction continuing for seven years through the beginning of 2018. The EREF is estimated to cost a total of [*] to construct (in constant 2007 dollars; Table 4.10-1, Type of Construction Costs by Location).

An estimated [*] would be spent within an 80-km (50-mi) radius (about [*], [*] would be spent elsewhere in the United States, and [*] would be spent internationally.

Of the total cost, an estimated [*] would be spent for buildings, [*] would be spent for equipment, and [*] would be expended for other construction costs. Of the [*] to be spent for building construction alone, an estimated [*] would be spent locally on labor and [*] would be spent locally on construction materials.

Table 4.10-2, Estimated Number of Construction Craft Workers by Annual Pay Ranges, lists the estimated average annual number of construction employees working on the EREF during construction and the estimated salary range. As shown in that table, a peak craft construction workforce of about 590 workers is anticipated in 2012. During early construction stages of the project, the workforce is expected to consist primarily of structural crafts, which should benefit the local area because this workforce is expected to come from the local area. As construction progresses, there would be a transition to predominantly mechanical and electrical crafts in the later stages. The bulk of this labor force is expected to come from the surrounding 120-km (75-mi) region due to the relatively low population of the local site area (Table 3.10-3, Labor Force and Employment). The available labor pool is expected to correlate with the required educational and skill levels needed for the construction workforce.

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4.10.1.2 Community Characteristic Impacts

The major impact of facility construction on human activities is expected to be a result of the influx of labor into the area on a daily or semi-permanent basis. AREVA Enrichment Services LLC (AES) estimates that approximately 15% of the 800-person construction workforce (120 workers), including management, would move into the Idaho Falls vicinity as new residents. Previous experience regarding construction for nuclear industry projects suggests that, of those who move, approximately 65% (80 of the 120 workers) would bring their families, which on average would consist of the worker, a spouse, and one school-aged child (USCB, 2000c). The likely increase in area population during peak construction, therefore, would total 280 (40 workers without families, plus 80 workers with their families). This is less than 0.4% of the Bonneville County's population of 82,522 in 2000, and less than 0.3% of the two-county region of influence (ROI) population of 124,257 in 2000 (Table 3.10-2, Racial Composition). This minimal increase and impact would be manageable, particularly considering the significant growth in Bonneville County and the ROI during the 1970-1980 period, low growth in the 1980-1990 period, and moderate growth in the 1990-2000 period (Table 3.10-1, Population Census and Projections). The overall change in population density and characteristics in Bonneville County due to construction of the EREF would be small.

AES estimated that 120 housing units would be needed to accommodate the new EREF construction workforce. In 2006, Bonneville County had 2,603 vacant housing units (7.2%) (estimates were not available for Bingham County for 2006). In 2000, Bonneville County had 1,731 vacant units and Bingham County had 986 vacant units, for a total of 2,717 in the ROI (Table 3.10-8, Housing). Even if all of the in-migrating construction workforce were to reside in Bonneville County, it would only represent a 4.6% reduction in the number of vacant houses available in 2006. If they were to reside throughout the two-county region of influence, it would only represent a 4.4% reduction in the number of vacant houses available in 2000. Accordingly, there should be no measurable impact related to the need for EREF construction worker housing.

The increase in jobs and population also would lead to a need for increased use of community services, such as police and fire protection, medical services, and schools. Some of the departments that could be affected by the construction workforce in-migration have identified existing needs that are not met. These existing needs could potentially affect their ability to meet additional future service needs as a result of the EREF. A representative of the Bonneville County Sheriff's Department, stated that the Tri-County Sheriff's Association covers most of southeastern Idaho, including Bonneville County and the City of Idaho Falls. The cities and counties within the Tri-County Sheriff's Association have mutual aid agreements to assist each other when the need arises. The Bonneville County Sheriff's Department has indicated an existing need to have mobile data terminals (MDTs) installed in its patrol vehicles; need for sonar equipment for the dive team's boat; and need for additional traffic enforcement vehicles and officers, detectives, and narcotics officers. In addition, the department has a desire to move from the old main building into a new facility. The department stated that construction of the EREF would likely require additional traffic enforcement officers and units, beyond their existing needs, to meet the service use demands created by the construction workforce.

A representative of the Idaho Falls Police Department indicated an existing need for a more permanent or a new building (it shares existing facilities with Bonneville County and rents some space that might be sold), to install MDTs in its patrol vehicles, and to obtain additional rifles for its officers. The department stated that construction of the EREF would likely require additional enforcement officers, vehicles, and equipment beyond their existing needs, to meet the service use demands created by the construction workforce.

A representative of the City of Idaho Falls Fire Department indicated that they have an existing need for a new station in the downtown area and another station on the south side of Idaho Falls, storage units at the backs of its buildings, a heavy rescue truck, installation of MDTs in all of its units, and some additional firefighters. The representative stated that increased demands as a result of the construction workforce might require the addition of another ambulance and EMT crew and a new fire station with associated vehicles, equipment, and staff on the west side of the city if population growth occurs there as a result of the EREF.

A representative of Eastern Idaho Regional Medical Center stated that the hospital has interlocal agreements with other facilities in the region and no current needs. They do not anticipate having additional needs to meet the potential increased demand created by the construction workforce for the EREF.

The estimated peak increase in school-age children due to EREF construction worker families is 80, or less than 1% of Bonneville County's public enrollment of 14,254 students and the two-county ROI enrollment of 24,296 (Table 3.10-9, Public and Private Educational Facilities). Based on the local area teacher-student ratio of approximately 1:18, the midpoint of traditional schools in the counties, and assuming an even distribution of students among all grade levels, the increase in students represents five classrooms. A representative of the Bonneville Joint School District 93 stated that they currently need additional teachers and staff, and funds to increase salaries to retain staff. Most schools are operating at their designed capacity so they soon would need to add an elementary school, followed by a middle school and a high school. The representative stated that completing its existing expansion plans would result in the added capacity needed to meet the potential new demands created by an in-migrating construction workforce.

A representative of the Idaho Falls School District 91 stated that they currently need an additional four full-time equivalent teachers and they need to modernize facilities, even though recent declines in enrollment have left the district with excess space. They stated that they would need to increase teacher and staff levels slightly to meet the needs of the in-migrating construction workforce.

Because the growth in jobs and population would occur over a period of several years, providers of the above services should be able to accommodate the projected population growth and demand for services. While additional investment in staff, facilities, and equipment may be necessary, local government revenues also would increase. As shown in Table 4.10-3, Estimated Annual Tax Payments, AES would pay an estimated [*] in annual property taxes [*] to Bonneville County during the last three full years of the seven-year construction period for the EREF, ending in early 2018, representing an [*] increase in annual county property tax revenues and a [*] increase in total annual county revenues (see Table 3.10-6: Bonneville County Budget Ending September 30, 2007). AES also would pay an estimated [*] in annual sales and use tax revenues (a total of [*] over five years) to the State of Idaho during construction of the EREF. These payments would provide the source for additional government investment in facilities and equipment. That revenue increase may lag somewhat behind the need for new investment, but the incremental nature of the growth should allow local governments to more easily accommodate the increase. Consequently, the impacts on community services will be small.

* Proprietary Commercial Information withheld in accordance with 10 CFR 2.390

4.10.2 Facility Operation

4.10.2.1 Jobs, Income, and Worker Population

Operation of the proposed EREF from 2014 through 2041 would lead to a permanent increase in employment, income, and population in the area. Employment at the EREF during operation would be up to 420 workers, which would be less than the size of the 590-person peak construction craft workforce. Even if all 420 operational workers came from outside the area, this would only represent a 0.8% increase in the total employed labor force of 56,150 in Bonneville and Bingham Counties in 2000, and a 7.5% increase in the 5,631 manufacturing employment in the two counties (Table 3.10-3, Labor Force and Employment, and Table 3.10-4, Employment by Industry). A significant number of the remaining operational jobs are likely to be filled by local residents because roughly 60% of Bonneville County and the two-county ROI residents have obtained some college education, completed graduate degrees, or completed professional degrees in 2000 (Table 3.10-10, Educational Enrollment and Attainment). In addition, some of the in-migrating construction workers would likely stay to become part of the operational workforce of the EREF.

The EREF annual operating payroll would be approximately $27.7 million for a workforce of 420, or about $65,983 per worker per year (in constant 2007 dollars). This average salary is approximately 57.8% more than the $41,805 median household income in Bonneville County in 2000 and about 45.6% higher than the $45,325 median household income for 2006. Similarly, the average EREF salary would be about 81.1% higher than the $36,423 median household income in Bingham County in 2000; the median household income in Bingham County in 2006 is not available (Table 3.10-5, Income Characteristics).

An increase in the area population is unlikely because most of the EREF workforce would likely come from the existing local workforce, including the proposed EREF construction workforce. But if it were to occur, Bonneville County probably would receive most of the new worker population. In particular, the region would not experience a boomtown effect, which generally describes the consequence of rapid increases in population (at least 5 to 10% per year) in small rural communities (i.e., communities with populations of a few thousand to a few tens of thousands and 48 to 80 km (30 to 50 mi) or more from a major city) undergoing rapid increases in economic activity (NRC, 1994). The overall change in population density and population characteristics in Bonneville County due to operation of the EREF would not be significant.

4.10.2.2 Community Characteristic Impacts

The increase in population due to EREF operation may be less than anticipated, due to the employment of local residents and construction workers who remain to become part of the operational workforce. Based on the number of vacant housing units available in the area (Table 3.10-8, Housing), even under a worst-scenario of full in-migration of the operational workforce, the relatively small need for housing units (420 units or 15.4% of those vacant units in the two-county region of influence in 2000) needed would not likely burden or raise prices within the local real estate market.

As stated above, many operational workers are anticipated to be hired from the existing local workforce. Thus, it is anticipated that impacts to schools may be minimal, compared to impacts during construction. If most of the EREF operational workforce is hired from the existing local workforce, then the estimated five additional classrooms needed for the EREF construction workforce may be sufficient to meet the increase of the EREF operational workforce. However, under a worst-case scenario of 100% in-migration, a maximum increase of 420 school-aged children in local elementary and secondary school enrollment during operation could require the addition of 18 more classrooms in the two-county region of influence, above those required for the construction phase.

Area law enforcement, fire, and medical services would be minimally affected because of the significantly smaller operational workforce versus the construction workforce, and potentially similar or less in-migration levels. As discussed in Section 4.10.1.2 (Community Characteristic Impacts), agreements exist among the cities in Bonneville County and other counties in southeastern Idaho for emergency services if adequate personnel and equipment are not available. Current available services should be able to absorb the service needs of new workers and residents. The development of new fire departments or police departments should not be necessary because EREF will maintain an on-site Fire Brigade/Emergency Response Team and Security Force. This on-site capability, in conjunction with response from agreement and supporting agencies from the county's mutual aid system, should be sufficient for response to the EREF.

4.10.3 Regional Impact Due to Construction and Operation

The impact estimates provided in Sections 4.10.1 and 4.10.2 are based on the populations of Bonneville County and the two-county ROI. The population in Idaho within 120 km (75 mi) of the site is larger than the combined population of Bonneville and Bingham Counties. Therefore, the projected construction and operations impacts, discussed in Sections 4.10.1 and 4.10.2 for Bonneville County and the two-county ROI are a conservative upper estimate compared to if the impacts were spread across the 120 km (75 mi) area (which would result in a smaller impact). This minor increase in population from proposed EREF construction (280 new workers and family members) and operations would produce a small impact on population characteristics, economic trends, housing, community services (i.e., health, social, and educational resources), and the tax structure and distribution within 120 km (75 mi) of the site during the construction and operational periods.

As shown in Table 3.10-1, Population Census and Projections, the census year 2000 population in Bonneville County was 82,522 and in Bingham County it was 41,735, for a total of 124,257. The three closest, larger population centers to the site are Idaho Falls at 32 km (20 mi) in Bonneville County, Shelley at 45 km (28 mi) in Bingham County, and Blackfoot at 77 km (48 mi) in Bingham County. The populations of these three areas in 2000 were approximately 50,730, 3,813, and 10,419, respectively, providing a combined total population of approximately 64,962. If the entire construction phase population increase of 280 workers and family members, reported in Section 4.10.1.2, is assumed to relocate to these three cities, a total construction phase population increase of approximately 0.4% would result. This would have a small impact to the region.

Because most of the 420 operational jobs likely would be filled by residents already living in the region, the impact during the operational period of the EREF will be small.

While all cities within 80 km (50 mi) of the EREF could be affected by construction and operation, including Shelley and Blackfoot, Idaho Falls has the greatest potential to experience any in-migration and thus could be the most affected because it is the closest to the facility, is the largest city within that radius, and thus would likely have the most social amenities to attract potential workers and in-migrants. The minor increase in population would produce a small impact on population characteristics, economic trends, housing, community services (i.e., health, social, and educational resources), and the tax structure and tax distribution within Idaho Falls, Idaho, during both the construction and operational periods of the EREF.

The estimated tax revenue and estimated allocations to the State of Idaho and Bonneville County resulting from the construction and operation of the EREF are provided in Tables 4.10-3, Estimated Annual Tax Payments. Annual tax payments are estimated to range from [*] (in constant 2007 dollars), for a total of [*] over the life of the facility. These payments would include [*] in annual net sales and use taxes from 2012 through 2016, [*] in annual net property taxes from 2015 through 2040, and [*] in annual income taxes in 2032 to [*] annually from 2033 through 2040.

The total socioeconomic impact due to the construction and operation of the EREF will be small.

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4.10.4 Decommissioning

Decontamination and decommissioning of the EREF is estimated to take about nine years to complete. This would provide ongoing employment opportunities for the operational workforce and additional employment opportunities for other county and regional residents. Expenditures on salaries and materials would contribute to the area economy. In addition, the State of Idaho would continue to benefit from sales tax and income tax revenues.

A detailed description of the decommissioning process and costs including workforce sizes, salaries and other expenditures, is provided in SAR Chapter 10, Decommissioning. The socioeconomic impact of decommissioning activities will be small.

4.10.5 Cumulative Impacts

A number of other development projects have been proposed for the two-county ROI that could have cumulative effects with the EREF, depending upon their scope and schedules for development. In Bonneville County, these developments could include the Snake River Landing planned community, Taylor Crossing planned community, The Narrows mixed use office/residential development, the Central Valley development, the McNeil Development that includes a Marriott Hotel and condominiums, the Sleep Inn Hotel, and the West Broadway soccer complex now being constructed. In Bingham County, planned developments would be more dispersed and industrial with construction of a 150-unit windfarm development and several cell towers.

These projects would provide additional employment opportunities for construction workers and would increase the economic activity in the region. Depending upon the timing of construction and operation of each of these projects, there could be competition between them to hire construction and operational employees. This competition could lead to some increase in salaries in the area. However, the labor pool is large enough within the immediate 80 km (50 mi), and the even greater 120-km (75-mi) surrounding region, that it should be a minor issue. They would also lead to additional, long-term operational employment opportunities for residents and might result in additional in-migration into the area.

Similar to labor, depending upon the timing of construction of each of these projects, and the types and amounts of construction materials needed, there could be a shortage in the supply of some materials and, thus, competition for obtaining those materials. This could lead to some increases in prices for materials that are in short supply. However, the impact would likely be small.

The cumulative socioeconomic impacts will be small.

4.10.6 Comparative Socioeconomic Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The positive socioeconomic impacts would be the same since three enrichment plants would be built.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The socioeconomic impacts would be about the same since overall SWU capacity would be about the same.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The socioeconomic impacts would be about the same since overall SWU capacity would be about the same.

TABLES

Table 4.10-1 Type of Construction Costs by Location
(Page 1 of 1)

Type of Expenditure	Percentage of Expenditure by Location (and in million $)			
	Local	National	Foreign	Total Construction Costs
Buildings	68% [ ]	30% [ ]	2% [ ]	100.0% [ ]
Equipment	2% [ ]	18% [ ]	80% [ ]	100.0% [ ]
Other	12% [ ]	62% [ ]	26% [ ]	100.0% [ ]
Total Locational Expenditures	[ ]	[ ]	[ ]	[ ]

Note: Estimates are calculated based upon approximate percentages, in million, 2007 dollars.

Information in “[ ]” is Proprietary Commercial Information withheld in accordance with 10 CFR 2.390

Table 4.10-2 Estimated Number of Construction Craft Workers by Annual Pay Ranges (Page 1 of 1)

Year	Annual Pay Ranges				Average Number of Workers/Year
	[ ]	[ ]	[ ]	[ ]	
2011	[ ]	[ ]	[ ]	[ ]	[ ]
2012	[ ]	[ ]	[ ]	[ ]	[ ]
2013	[ ]	[ ]	[ ]	[ ]	[ ]
2014	[ ]	[ ]	[ ]	[ ]	[ ]
2015	[ ]	[ ]	[ ]	[ ]	[ ]
2016	[ ]	[ ]	[ ]	[ ]	[ ]
2017	[ ]	[ ]	[ ]	[ ]	[ ]
2018	[ ]	[ ]	[ ]	[ ]	[ ]

Note: Annual pay ranges are based upon original pay ranges, in 2002 dollars, escalated to 2007 dollars using the U.S. Bureau of Labor's consumer price index (CPI) on-line inflation calculator, resulting in an increase of 15.254% over that period or a simple annual average of 3.051%.

Information in "[ ]" is Proprietary Commercial Information withheld in accordance with 10 CFR 2.390

Table 4.10-3 Estimated Annual Tax Payments
(Page 1 of 1)

Year	Estimated Tax Payments[1]			
	Income Tax	Net Property Tax	Net Sales and Use Tax	Total
2011	0.0	0.0	0.0	0.0
2012	0.0	0.0	3.8	3.8
2013	0.0	0.0	6.4	6.4
2014	0.0	0.0	2.6	2.6
2015	0.0	3.4	2.6	6.0
2016	0.0	3.4	2.6	6.0
2017	0.0	3.4	0.0	3.4
2018	0.0	3.4	0.0	3.4
2019	0.0	3.4	0.0	3.4
2020	0.0	3.4	0.0	3.4
2021	0.0	3.4	0.0	3.4
2022	0.0	3.4	0.0	3.4
2023	0.0	3.4	0.0	3.4
2024	0.0	3.4	0.0	3.4
2025	0.0	3.4	0.0	3.4
2026	0.0	3.4	0.0	3.4
2027	0.0	3.4	0.0	3.4
2028	0.0	3.4	0.0	3.4
2029	0.0	3.4	0.0	3.4
2030	0.0	3.4	0.0	3.4
2031	0.0	3.4	0.0	3.4
2032	3.0	3.4	0.0	6.4
2033	9.0	3.4	0.0	12.4
2034	9.0	3.4	0.0	12.4
2035	9.0	3.4	0.0	12.4
2036	9.0	3.4	0.0	12.4
2037	9.0	3.4	0.0	12.4
2038	9.0	3.4	0.0	12.4
2039	9.0	3.4	0.0	12.4
2040	9.0	3.4	0.0	12.4
Totals	75.0	88.4	18.0	181.4

(1) In millions, constant 2007 dollars

4.11 ENVIRONMENTAL JUSTICE

This section examines whether there are minority or low-income populations residing within a 6.4-km (4-mi) radius of the proposed Eagle Rock Enrichment Facility (EREF) for which further consideration of environmental impacts is warranted in order to determine the potential for environmental justice concerns. The evaluation was performed using the 2000 population and economic data available from the U.S. Census Bureau for that area, and was done in accordance with the procedures contained in NUREG-1748 (NRC, 2003a). This guidance was endorsed by the NRC Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (FR, 2004). As discussed below, no minority or low-income populations were identified that would require further analysis of environmental justice concerns under the criteria established by the NRC.

4.11.1 Census Block Group Procedure and Evaluation Criteria

The nearest residence is approximately 7.7 km (4.8 mi) from the proposed site (see Section 3.1, Land Use). Because this is outside of the 6.4-km (4-mi) radius (130-km2 [50-mi2] area) required to be examined by the NRC (NRC, 2003a), no environmental justice disproportionate adverse impacts would occur to minority or low-income populations. However, the proposed site does extend across four census block groups and to show additional compliance with the NRC requirements, a census block group analysis was conducted to determine whether the remainder of those census block groups (i.e., the portions lying outside of the 6.4-km [4-mi] radius) had potential minority or low-income populations.

The determination of whether the potential for environmental justice concerns exist was made in accordance with the detailed procedures set forth in Appendix C to NUREG-1748 (NRC, 2003a). Census block group (CBG) data from the 2000 decennial census were obtained from the U. S. Census Bureau for the minority and low-income populations within the four potentially affected CBGs. For minority populations, data were obtained about the number and percentage of individuals within each CBG for specific minority population group (i.e., Black or African-American, American Indian and Alaskan Native, Asian, Native Hawaiian and other Pacific Islander, Hispanic or Latino, and other races) and for the aggregate minority populations. For low-income populations (defined in NUREG-1748 as those households falling below the U.S. Census Bureau-specified poverty level), the total number of individuals and the associated percentages living below the poverty level also were obtained. The low-income poverty data used in the evaluation was for 1999. More current information was not used to conduct this analysis because Appendix C of NUREG-1748 recommends using the U.S. Census Bureau's most recent decennial data, and also because the U.S. Census Bureau does not provide intercensal population estimates for geographic areas with populations of less than 85,000 people. In examining alternative areas for the proposed site, environmental justice was considered as part of the overall site selection process. However, the analysis process was not as detailed for the other sites as the process described in this section for the proposed site.

The above-described minority and low-income U.S. population percentage data were then compared to their counterparts for their respective county and state data. These comparisons were made pursuant to the "20%" and "50%" criteria contained in Appendix C to NUREG-1748 (NRC, 2003a), to determine: (1) if any CBG contained a minority population group, aggregate minority population, or low-income percentage that exceeded its county or state counterparts by more than 20 percentage points; and (2) if any CBG was comprised of more than 50% minority (either by individual group or in the aggregate) or low-income people.

Based on its comparison of the relevant CBG data to their county and state counterparts, as discussed below, it was determined that no further evaluation of potential environmental justice concerns was necessary, because no CBG within the 6.4-km (4-mi) radius of the proposed site contained a minority or low-income population exceeding the NUREG-1748 "20%" or "50%" criteria (NRC, 2003a).

4.11.2 Census Block Group Results

The 6.4-km (4-mi) radius around the proposed site includes parts of Bonneville, Bingham, and Jefferson Counties, Idaho (Figure 4.11-1, 6.4-km (4-mi) Radius and Census Block Groups). Within that area, there are three census tracts with a total of four census block groups:

- Bonneville County, Census Tract 9715, Census Block Groups 1 and 2;
- Bingham County, Census Tract 9503, Census Block Group 1; and
- Jefferson County, Census Tract 9601, Census Block Group 3.

The minority populations for each of the CBGs comprising the proposed site, as well as the total minority populations in the three corresponding counties and the state of Idaho, are enumerated in Table 4.11-1, Minority Populations, 2000.

Table 4.11-1 shows that the largest minority group in Idaho in 2000 was of Hispanic or Latino origin, accounting for 7.9% of the total population. This was also true for each county and all of the census block groups, ranging from 6.9% to 23.4%. The greatest Hispanic or Latino populations, within the 6.4-km (4-mi) radius of the proposed site, were found in Bonneville County, Census Tract 9715, CBG 1 – 23.4%; Jefferson County, Census Tract 9503, CBG 3 – 23.1%; and Bingham County, Census Tract 9503, CBG 1 – 18.2%. Similarly, the second largest minority group in all of these jurisdictions was classified as “other races,” comprising 4.2% of the State of Idaho population and 3.7% to 18.8% of the county or CBG populations. In addition, the aggregate percentage of minority populations in the State of Idaho in 2000 was 9.0%, with the counties and CBGs ranging from 7.2% to 21.5%. Thus, Table 4.11-1 demonstrates that no individual CBG covered by the proposed site was comprised of more than 50% of any individual or aggregate minority population. Moreover, none of these percentages exceeds the applicable state or county percentages for any individual or aggregate minority population by more than 20 percentage points.

Table 4.11-2, Poverty Status (Low-Income Population) and Income Levels, 1999, shows that 11.8% of individuals in the state of Idaho lived below the poverty level in 1999. In comparison, the percentage of individuals living below the poverty level ranged from 6.6% to 23.3% in the counties and CBGs. The greatest low-income populations, within the 6.4-km (4-mi) radius of the proposed site, were found in Jefferson County, Census Tract 9503, CBG 3 – 23.3%; Bonneville County, Census Tract 9715, CBG 1 – 15.8%; and Bingham County, Census Tract 9503, CBG 1 – 11.7%. Thus, Table 4.11-2 demonstrates that no individual CBG covered by the proposed site is comprised of more than 50% low-income minority populations. Moreover, none of these percentages exceeds the applicable state or county percentages for any low-income population by more than 20 percentage points.

In addition, AES has consulted by letter with the Shoshone-Bannock Tribe. A copy of the letter is included in ER Appendix A.

Agency representatives at the Bonneville County Social Services Department and the Bonneville County Health and Welfare Office were contacted and indicated that they did not collect data or other information about minority, low income, or other populations of concern.

They also indicated that if they did, this information would be kept confidential. Thus, information was not available about where such populations might reside, what their concerns might be, or how they might be affected by the EREF.

Based on this analysis of the above described data, performed in accordance with the criteria, guidelines, and procedures set forth in NUREG-1748, it is concluded that no minority or low income populations exist that would warrant further examination of environmental impacts upon such populations.

4.11.3 Comparative Environmental Justice Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action," i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The environmental justice impacts would be the same since it is assumed there are no disproportionate impacts associated with this alternative scenario.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The environmental justice impacts would be the same since it is assumed there are no disproportionate impacts associated with this alternative scenario.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The environmental justice impacts would be the same since it is assumed that there are no disproportionate impacts associated with this alternative scenario.

TABLES

Table 4.11-1 Minority Populations, 2000
(Page 1 of 1)

Year/Minority	Jurisdiction															
	Bonn. County		Bonn. - BG 1		Bonn. - BG 2		Bingham County		Bingham - BG 1		Jeff. County		Jeff. - BG 3		State of Idaho	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Total Population	82,522	100	790	100	987	100	41,735	100	1,438	100	19,155	100	957	100	1,293,953	100
Minority Population*	5,948	7.2	170	21.5	74	7.5	7,332	17.6	234	16.3	1,749	9.1	202	21.1	116,649	9.0
One Race:	81,316	98.5	779	98.6	977	99.0	40,840	97.9	1,414	98.3	18,901	98.7	942	98.4	1,268,344	98.0
White	76,574	92.8	620	78.5	913	92.5	34,403	82.4	1,204	83.7	17,406	90.9	755	78.9	1,177,304	91.0
Black or African American	403	0.5	7	0.9	1	0.1	70	0.2	3	0.2	53	0.3	0	0.0	5,456	0.4
American Indian & Alaska Native	535	0.6	8	1.0	3	0.3	2,798	6.7	28	1.9	89	0.5	2	0.2	17,645	1.4
Asian	675	0.8	9	1.1	9	0.9	236	0.6	2	0.1	44	0.2	5	0.5	11,889	0.9
Native Hawaiian and other Pacific Islander	56	0.1	0	0.0	1	0.1	13	0.0	0	0.0	15	0.1	0	0.0	1,308	0.1
Some other race	3,073	3.7	135	17.1	50	5.1	3,320	8.0	177	12.3	1,294	6.8	180	18.8	54,742	4.2
Two or more races:	1,206	1.5	11	1.4	10	1.0	895	2.1	24	1.7	254	1.3	15	1.6	25,609	2.0
Hispanic or Latino**	5,703	6.9	185	23.4	81	8.2	5,550	13.3	261	18.2	1,907	10.0	221	23.1	101,690	7.9

Notes: BG = block group
Bonn. = Bonneville County
Jeff. = Jefferson County
* Minority Population is the total of the population indicating that they are of one race or two or more races, excluding Hispanic or Latino ethnicity.
** Those reporting to be of Hispanic or Latino Ethnicity can also be of any reported single or multiple races. These numbers are reported separately from Race to avoid double-counting people.

Sources: USCB, 2000a; USCB, 2000b; USCB, 2000c; USCB, 2000n; USCB, 2000o; USCB, 2000p; USCB, 2000w

Table 4.11-2 Poverty Status (Low-Income Population) and Income Levels, 1999
(Page 1 of 1)

Poverty Status/Income Levels	Jurisdiction							
	Bonn. County	Bonn. - BG 1	Bonn. - BG 2	Bingham County	Bingham - BG 1	Jeff. County	Jeff. - BG 3	State of Idaho
Total Population	81,532	692	1,053	41,342	1,384	19,155	957	1,263,205
Number of Individuals Below the Poverty Level	8,260	109	69	5,137	162	1,984	223	148,732
Percent of Individuals Below the Poverty Level	10.1%	15.8%	6.6%	12.4%	11.7%	10.4%	23.3%	11.8%
Median Household Income	$41,805	$36,458	$49,792	$36,423	$36,131	$37,737	$30,417	$37,572
Per Capita Income	$18,326	$11,733	$21,715	$14,365	$14,909	$13,838	$10,279	$17,841

Notes: BG = block group
Bonn. = Bonneville County
Jeff. = Jefferson County
The Total Population numbers are based upon the USCB sample data set, and not the USCB total jurisdictional population levels from the 100% data set.

Sources: USCB, 2000q; USCB, 2000r; USCB, 2000s; USCB, 2000t; USCB, 2000u; USCB, 2000v; USCB, 2000w

FIGURES

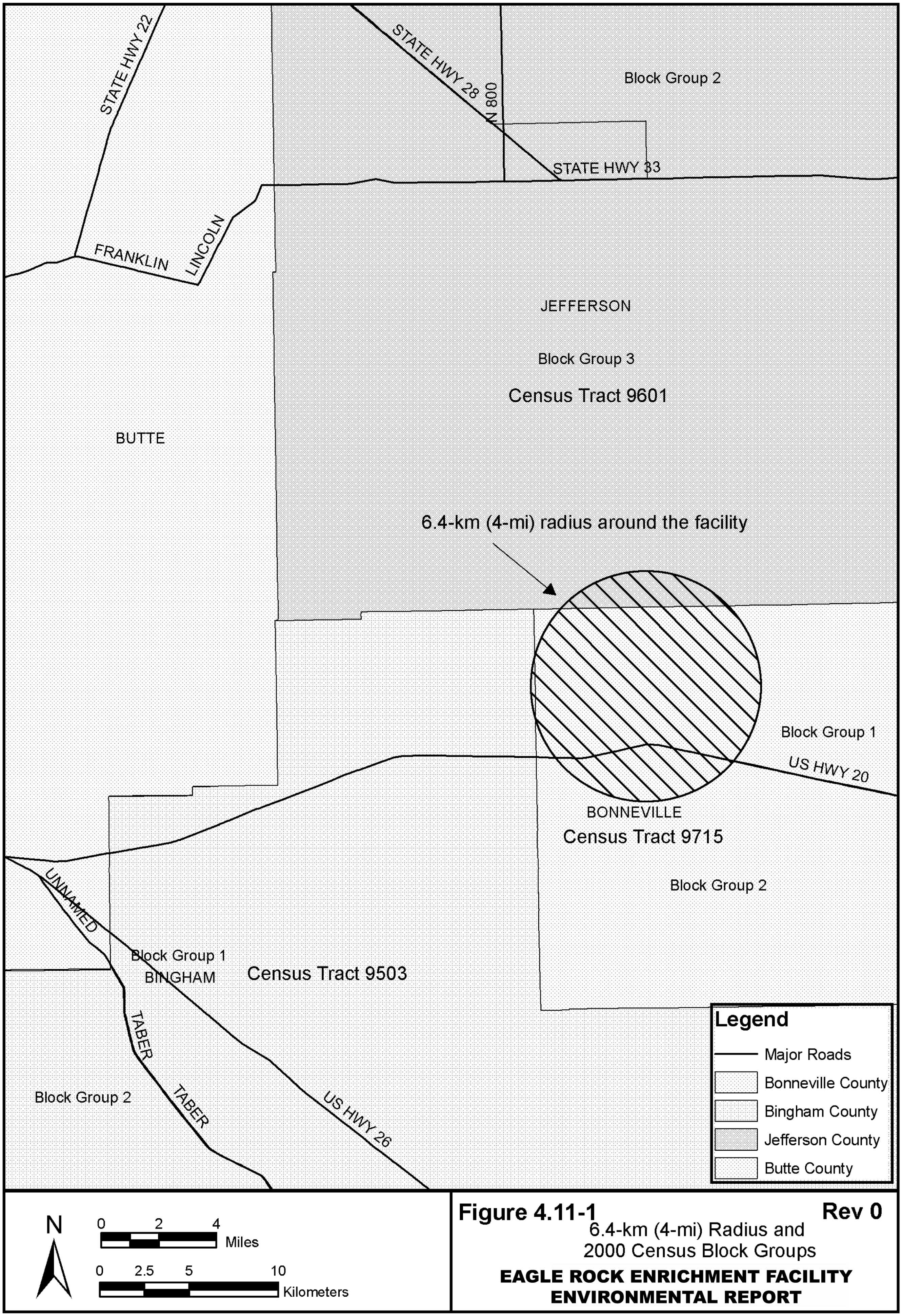


Figure 4.11-1 **Rev 0**

6.4-km (4-mi) Radius and 2000 Census Block Groups

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

4.12 PUBLIC AND OCCUPATIONAL HEALTH IMPACTS

4.12.1 Nonradiological Impacts

Sources of nonradiological exposure to the public and to facility workers are characterized below. Nonradiological effluents have been evaluated and do not exceed criteria in 40 CFR 50, 59, 60, 61, 122, 129, or 141 (CFR, 2008nn) (CFR, 2008rr) (CFR, 2008ss) (CFR, 2008tt) (CFR, 2008uu) (CFR, 2008vv) (CFR, 2008q). In addition, all regulated gaseous effluents will be below regulatory limits as specified by the Idaho Department of Environmental Quality (DEQ).

Radionuclides, hydrogen fluoride, and methylene chloride are governed as National Emission Standards Hazardous Air Pollutants (NESHAP) (CFR, 2008tt). Details of radiological gaseous effluent impacts and controls are described in Section 4.12.2, Radiological Impacts. A detailed list of the chemicals that will be used at the EREF, by building and exterior areas, is contained in Tables 2.1-2 through 2.1-6. ER Figure 2.1-4 indicates where these buildings and areas will be located on the EREF site.

4.12.1.1 Routine Gaseous Effluent

Routine gaseous effluents from the facility are listed in Table 3.12-3, Estimated Annual Gaseous Effluent. The primary material in use at the facility is uranium hexafluoride (UF_6). UF_6 is hygroscopic (moisture absorbing) and, in contact with water, will chemically break down into uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF). When released to the atmosphere, gaseous UF_6 combines with humidity to form a cloud of particulate UO_2F_2 and HF fumes. Inhalation of UF_6 typically results in internal exposure to UO_2F_2 and HF. In addition to a potential radiation dose, a worker would be subjected to two other primary toxic effects: (1) the uranium in the uranyl complex acts as a heavy metal poison that can affect the kidneys and (2) the HF can cause severe irritation to the skin and lungs at high concentrations.

Of primary importance to the EREF is the control of UF_6. The UF_6 readily reacts with air, moisture, and some other materials. The most significant reaction products in this plant will be HF, UO_2F_2, and small amounts of uranium tetrafluoride (UF_4). Of these, HF is the most significant hazard, being toxic to humans. Refer to ER Section 3.11.4, Public and Occupational Exposure Limits, for public and occupational exposure limits.

As described in ER Section 3.11.4 and shown in ER Table 3.11-7, Hydrogen Fluoride (HF) Regulations and Guidelines, there is a wide range of regulatory limits, which in turn depend on exposure (acute vs. chronic) and population (worker vs. public). The OSHA limit to worker exposure, for example, is 2.0 mg/m^3 for an 8-hr workday (OSHA, 2008). The state of California has adopted a chronic Reference Exposure Level (REL) of 14 µg/m3 (CAO, 2003). A chronic REL is a dose or concentration at or below which adverse health effects are not likely to occur. The California REL is by far the most stringent of any state or federal agency for HF, regardless of exposure or population.

By comparison, the annual expected average HF concentration emission from a 3 million SWU/yr centrifuge enrichment plant is calculated as 3.9 $\mu g/m^3$ at the point of discharge (rooftop) without atmospheric dispersion taken into consideration. Referring to Table 3.12-3, based on the estimated annual HF gaseous effluent of <1.0 kg (<2.2 lb), if standard dispersion modeling techniques are applied to estimate the exposure to the nearest public receptors under normal operating conditions from the EREF, the concentration is considerably lower. For instance, the concentration is calculated to be 1.4×10^{-4} $\mu g/m^3$ at the site boundary; 1.1×10^{-4} $\mu g/m^3$ at the nearest recreational area, a BLM hiking trail about 0.5 km (0.3 mi) south-southwest from the site boundary; and 1.6×10^{-5} $\mu g/m^3$ at the nearest business, located 4.7 km (2.9 mi) southwest. At 8 km (5 mi), the concentration is calculated to be 6.7×10^{-6} µg/m^3. The nearest resident to the site, or other sensitive receptor (e.g., schools and hospitals) is located beyond 8 km (5 mi) from the proposed EREF footprint.

These comparisons demonstrate that the Eagle Rock Enrichment Facility gaseous HF emissions (even at rooftop without dispersion considered) will be well below any existing standard and, as a result, will have a negligible environmental and public health impact.

Methylene chloride is used in small bench-top quantities to clean certain components. All chemicals at EREF will be used in accordance with the manufacturers recommendations, health and safety regulations and under formal procedures. AES will investigate the use of alternate solvents and/or apply control technologies as required. The remaining effluents listed in Table 3.12-4, Estimated Annual Liquid Effluent, will have no significant impact on the public because they will be used in deminimus levels or are nonhazardous by nature. All regulated gaseous effluents will be below regulatory limits as specified by the Idaho DEQ Air Quality Division.

Worker exposure to in-plant gaseous effluents listed in Table 3.12-3, Estimated Annual Gaseous Effluent, will be minimal. No exposures exceeding 29 CFR 1910, Subpart Z are anticipated (CFR, 2008n). Leaks in UF_6 components and piping would cause air to leak into the system and would not release effluent. All maintenance activities utilize mitigative features including local flexible exhaust hoses connected to the Gaseous Effluent Vent System, thereby minimizing any potential for occupational exposure. Laboratory and maintenance operations activities involving hazardous gaseous or respirable effluents will be conducted with ventilation control (i.e., fume hoods, local exhaust or similar) and/or with the use of respiratory protection as required.

4.12.1.2 Routine Liquid Effluent

Routine liquid effluents are listed in Table 3.12-4, Estimated Annual Liquid Effluent. The facility does not discharge any industrial effluents to natural surface waters or grounds on site, and there is no facility tie-in to a Publicly Owned Treatment Works (POTW). Liquid process effluents will be contained on the EREF site via collection tanks, sampled and analyzed to determine if treatment is required before release to the atmosphere by evaporation. See Section 2.1.2.3.3 for further discussion of the Liquid Effluent Collection and Treatment System.

There is no water intake from surface water systems in the region. Water supplies will be from on-site groundwater wells. Treated domestic sanitary effluents will flow to a lined retention basin to prevent infiltration, as will storm water from the Cylinder Storage Pads. No public acute or chronic (cumulative) impact is expected from routine liquid effluents.

Worker exposure to liquid in-plant effluents shown in Tables 3.12-2, Estimated Annual Non-Radiological Wastes and 3.12-4, Estimated Annual Liquid Effluent will be minimal. No exposures exceeding 29 CFR 1910, Subpart Z are anticipated (CFR, 2008n). Additionally, handling of all chemicals and wastes will be conducted in accordance with the site Environment, Health, and Safety Program which will conform to 29 CFR 1910 and specify the use of appropriate engineered controls, including personnel protective equipment, to minimize potential chemical exposures. As a result, no worker acute or chronic (cumulative) impact is expected from routine liquid effluents.

4.12.2 Radiological Impacts

Sources of radiation exposure incurred by the public generally fall into one of two major groupings, naturally-occurring radioactivity and man-made radioactivity. Naturally-occurring radioactivity includes primordial radionuclides (nuclides that existed or were created during the formation of the earth and have a sufficiently long half-life to be detected today) and their progeny nuclides, and nuclides that are continually produced by natural processes other than the decay of the primordial nuclides. These nuclides are ubiquitous in nature, and are responsible for a large fraction of radiation exposure referred to as background exposure. Uranium (U), the material used in the EREF operations, is included in this group. Man-made radioactivity, which includes radioactivity generated by human activities (e.g., fallout from weapons testing, medical treatments, and x-rays), also contributes to background radiation exposure. The combined relative concentrations of naturally-occurring radioactivity and man-made radioactivity in the environment vary extensively around the world, with variations seen between areas in close proximity. The concentration of radionuclides and radiation levels in an area are influenced by such factors as geology, precipitation, runoff, topsoil disturbances, solar activity, barometric pressure, and a host of other variables. The annual total effective dose equivalent from background radiation in the United States varies from 2.0 to 3.0 mSv (200 to 300 mrem) depending on the geographic region or locale and the prevalence of radon and its daughters.

Workers at the EREF are subject to higher potential exposures than members of the public because they are involved directly with handling uranium cylinders, processes for the enrichment of uranium, and decontamination and maintenance of equipment. During routine operations, workers at the plant may potentially be exposed to radiation from uranium via inhalation of airborne particles and direct exposure to equipment and components containing uranic materials. The radiation protection program at the EREF requires routine radiation surveys and air sampling to assure that worker exposures are maintained as low as reasonably achievable (ALARA). In addition, exposure-monitoring techniques at the plant include use of personal dosimeters by workers, personnel breathing zone air sampling, and annual whole-body counting.

In addition to the radiological hazards associated with uranium, workers may be potentially exposed to the chemical hazards associated with uranium. The material, UF_6, is hygroscopic (moisture absorbing) and, in contact with water, will chemically breakdown into UO_2F_2 and HF. When released to the atmosphere, gaseous UF_6 combines with humidity to form a cloud of particulate UO_2F_2 and HF fumes. The reaction is very fast and is dependent on the availability of water vapor. Consequently, an inhalation of UF_6 is typically an internal exposure to HF and UO_2F_2. In addition to the radiation dose, a worker would be subjected to two other primary toxic effects: (1) the uranium in the uranyl complex acts as a heavy metal poison that can affect the kidneys and (2) the HF can cause acid burns to the skin and lungs if concentrated. Because of low specific activity values, the radiotoxicity of UF_6 and its products is less than their chemical toxicity.

Both a radiation protection program and a health and safety program will protect workers at the EREF. The Radiation Protection Program will comply with all applicable NRC requirements established in 10 CFR 20 (CFR, 2008x), Subpart B. Similarly, the Health and Safety Program at the EREF will comply with all applicable OSHA requirements established in 29 CFR 1910 (CFR, 2008n).

The general public and the environment may be impacted by radiation and radioactive material from the EREF in two primary ways. Potential radiological impacts may occur from (1) gaseous and liquid effluent discharges associated with controlled releases from the uranium enrichment process lines during routine operations and from decontamination and maintenance of equipment, and (2) direct radiation exposure associated with transportation and storage of UF_6 feed cylinders, product cylinders, depleted uranium or tails cylinders and empty cylinders with heels or residual uranic materials and progeny decay products.

The potential radiological impacts to the public from operations at the EREF are those associated with chronic exposure to low levels of radiation, not the immediate health effects associated with acute radiation exposure. The major sources of potential radiation exposure are the effluent from the Separations Building Modules, Technical Support Building (TSB) and direct radiation from the combined Full Cylinder Storage Pad, Full Feed Cylinder Storage Pad, Empty Cylinder Storage Pad and, to a lesser degree, the Product Cylinder Storage Pad. The Centrifuge Assembly Building is a potential minor source of radiation exposure. It is anticipated that the total amount of uranium released to the environment via airborne effluent discharges from the EREF will be less than 10 grams (0.35 ounces) (0.253 MBq or 6.84 μCi) per year. Due to the anticipated low volume of contaminated liquid waste and the effectiveness of treatment processes, no waste in the form of liquid effluent discharges are expected. Water vapor from liquid processing that is released to the atmosphere is not expected to have a significant radiological impact to the public or the environment. In addition, the radiological impacts associated with direct radiation from indoor operations from a relatively small number of UF_6 cylinders at any time are not expected to be a significant contributor because the low-energy gamma-rays associated with the uranium will be absorbed almost completely by the process lines, equipment, and building structures at the EREF. However, the outdoor accumulation of full feed, full tails, full product and empty cylinders with heels on all the cylinder storage pads may present the highest potential for direct radiation impact to the public at or beyond the plant fence line. The combined potential radiological impacts associated with the small quantity of uranium in effluent discharges and direct radiation exposure due to stored feed, product, tails and empty UF_6 cylinders are expected to be a small fraction of the general public dose limits established in 10 CFR 20 (CFR, 2008x) and within the uranium fuel cycle standards established in 40 CFR (CFR, 2008f). The site area itself is very sparsely populated with no permanent residences within 5 miles of the center of the facility complex. Figures 4.12-1 and 4.12-2 show the site plan and facility layout for the EREF.

The principle isotopes of uranium, ^{238}U, ^{236}U, ^{235}U, and ^{234}U, are expected to be the primary nuclides of concern in effluent waste discharged from the plant. However, their concentrations in waste released to the atmosphere are expected to be very low because of engineered controls and treatment processes prior to discharge. In addition, a combination of the effluent monitoring and environmental monitoring/sampling programs will provide data to identify and assess plant's contribution to environmental uranium at the EREF site. Both monitoring programs have been designed to provide comprehensive data to demonstrate that plant operations have no adverse impact on the environment. Section 6.1, Radiological Monitoring, provides detailed descriptions of the two monitoring programs.

The enrichment process system operates sub-atmospherically such that any air leaks are into the equipment and not into the building environment. There are six Gaseous Effluent Ventilation Systems for the plant: (1) the Separations Building Modules (SBM) Safe-by-Design GEVS (one in each of the two modules), (2) the Separations Building Modules Local Extraction GEVS (one in each of the two modules), (3) the Technical Support Building (TSB) GEVS and (4) the Centrifuge Test and Post Mortem Facilities GEVS within the Centrifuge Assembly Building (CAB). In addition, the TSB, the Blending, Sampling & Preparation Building (BSPB), and the Centrifuge Test and Post Mortem Facilities have HVAC systems that function to maintain negative pressure and exhaust filtration for rooms served by these systems.

The SBM Safe-by-Design GEVS sub-atmospheric duct system transports potentially contaminated gases to a set of redundant filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and fans. The cleaned gases are discharged via SBM rooftop exhaust vents to the atmosphere. The SBM Local Extraction GEVS collects potentially contaminated gaseous effluent from local flexible hose connections that are used during cylinder connection and disconnection and maintenance activities. The cleaned gases are discharged via SBM rooftop exhaust vents to the atmosphere.

The TSB GEVS transports potentially contaminated gases to a set of redundant filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and fans. The Centrifuge Test and Post Mortem Facilities GEVS has one set of filters (pre-filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and a single fan. The TSB Contaminated Area HVAC system has two active sets of filters (roughing filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and fans. The Ventilated Room HVAC System in the BSPB and Centrifuge Test and Post Mortem Facilities Exhaust Filtration (HVAC) System each have one set of filters (roughing filter, high efficiency particulate air filter, potassium carbonate impregnated activated carbon filter, a final high efficiency particulate air filter) and one fan. The TSB GEVS and TSB Contaminated Area HVAC System discharge cleaned gases via exhaust vents on the roof of the TSB. The Ventilated Room HVAC System discharges cleaned gases via an exhaust vent on the roof of the BSPB. The Centrifuge Test and Post Mortem Facilities GEVS and Exhaust Filtration System discharge cleaned gases via exhaust vents on the roof of the CAB.

Discharges of gaseous effluent from all GEVS and negative pressure HVAC units result in effectively ground-level plumes because the release points are at roof top level or slightly above the SBMs, TSB, and CAB roofs(Figure 6.1-1, Effluent Release Points and Meteorological Tower, identifies the location of effluent release points from the facility complex to the environment). Consequently, airborne concentrations of uranium present in gaseous effluent continually decrease with distance from the release point. Therefore, the greatest off-site radiological impact is expected at or near the site boundary locations in each sector. Site boundary distances have been determined for each sector (refer to Section 4.6.2, Air Quality Impacts from Operation, for details). There are no residents within 8 km (5 miles). It is assumed that a residence is located at 8 km (5 mi) in the sector of most limiting atmospheric dispersion and deposition for purposes of dose analysis. Other important receptor locations, such as local businesses or temporarily occupied structures, such as potato cellars, have also been identified within an 8 km (5 mi) radius of the EREF site (refer to Section 3.1, Land Use). With respect to ingestion pathways, there are no residential gardens within 8 km (5 miles) radius. Commercial irrigated crop fields are situated in the site area as described in Section 3.1, Land Use. Cattle grazing across the open range has also been observed in the vicinity of the site (refer to Section 3.1). The radiological impacts on members of the public and the environment at these potential receptor locations are expected to be only small fractions of the radiological impacts that have been estimated for the site boundary locations because of the low initial concentrations in gaseous effluent and the high degree of dispersion that takes place as the gaseous effluent is transported.

The potential off-site radiological impacts to members of the general public from routine operations at the EREF were assessed through calculations designed to estimate the annual committed effective dose equivalent (CEDE) and annual committed dose equivalent to organs from effluent releases. The calculations also assessed impacts from direct radiation from stored uranium in feed, product, depleted uranium or tails cylinders, and empty cylinders containing heels. The term “dose equivalent” as described throughout this section refers to a 50-year committed dose equivalent. The addition of the effluent related doses and direct dose equivalent from fixed sources provides an estimate of the total effective dose equivalent (TEDE) associated with plant operations. The calculated annual dose equivalents were then compared to regulatory (NRC and EPA) radiation exposure standards as a way of illustrating the magnitude of potential impacts.

4.12.2.1 Pathway Assessment

4.12.2.1.1 Routine Gaseous Effluent

Most of the airborne uranium is removed through filtration prior to the discharge of gaseous effluent to the atmosphere. However, the release of uranium in extremely low concentrations is expected and raises the potential for radiological impacts to the general public and the environment. The total annual discharge of uranium in routine gaseous effluent from a similar designed 1.5 million SWU uranium enrichment facility (about half the size of the EREF) was estimated to be less than 30 g (1.1 oz) (NRC, 1994). The uranium source term applied in the assessment of radiological impacts for routine gaseous effluent from that plant was 4.4 MBq (120 μCi) per year. The NRC noted that actual uranium discharges in gaseous effluent for European facilities with similar design and throughput were significantly lower (i.e., < 1 MBq (28 μCi) per year) (NRC, 1994).

The EREF is modeled for dose purposes as a 3.3 million SWU facility. As mentioned previously, the annual discharge of uranium in routine gaseous effluent discharged from the EREF is expected to be less than 10 g (0.35 oz). This corresponds to less than 0.253 MBq (6.84 μCi) per year. This uranium release is based on the actual operating experience gained from European plants of similar design and capacity. As a conservative assumption for assessment of potential radiological impacts to the general public, the uranium source term used in the assessment of radiological impacts for routine gaseous effluent releases from the EREF was taken as 9.8 MBq (264 μCi) per year, which is equal to the source term applied to the 1.5 million SWU plant described in NUREG-1484 (NRC, 1994) times the ratio of the plant capacities between the two different sized enrichment facilities (i.e., 3.3 million SWU / 1.5 million SWU).

There are several exposure pathways to members of the public that can be associated with plant effluent, including: (1) direct radiation due to deposited radioactivity on the ground surface (ground plane exposure), (2) direct exposure from suspended material in a passing airborne cloud, (3) inhalation of airborne radioactivity from a passing effluent plume, and (4) ingestion of food products that was contaminated by plant effluent radioactivity. Of these exposure pathways, inhalation exposure is expected to be the predominant pathway at site boundary locations and also at off-site locations that are relatively close to the site boundary. The reason for this is that the discharge point for gaseous effluent from the plant, roof-top exhaust vents, result in ground level effluent plumes. For ground level plume, the airborne concentration(s) within the plume decreases with the distance from the discharge point. Consequently, for gaseous effluent from the EREF, the highest off-site airborne concentrations (and, hence, the greatest radiological impacts) are expected at locations close to the site boundary. Beyond these locations, the concentration of airborne radioactive material decreases continually as it is transported because of dispersion and depletion processes. For example, based on a comparison of the atmospheric dispersion factors for a ground level effluent release from the EREF calculated for the site boundary, at 1,980 m (6,496 ft), and for the 3.2 km (2.0 mi) distance in the west sector, the concentration at the 3.2 km (2.0 mi) distance is approximately 3.1 times lower than at the site boundary. Although radiological impacts via the ingestion exposure pathways come into play for distances beyond the site boundary, the concentrations of radioactive material will have been greatly reduced by the time effluent plumes reach those locations.

The radiological impacts from routine gaseous effluents were estimated for all exposure pathways including inhalation and immersion in the effluent plume, direct dose from ground plane deposition, and ingestion of food products (stored and fresh vegetables, milk and meat) assumed to be grown or raised at the nearest resident location. For both the inhalation and ingestion exposure pathways, the Exposure-to-Dose conversion factors (DCFs) were taken from Federal Guidance Report 11 (EPA, 1988) and were applied for both the committed organ dose equivalent and the committed effective dose equivalent. No assumptions were made concerning the chemical form of the uranic material deposited by the plume. As a consequence, the most conservative parameters applicable to inhalation and ingestion were assumed in the selection of dose factors from Federal Guidance Report 11 (EPA, 1988). The effective dose equivalent was calculated for the ingestion and inhalation pathways. In addition, the dose equivalent was calculated for seven organs (gonads, breast, lung, red bone marrow, bone surface, thyroid, and the remainder organs).

For direct dose from material deposited on the ground plane or from the passing cloud, the DCFs from Federal Guidance Report No.12 (EPA, 1993) have been applied. For ground plane exposures, it is assumed that the material deposited from the passing cloud remains on the ground surface as an infinite source plane (i.e., no mixing with soil). This provides the most conservative assumption for direct ground plane exposure. The dose from ground plane deposition was evaluated after 30 years (end of expected license period) to account for the maximum buildup of released activity, including the in-growth of radionuclide progeny from the primary uranium isotopes that make up the expected release from the plant. This provides the upper bound on any single year of projected plant impacts. For external exposures from plume immersion and ground plane exposure, the skin is added to those organs that were evaluated for internal exposures (inhalation and ingestion).

The dose factors in the Federal Guidance Report -11 (EPA, 1988) are derived for adults. In order to estimate the impact to other age groups, the doses calculated to adults were adjusted for difference in food consumption or inhalation rates as taken from NRC Regulatory Guide 1.109 (NRC, 1977b) and then multiplied by the relative age dependent dose factor for the effective dose equivalent as found for the different ages in the International Commission of Radiological Protection (ICRP) Report No.72 (ICRP, 1995). With respect to the DCF’s for adults, the relative ingestion dose commitment multiplier by age group for the four isotopes of uranium of concern averaged 1.0 (adults), 1.5 (teens), 1.8 (children), and 7.5 (infants). For the inhalation pathway, these relative dose commitment multipliers are 1.0 (adult), 1.2 (teens), 2.02 (children), and 4.25 (infants).

The ingestion pathway models for locally grown or raised food products were taken from NRC Regulatory Guide 1.109 (NRC, 1977b). The models project isotopic concentrations in vegetation, milk, and meat products based on the annual quantity of uranium material assumed to be released to the air and the atmospheric dispersion and deposition factors at key receptor locations of interest. These food product concentrations were then used to determine the ingestion committed effective dose equivalent and organ doses by multiplying the individual organ and effective dose conversion factors by the food product concentrations and the annual individual usage factors from the NRC Regulatory Guide 1.109 (NRC, 1977b).

The key receptor locations (critical populations) for determining dose impacts included the site boundary with the most restrictive atmospheric dispersion factors (depleted X/Q and deposition factor, D/Q) as well as boundary locations where direct doses from fixed sources are predicted to be the highest. Also included as key locations of interest are nearby private businesses or locations that have intermittent occupancy by members of the public, such as agricultural workers at potato cellars. A resident was also assumed to be present full time in the sectors with the most limiting dispersion factors at an 8 kilometer (5 mile) distance. A site area land use census indicated no residences within 8 kilometers (5 miles) of the center of the EREF facilities. Section 3.1.2, Local and Regional Setting, indicates that the closest residence as measured from the edge of the EREF facility footprint is approximately 7.7 km (4.8 mi) to the east.

The annual average atmospheric dispersion factors used in the radiological impacts assessment were calculated as described in Section 4.6, Air Quality Impacts and are provided in Table 4.6-12, Sector Average Concentration, Depleted, Decayed, χ/Q Values (sec/m^3) for Special Receptors are from Table 4.6-14, Sector Average D/Q Values (1/m^3) for Special Receptors . The meteorological data was taken from the Idaho National Engineering Laboratory (INEL) reservation which is adjacent to the EREF and includes meteorological data covering the years from 2003 through 2007.

Three groups of individuals (members of the public) or exposure scenarios were evaluated for both potential and real receptors located at or beyond the site boundary. For the first group, the dose impact to the nearest (and highest potentially impacted) residence (assumed at 8 km (5 mi) NE for deposition pathways and north for inhalation and cloud exposures) was evaluated for all exposure pathways (inhalation and plume immersion, direct dose from ground plane deposition, and ingestion of food products which include fresh and stored vegetables, milk and meat postulated to be grown or raised at this location). The analysis included dose equivalent assessments for all four age groups (adults, teens, children, and infants) for these pathways. The occupancy time was assumed to be continuous for a full year, along with a conservative residential shielding factor of 1.0 for direct radiation exposures. This location provides for an assessment of doses to real members of the public.

The second group of individuals (critical populations) are those associated with local businesses (temporary occupancy of potato cellars) situated near the plant site in the South (S) and Southwest (SW) sectors. For this group, the location of maximum potential impact was determined. The location, which bounds both of the identified potato cellars, is at 4.0 km (2.5 miles) in the SW sector. This is the location for the most limiting dispersion for a non-EREF worker (i.e., local business). At this distance, the direct dose contribution from fixed radiation sources, i.e., all outdoor UF_6 cylinder storage pads, is not a significant contributor to the total dose when compared to the gaseous effluent pathways. Since these are outdoor businesses, the annual occupancy is taken as 2,000 hours, along with a residential shielding factor of 1.0 (i.e., no shielding credit). In addition, only the inhalation and plume immersion pathways along with direct dose equivalent from ground plane deposition are applied (no food product consumption - gardens or animals - is associated with the performance of the business activity). The age group of interest, is taken as adults (>17 years) as the only significant age group assumed to spend substantial time at any work location.

The third group of postulated individuals (critical populations) is associated with transient populations who come right up to the site boundary, and are assumed to stay for the equivalent of a standard work year (2,000 hours). This high occupancy time maximizes the dose impacts for activity on land bordering the site boundary. This also provides an estimate for on-site dose equivalents (EREF occupational dose equivalents) for that portion of the EREF staff whose jobs take them into the general area of the plant property away from the buildings. As with the group of local area businesses noted above, the residential shielding factor is set at 1.0 (no shielding credit) since any activity is assumed to take place outdoors. In addition, only the gaseous release exposure pathways of inhalation and plume immersion along with direct dose equivalent from ground plane deposition are applied (no food product ingestion pathways are expected to exist along the site boundary line). The total impact for the site boundary also includes direct radiation from the Full Feed, Full Tails, Full Product, and Empty Cylinder Storage Pads on-site. The age group of interest is taken as adults as these locations are associated with worker related activities.

In addition to the above noted critical groups for members of the public, a bounding assessment was performed by assuming a hypothetical residence was located at the highest impacted site boundary (North (N) to Northeast (NE)). All the potential exposure pathways including direct radiation from cylinder storage pads, plume inhalation, and plume immersion, direct dose from ground plane deposition (30 year build-up of deposited material), and ingestion of food products (made up of fresh and stored vegetables, milk, and meat postulated to be grown or raised at the maximally impacted site boundary location) were assumed. The analysis included dose equivalent assessments for all four age groups (adults, teens, children, and infants) for these pathways, and 100% occupancy time for a full year, along with a conservative residential shielding factor of 1.0 for direct radiation exposures. The use of a hypothetical residence for all pathways and age groups places an upper bound on the dose impact that might be associated with changes in land use around the facility over its operating life.

Transit time for an accidental gaseous release (involving uranic or HF materials) ranges from a few minutes (to the boundary) to hours (to the nearest resident) for the critical populations discussed above. The nearest known location from which a member of the public can obtain drinking water is associated with irrigated crop lands that fall within an 8 km (5 mi) radius of the site, where transit times for gaseous releases are on the order of tens of minutes. Other than walking trails within 8 km (5 mi) of the site, there are no recreational facilities, schools or hospitals within 8 km (5 mi) of the EREF.

Projected annual average air concentrations of uranic material assumed to be released (9.8 MBq/yr (264 μCi/yr) are also estimated at critical receptor group locations. Table 4.12-26, Annual Average Effluent Air Concentrations at Critical Receptors, provides the calculated air concentrations at the maximum site boundary, nearest resident and off-site business location. Table 4.12-27, 30 Years Accumulation Soil Concentrations at Critical Receptors, provides estimates of surface soil concentrations at the same critical receptor group locations assuming 30 years of gaseous effluent accumulation.

4.12.2.1.2 Routine Liquid Effluent

The design of the EREF includes liquid waste processing to remove uranic material from the waste stream by precipitation, filtration and evaporation. Section 2.1.2, Proposed Action, provides an overview of the liquid effluent treatment system. From an effluent standpoint, an important design feature of the liquid effluent treatment system is that there is no direct discharge of liquid effluents off-site.

The Liquid Effluent Collection and Treatment System for the EREF includes two stages of precipitation and filtration to remove uranic material contained in liquid effluents collected from plant processes. The final process stage of evaporation releases the resulting distillate steam directly to the atmosphere without condensing vapor out of the air stream.

The liquid waste system collects liquid effluents including citric acid and degreasing water used in the decontamination of plant components, and miscellaneous effluents from laboratory operation, system condensates, and floor washings for treatment and removal of any uranic content before release to the environment. The first processing or treatment stage (KDU Recovery Stage) takes the collected waste liquids and adds a precipitating agent (KOH) to recover solids that can be removed in this form. The supernatant from this stage is passed through a micro filtration unit to clarify the liquid stream before passing it on to the second stage (Fluoride Recovery Stage) of precipitation. In this second stage, $Ca(OH)_2$ is added to form a fluoride precipitate. This waste stream is then passed through a filter to remove any solids remaining from the precipitation step. The remaining liquid stream is then collected and fed to a waste evaporator which releases the distillate steam to the atmosphere. As a result of these multiple stages of precipitation, filtration and evaporation, no significant amount of uranic material is expected to be released to the environment.

The Liquid Effluent Collection and Treatment System is designed for a uranium concentration of 0.5 mg/liter in the waste fed to the evaporator. From NUREG-0017 (PWR-GALE code) (NRC, 1985a), the decontamination factor (DF) between the feed liquid and the distillate for evaporators is assumed to be 1,000. This factor can be applied to the feed concentration in order to estimate the carryover to the distillate. It is also estimated that the processing of liquid effluent will generate 29,600 L/yr (7,825 gal/yr) of distillate released to the atmosphere from the evaporator. By multiplying the volume of distillate released by the estimated distillate concentration of uranic material, the annual release of uranium can be estimated. An additional margin of 20% is added to the resulting estimates to cover uncertainties in the estimates as the following shows.

<u>Atmospheric distillate release:</u>

0.50 mg/L x 10^{-3} (DF) = 5.0 x 10^{-4} mg/L in evaporator distillate.

Next:

29.62 m^3/yr distillate release x 10^3 L/m^3 x 5.0 x 10^{-4} mg/L = 14.8 mg/yr of uranic material released

Plus margin (20%):

14.8 mg/yr of uranic material released x 1.2 x 10^{-3} g/mg = 0.0178 g/yr total U

Assuming natural uranium, this mass is equivalent to 450 Bq (1.22 x 10^{-2} μCi).

This release via the distillate is only 0.0046% of the bounding source term of 9.8 MBq/yr (264 μCi/yr) assumed for plant gaseous effluent releases. Therefore, the source term for gaseous releases bounds the liquid pathway as well.

4.12.2.1.3 Direct Radiation Impacts

Storage of feed, product, and depleted and empty uranium cylinders at the EREF may have an impact due to direct and scatter (sky shine) radiation to the site boundary, and to lesser extents, off-site locations. The combined Full Feed, Full Tails, and Empty Cylinder Storage Pads is the most significant portion of the total direct dose equivalent.

The MCNP5 computer code (LANL, 2003) was used to calculate the direct dose equivalent from the full cylinder storage pads. A conservative maximum number of full tails cylinders accumulated after 30 years of operations (16,819 cylinders) at the EREF was used in this calculation. Also included in the analysis were full feed cylinders (356), empty feed cylinders (356), empty product cylinders (258), and empty cylinders waiting to be filled with tails (311). The empty feed cylinders were included because they contain radioactively decaying residual material. These empty cylinders produce a higher dose equivalent than full cylinders due to the absence of self-shielding from the UF_6 feed material. The empty cylinders waiting to be filled with tails were conservatively treated as empty feed cylinders with regards to the decaying residual materials. Direct dose from product cylinders stored on the Full Product Cylinder Storage Pad (516 cylinders) were also included in the analysis. Values used for full tails cylinders and empty tails cylinders waiting to be filled are greater than the calculated number of cylinders, therefore, the environmental impact due to direct radiation is conservative. The location of the cylinder storage pads are shown in Figures 4.12-1 and 4.12-2.

The photon source intensity and spectrum were calculated using the ORIGEN-2 computer code (NRC, 2000). The generation of photons in UF_6 from beta particles emitted by the decay of uranium (i.e., Bremsstrahlung) is conservatively treated as if the material was UO_2 by the ORIGEN-2 code based on density differences between UO_2 and UF_6.

In addition to the photon source term, there is a two-component neutron source term from the cylinders. The first component of the neutron source term is due to spontaneous fission by uranium. For this component a fission spectrum for ^{252}Cf, as taken from the Monte Carlo N-particle (MCNP) manual (LANL, 2000), is assumed. The second component is due to neutron emission by fluorine after alpha particle capture (“alpha-n reaction”). ORIGIN-S from the SCALE 5.1 package was used to determine the neutron spectrum from the alpha-n reaction. ORIGEN-S also provided the source intensity for both components of the neutron source term.

The regulatory dose equivalent limit to members of the public for areas beyond the EREF fence boundary is 0.25 mSv (25 mrem) per year (including direct and effluent contributions) (CFR, 2008x) (CFR, 2008f). The evaluation of the combined Full Feed, Full Tails, and Empty Cylinder Storage Pads and Product Cylinder Storage Pad contribution to the off-site dose equivalent was based upon a site design criterion of no more than 0.20 mSv (20 mrem) at the site boundary to account for uncertainties in the calculation and to provide conservatism. The annual off-site dose equivalent was calculated at the EREF site boundary assuming 2,000 hours per year occupancy. Implicit in the use of 2,000 hours is the assumption that the dose equivalent is calculated to a non-resident (i.e., a worker at an unrelated business or someone engaged in outdoor farming, ranching, or recreational activities). The annual dose equivalents for the actual nearest off-site work location and at the nearest real residence were also calculated.

The dose equivalent at the maximum impacted EREF site boundary (North) is 0.0171 mSv/yr (1.71 mrem/yr) assuming 2,000 hours per year occupancy. The dose equivalent at the nearest actual off-site work location, SW, 4.7 km (2.9 mi) is 4.0E-19 mSv/yr (4.0E-17 mrem/yr). The dose equivalent at the nearest real residence which lies beyond 8 km (5 mi) of the facility structures, is estimated to be less than 1E-19 mSv/yr (<1E-17 mrem/yr). In the latter case, full-time occupancy (i.e., 8,766 hours per year) is assumed. Figure 4.12-3, Combined Cylinder Storage Pad Dose Equivalent Isopleths (mSv/2,000 hrs), and Figure 4.12 4, Combined Cylinder Storage Pad Dose Equivalent Isopleths (mrem/2000 hrs, show the on-site dose equivalent contours for the summed contributions from the combined Full Feed, Full Tails and Empty Cylinder Storage Pads Cylinder Storage Pad and the Full Product Cylinder Storage Pad for 2,000 hours per year occupancy. Figure 4.12-5, Combined Cylinder Storage Pad Annual Dose Equivalent Isopleths (mSv/8,766 hrs), and Figure 4.12.2-6, Combined Cylinder Storage Pad Annual Dose Equivalent Isopleths (mrem/8,766 hrs), show the dose equivalent contours assuming full-time occupancy (8,766 hrs per yr). Table 4.12-1, Direct Radiation Annual Dose Equivalent by Source, summarizes the annual dose equivalents from fixed radiation sources at different locations of interest.

4.12.2.1.4 Population Dose Equivalents

The local area population distribution was derived based on the four most recent U.S. Census Bureau decennial census data (1970 – 2000) for the ten counties in Idaho (Bannock, Bingham, Blaine, Bonneville, Butte, Caribou, Clark, Fremont, Madison, and Power) that fall within (entirely or in part) the 80 km (50 mi) radius of the EREF site (USCB, 2008b; USCB, 2008d). Additional annual county population projections were obtained for 2001 to 2004 (USCB, 2008c). Quadratic or linear equations were fit to trend lines to calculate population projections for each county for the period 2010 through 2050 to estimate the population close to the end of plant operating life. The population distribution was projected within SECPOP 2000 population rosette and tables (NRC, 2003e) in 10 concentric bandsat 0 to 1.6km (0 to 1 mi), 1.6 to 3.2 km (1 to 2 mi), 3.2 to 4.8 km (2 to 3 mi), 4.8 to 6.4 km (3 to 4 mi), 6.4 to 8.0 km (4 to 5 mi), 8.0 to 16 km (5 to 10 mi), 16 to 32 km (10 to 20 mi), 32 to 48 km (20 to 30 mi), 48 to 64 km (30 to 40 mi), and 64 to 80 km (40 to 50 mi), and 16 directional sectors, each consisting of 22 ½ degrees, centered on the EREF site. The resident populations have been projected by calculating a decadal growth rate using county population projections. Decadal growth rate projections were entered into SECPOP 2000 (NRC, 2003e) population multiplier for the time period of interest. Table 4.12-2, Population Data for the Year 2050, provides the resulting 80 km (50 mi) population distribution for the year 2050. The age distribution (adults-71%, teens-11%, children-18%, infants-2%) from Regulatory Guide 1.109 (NRC 1977b) was applied to the total population for all exposure pathways including the determination of annual committed dose equivalent from ingestion and inhalation where age also affects the amount of annual intake (air and food).

The collective dose equivalent from gaseous effluents from all Separation Building GEVS, the TSB GEVS, TSB liquid waste evaporator distillate, and the Centrifuge Test and Post Mortem GEVS, and negative pressure HVAC units servicing those areas of the facilities which could contain contaminated exhaust room air, are calculated for the 80 km (50 mi) population based on all pathways calculated for the nearest resident, applied to the general population. For the ingestion of food products, it was assumed that the 80 km (50 mi) area produced sufficient volume to supply the entire population with their needs. This is supported by the regional food production (vegetables, milk and meat) data shown on Tables 4.12-3 thru 4.12-8 where the total area production exceeds the amount that the same region’s population could consume based on annual average usage factors for the general population (NRC, 1977b). Individual total effective dose equivalents were calculated for each age group by sector and then multiplied by the estimated age-dependent population for that sector to obtain the collective dose equivalent. The collective dose equivalents for each age group were then added to provide the total population collective dose equivalents. Table 4.12-9, Collective Population Effective Dose Equivalents to All Ages (Person-Sieverts), and Table 4.12-10, Collective Population Effective Dose Equivalents to All Ages (Person-Rem) summarize the total collective dose for the entire population within the 80 km (50 i) radius of the EREF site in units of Person-Sieverts and Person-rem, respectively. Table 4.12-11, Summary of 50 Mile Population for All Age Groups – All Airborne Pathways, provides a summary of the various organ dose equivalents to the same 80 km (50 mi) population from all airborne release pathways of exposure.

4.12.2.1.5 Mitigation Measures

Although routine operations at the EREF may create the potential for radiological and non-radiological impacts on the environment and members of the public, the plant design incorporates features to minimize gaseous and liquid effluent releases and to keep them well below regulatory limits. These features include:

- Process systems that handle UF_6 operate at sub-atmospheric pressure, which minimizes outward leakage of UF_6.
- UF_6 cylinders are moved only when cool and when UF_6 is in solid form, which minimizes the risk of inadvertent release due to mishandling.
- Process off-gas from UF_6 purification and other operations passes through desublimers to solidify and reclaim as much UF_6 as possible. Remaining gases pass through high-efficiency filters and chemical absorbers, which remove HF and uranium compounds.
- Wastes generated by decontamination of equipment and systems are subjected to processes that separate uranium compounds and various other heavy metals in the waste material.
- Liquid and solid waste handling systems and techniques are used to control wastes and effluent concentrations.
- Gaseous effluent passes through pre-filters, HEPA filters, and activated carbon filters, all of which greatly reduce the radioactive material in the final discharged effluent to very low concentrations.
- Liquid waste is routed to collection tanks, and treated through a combination of precipitation, filtration and evaporation to remove radioactive material prior to release of the distillate vapors to the atmosphere.
- Effluent paths are monitored and sampled to assure compliance with regulatory discharge limits.

During routine operations, the potential for radioactivity from the combined Full Feed, Full Tails, and Empty Cylinder Storage Pads, and the Full Product Cylinder Storage Pad impacting the public is low because all cylinders are surveyed for external contamination before they are placed on the storage pads. Therefore, runoff from the pads during rainfall is not expected to be a significant exposure pathway. Runoff water from all cylinder storage pads is directed to the Cylinder Storage Pads Stormwater Retention Basin for evaporation of the collected water. Periodic sampling of the soil from the basin is performed to identify the accumulation or buildup of residual uranic material due to surface contamination washed off by rainwater to the basin (see ER Section 6.1, Radiological Monitoring). No liquids from the retention basin are discharged directly off-site. In addition, direct radiation from the all cylinder storage pads is monitored on a quarterly basis using thermoluminescent dosimeters (TLDs) or by pressurized ion chamber measurements.

4.12.2.2 Public and Occupational Exposure Impacts

The assessment of the dose impacts resulting from the annual airborne liquid and gaseous effluents for the EREF site indicate that the principal radionuclides with respect to the dose equivalent contribution to individuals are ^{234}U and ^{238}U. Each of these nuclides contributes about the same level of committed dose. The critical organ for all receptor locations and age groups was found to be the lung as a result of the inhalation pathway. This committed dose equivalent to the lung dominated all other exposure pathways by an order of magnitude or more.

In addition to the 80 km (50 mi) cumulative population dose impacts, four critical individual groups were evaluated. These include (1) transient individuals engaged in non-EREF related activities which bring them close to the site boundary for a portion of the year, (2) the nearest real or existing residence to the EREF site, (3) local business operations which bring members of the public in the vicinity of the EREF site for a portion of the year, and (4) a hypothetical bounding individual assumed to be located as a residence at the most limiting site boundary. This individual is exposed to all potential pathways and has a 100% occupancy factor.

For the first critical group of transient individuals, the location of highest calculated off-site dose occurs at the NNE site boundary for the ground plane exposure pathway which is controlled by atmospheric deposition (D/Q). For the exposure pathways of cloud immersion and inhalation, the SW site boundary was limiting based on maximum sector annual average depleted χ/Q. No food product intake is included since transients would not be expected to be involved with the consumption of any such products raised next to the property boundary. The assumed combination of these limiting site boundary sectors lead to an annual effective dose equivalent of 7.7E-05 mSv (7.7E-03 mrem), with a maximum annual organ (lung) committed dose of 6.3E-04 mSv (6.3E-02 mrem). Table 4.12-17, Annual Dose Equivalents to Maximum Site Boundary, provides a summary of all organ and effective dose equivalents by exposure pathway at the limiting site boundary for individual members of the public engaged in such outdoor activities not associated with EREF operations. The dose estimates assume 2000 hours per year of occupancy time.

The second critical group of members of the public relates to the nearest resident. Based on a 2008 land use census of the site area, there are no residences located within 8 km (5 mi) in any direction. For purposes of analysis, a residence at 8 km (5 mi) was assumed in the most limiting sector with respect to atmospheric deposition (NE for D/Q) and dispersion (N for depleted χ/Q). The maximum annual effective dose equivalent (to the teenager) is 1.8E-05 mSv (1.8E-03 mrem), or approximately a factor of 4 lower than the site boundary transient critical group. The maximum annual organ (lung) at this nearest residence was estimated to be 1.3E-04 mSv (1.3E-02 mrem) to the teenager age group. Tables 4.12-12 through 4.12-15 provides a summary of all organ and effective dose equivalents by exposure pathway (cloud immersion, ground plane, inhalation, and ingestion of vegetables, milk, and meat) for airborne releases at the limiting existing residence for individual members (adults, teens, children, and infants) of the public.

The third critical group includes those individuals associated with nearby businesses. The business locations identified by land use census are potato cellars. A location which bounds the dose impact to the existing work locations is in the SW direction, approximately 4 km (2.5 mi) from the facility. The annual effective dose equivalent for this location from all airborne releases is 7.9E-05 mSv (7.9E-04 mrem). The maximum organ (lung) committed dose for a receptor at this location was estimated at 6.6E-05 mSv (6.6E-03 mrem) from one year's exposure (2000 hours occupancy) for the assumed pathways of cloud immersion, ground plane direct radiation and inhalation. No local produced food ingestion pathways are included for worker (adults) related activities. Table 4.12-16, Annual Dose Equivalents to Nearby Business (Adult), summarizes the airborne release dose impacts by organ and pathway to the nearest business.

The fourth category of members of the public assessed for potential exposures from routine operations is the postulated hypothetical residence situated at the site boundary where the maximum dose impact could occur. The exposure of this group of individuals would include all airborne exposure pathways (cloud immersion, ground plane direct, inhalation and ingestion of food products such as vegetables, milk (cow), and meat grown or raised at the boundary line). Full time occupancy is assumed and no residential shielding is applied. This category of individuals represents an upper bound for exposures that should not be exceeded over the operating life of EREF. The hypothetical residence is assumed to be at the NNE boundary line, 1.1 km (0.68 mi) where maximum ground deposition is key (ground plane exposure and food production). For the exposure pathways limited by air concentrations, i.e., inhalation and cloud exposure, the maximum annual average depleted χ/Q location of the SW boundary at 1.0 km (0.63 mi) is assumed. The maximum annual effective dose equivalent to the teenager is 4.5E-04 mSv (4.5E-02 mrem). The maximum annual organ dose (lung) at this hypothetical residence was estimated to be 3.3E-03 mSv (3.3E-01 mrem) to the teenager age group. Tables 4.12-18 through 4.12-21 provides a summary of all organ and effective dose equivalents by exposure pathway (cloud immersion, ground plane, inhalation and ingestion of vegetables, milk, and meat) for airborne releases at the bounding hypothetical residence for individual members (adults, teens, children and infants) of the public.

In summary, the combination of liquid and gaseous related annual effluent dose impacts are summarized in Table 4.12-22, Maximum Annual Liquid and Gas Radiological Impacts. As shown on Table 4.12-23, Annual Effective Total Dose Equivalent (All Sources), the dominant source of off-site radiation exposure is from direct (and scatter) radiation from the cylinder storage pads (fixed sources). Table 4.12-1, Maximum Annual Gaseous & Liquid Radiological Impacts, provides a listing of direct radiation exposures at key locations of critical receptor groups assuming all cylinder storage pads were at design capacity.

The maximum annual dose equivalent from fixed sources of radiation was found along the north site boundary with an estimated impact of 0.0171 mSv /yr (1.71 mrem/yr) for 2000 hours per year occupancy. Table 4.12-23, Annual Total Effective Dose Equivalent (All Sources), provides the combined impact from liquid, gases and fixed radiation sources. The annual total effective dose equivalent (TEDE) at the maximum exposure point (northern site boundary) is estimated to be 0.075 mSv (7.5 mrem) assuming full cylinder storage pads and full time occupancy for the hypothetical residence. The calculated dose equivalents are all below the 1 mSv (100 mrem/yr) TEDE requirement per 10 CFR 20.1301 (CFR, 2008x), and also within the 0.25 mSv (25 mrem/yr) dose equivalent to the whole body and any organ as indicated in 40 CFR 190 (CFR, 2008f). It is therefore concluded that the operation of the EREF will not exceed the dose equivalent criteria for members of the public as stipulated in Federal regulations.

Table 4.12-9, Collective Population Effective Dose Equivalents to All Ages Population (Person-Sieverts), and Table 4.12-10, Collective Population Effective Dose Equivalents to All Ages Population (Person-rem), provide the estimated collective effective dose equivalent to the 80 km (50 mi) population (all age and exposure pathways). Table 4.12-11, Summary of 50 Mile Population for All Age Groups – All Airborne Pathways, summarizes the population dose impacts by organ. The estimated effective dose equivalent for the total population is 7.4E-05 Person-Sv (7.4E-03 Person-rem). This is a small fraction of the collective dose from natural background for the same population.

In addition to members of the public along the site boundary and beyond, estimates of annual facility area radiation dose rates have been made along with projections of occupational (EREF worker) personnel exposures during normal operations. Table 4.12-24, Estimated EREF Occupational Dose Equivalent Rates, and Table 4.12-25, Estimated EREF Occupational (Individual) Exposures, summarize the annual dose equivalent rates and projected dose impacts for different areas of the plant, and for different employee work functions. Section 4.1 of the EREF Safety Analysis Report (SAR) provides a detailed description of the EREF radiation protection program for controlling and limiting occupational exposures for plant workers.

4.12.3 Environmental Effects of Accidents

4.12.3.1 Accident Scenarios

All credible accident sequences were considered during the Integrated Safety Analysis (ISA) performed for the facility. Accidents evaluated fell into two general types: criticality events and

UF_6 releases. Criticality events and some UF_6 release scenarios were shown to result in potential radiological and HF chemical exposures, respectively, to the public. Gaseous releases of UF_6 react quickly with moisture in the air to form HF and UO_2F_2. Consequence analyses showed that HF was the bounding consequence for all gaseous UF_6 releases to the environment. For some fire cases, uranic material in waste form or in chemical traps provided the bounding case. Accidents that produced unacceptable consequences to the public resulted in the identification of various design bases, design features and administrative controls.

During the ISA process, evaluation of most accident sequences resulted in identification of design bases and design features that prevent a criticality event or chemical release to the environment. Table 4.12-28, Accident Criteria Chemical Exposure Limits by Category, lists the accident criteria chemical exposure limits by category for intermediate consequence and high consequence categories. Examples of preventive controls for criticality events include limits on UF_6 quantities or equipment geometry for UF_6 vessels that eliminate the potential for a criticality event. Examples of preventive controls for UF_6 releases include highly reliable protection features to prevent overheating of UF_6 cylinders and explicit design basis such as that for seismic events.

These preventive controls reduce the likelihood of the accident (criticality events and HF release scenarios) such that the risk is reduced to acceptable levels as defined in 10 CFR 70.61 (CFR, 2008oo). All HF release scenarios with the exception of those caused by one fire case are controlled through design features or by administrative procedural control measures.

The seismic accident scenario considers an earthquake event of sufficient magnitude to fail the UF_6 process piping and some UF_6 components resulting in a large gaseous UF_6 release inside the buildings housing UF_6 process systems. The HVAC system then provides a pathway for the release to exit the building. Several accident sequences involving HF releases to the environment due to seismic events were prevented using design features to preclude the release of UF_6 from process piping and components. These preventive features reduce the dose equivalent consequences to the public for these accident sequences to below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2008oo).

The fire accident scenario considers a fire within the Technical Support Building (TSB) that causes the release of uranic material from open waste containers and chemical traps during waste drum filling operations in the Chemical Trap Workshop. The mitigation feature is the automatic shutoff of room HVAC system during a fire event to limit room release to the outside environment. With mitigation, the dose equivalent consequences to the public for this accident sequence has been reduced to below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2008oo).

Without prevention, the bounding seismic scenario results in a 30-minute radiological dose equivalent of 0.019 mSv (1.9 mrem) TEDE, a 30-minute uranium inhalation intake of 0.30 mg, a 24-hour airborne uranium concentration of 0.021 mg U/m^3, and a 30-minute HF chemical exposure to 3.22 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2008oo). With prevention, the bounding seismic scenario is completely prevented since the release is precluded by design features of the UF_6 process systems.

Without mitigation, the bounding fire scenario results in a 30-minute radiological dose equivalent of 0.015 mSv (1.5 mrem) TEDE, a 30-minute uranium inhalation intake of 0.25 mg, a 24-hour airborne uranium concentration of 0.0096 mg U/m^3, and a 30-minute HF chemical exposure to 1.33 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is an intermediate consequence as defined in10 CFR 70.61 (CFR, 2008oo).

With mitigation,the bounding fire scenario results in a 30-minute radiological dose equivalent of < 0.0092 mSv (< 0.92 mrem) TEDE, a 30-minute uranium inhalation intake of < 0.15 mg, a 24-hour airborne uranium concentration of < 0.0096 mg U/m^3, and a 30-minute HF chemical exposure to < 0.80 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is a below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2008oo).

4.12.3.2 Accident Mitigation Measures

Potential adverse impacts for accident conditions are described in ER Section 4.12.3.1 above. One accident sequence involving HF release to the environment due to a fire event was mitigated using design features to delay and reduce the UF_6 release inside the building from reaching the outside environment. This mitigative feature is the automatic shutoff of room HVAC system during a fire event. With mitigation, the dose equivalent consequences to the public for this accident sequence has been reduced to below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2008oo).

4.12.3.3 Non-Radiological Accidents

A review of non-radiological accident injury reports for the Capenhurst facility was conducted for the period 2003-2007 (Urenco, 2003; Urenco, 2004; Urenco, 2005; Urenco, 2006; Urenco, 2007). No injuries involving the public were reported. Injuries to workers occurred due to accidents in parking lots and offices as well as in the plant. The typical causes of injuries sustained at the Capenhurst facility are summarized in Table 4.12-29, Causes of Injuries at Capenhurst (2003-2007). Non-radiological accidents to equipment that did not result in injury to workers are not reported by Capenhurst.

4.12.4 Comparative Public and Occupational Exposure Impacts of No Action Alternative Scenarios

Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action" (i.e., not building the EREF). The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The public and occupational exposure impacts would be the same since three enrichment plants would be built and the SWU capacity would be about the same.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The public and occupational exposure impacts would be about the same since overall SWU capacity would be about the same.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The public and occupational exposure impacts would be about the same since overall SWU capacity would be about the same.

TABLES

Table 4.12-1 Direct Radiation Annual Dose Equivalent by Source
(Page 1 of 1)

Location	Annual Occupancy (hrs/yr)	Main+ & Product Cylinder Storage Pads mSv/yr	Main+ & Product Cylinder Storage Pads mrem/yr
Site Fence, North* 762 m (2500 ft)	2,000	1.71E-02	1.71E+00
Nearest Actual Business, SW 4.7 km (2.9mi)**	2,000	4.04E-19	4.04E-17
Nearest Actual Residence, >8 km (>5 mi)***	8,760	<1E-19	<1E-17

Notes:

+ Main Cylinder Storage Pad refers to the combined Full Tails, Full Feed, and Empty Cylinder Storage Pad located on the north side of the facility complex.

* Distance from the nearest edge of the Full Tails, Full Feed, and Empty Cylinder Storage Pad. .

** Nearest off-site location (potato cellar) from edge of facility footprint.

*** No resident within 5 miles (8 km) from edge of facility footprint.

Table 4.12-2 Population Data for the Year 2050
(Page 1 of 1)

Population (All Ages) Distribution within
80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	921	223	146	70	1,360
NNE	0	0	0	0	0	0	290	559	157	831	1,837
NE	0	0	0	0	0	3	193	8	1,365	4,882	6,451
ENE	0	0	0	0	0	3	1,561	9,655	29,946	4,229	45,394
E	0	0	0	0	0	17	1,004	13,654	3,436	37	18,148
ESE	0	0	0	0	0	14	12,744	68,188	421	0	81,367
SE	0	0	0	0	0	0	741	10,303	21	2	11,067
SSE	0	0	0	0	0	75	142	6,214	78	114	6,623
S	0	0	0	0	0	0	169	20,589	3,835	61,264	85,857
SSW	0	0	0	0	0	0	49	757	1,172	3,477	5,455
SW	0	0	0	0	0	0	49	55	5	38	147
WSW	0	0	0	0	0	0	0	33	9	6	48
W	0	0	0	0	0	0	0	0	10	2,142	2,152
WNW	0	0	0	0	0	0	0	56	220	562	838
NW	0	0	0	0	0	0	0	0	0	84	84
NNW	0	0	0	0	0	0	53	299	58	18	428
Ring Totals=	0	0	0	0	0	112	17,916	130,593	40,879	77,756	267,256
Cum. Totals =	0	0	0	0	0	112	18,028	148,621	189,500	267,256	

Table 4.12-3 Estimated Vegetable (Below Ground) Production (Kg/yr)
(Page 1 of 1)

Distribution within 80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	34,950,000	38,830,000	54,360,000	0	128,140,000
NNE	0	0	0	0	0	1,456,000	17,470,000	48,540,000	108,900,000	0	176,366,000
NE	105,500	0	0	0	0	10,190,000	29,120,000	0	87,150,000	56,010,000	182,575,500
ENE	105,500	189,800	0	369,100	1,898,000	15,820,000	63,270,000	207,500,000	290,500,000	298,800,000	878,452,400
E	126,500	126,500	0	0	1,139,000	15,820,000	63,270,000	84,360,000	58,100,000	112,100,000	335,042,000
ESE	105,500	0	0	590,500	1,898,000	15,820,000	44,290,000	187,100,000	149,700,000	0	399,504,000
SE	105,500	0	0	73,820	189,800	1,582,000	80,190,000	187,100,000	0	0	269,241,120
SSE	0	0	527,300	0	0	0	64,150,000	213,800,000	18,710,000	0	297,187,300
S	0	0	0	0	0	0	48,110,000	240,600,000	187,100,000	193,700,000	669,510,000
SSW	0	0	0	0	0	0	16,040,000	213,800,000	187,100,000	303,600,000	720,540,000
SW	0	0	0	295,300	949,100	0	16,040,000	26,730,000	0	25,300,000	69,314,400
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	5,249,000	5,249,000
WNW	0	0	0	0	0	0	0	1,944,000	2,722,000	3,499,000	8,165,000
NW	0	0	0	0	0	0	0	0	0	3,658,000	3,658,000
NNW	0	0	0	0	0	0	2,912,000	38,830,000	27,180,000	0	68,922,000
totals	548,500	316,300	527,300	1,328,720	6,073,900	60,688,000	479,812,000	1,489,134,000	1,171,522,000	1,001,916,000	4,211,866,720

Note: Annual growing period for food products estimated to be 6 months long.

Table 4.12-4 Estimated Vegetable (Below Ground) Production (lbs/yr)
(Page 1 of 1)

Distribution within 80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	77,050,000	85,610,000	119,900,000	0	282,560,000
NNE	0	0	0	0	0	3,210,000	38,520,000	107,000,000	240,100,000	0	388,830,000
NE	232,500	0	0	0	0	22,470,000	64,210,000	0	192,100,000	123,500,000	402,512,500
ENE	232,500	418,500	0	813,700	4,185,000	34,870,000	139,500,000	457,500,000	640,500,000	658,800,000	1,936,819,700
E	279,000	279,000	0	0	2,511,000	34,870,000	139,500,000	186,000,000	128,100,000	247,000,000	738,539,000
ESE	232,500	0	0	1,302,000	4,185,000	34,870,000	97,640,000	412,500,000	330,000,000	0	880,729,500
SE	232,500	0	0	162,700	418,500	3,487,000	176,800,000	412,500,000	0	0	593,600,700
SSE	0	0	1,162,000	0	0	0	141,400,000	471,400,000	41,250,000	0	655,212,000
S	0	0	0	0	0	0	106,100,000	530,300,000	412,500,000	427,100,000	1,476,000,000
SSW	0	0	0	0	0	0	35,360,000	471,400,000	412,500,000	669,300,000	1,588,560,000
SW	0	0	0	651,000	2,092,000	0	35,360,000	58,930,000	0	55,780,000	152,813,000
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	11,570,000	11,570,000
WNW	0	0	0	0	0	0	0	4,286,000	6,000,000	7,715,000	18,001,000
NW	0	0	0	0	0	0	0	0	0	8,064,000	8,064,000
NNW	0	0	0	0	0	0	6,421,000	85,610,000	59,930,000	0	151,961,000
totals	1,209,000	697,500	1,162,000	2,929,400	13,391,500	133,777,000	1,057,861,000	3,283,036,000	2,582,880,000	2,208,829,000	9,285,772,400

Note: Annual growing period for food products estimated to be 6 months long.

Table 4.12-5 Estimated Milk Production (Liters/yr)
(Page 1 of 1)

Distribution within 80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	4,970,000	5,522,000	7,731,000	0	18,223,000
NNE	0	0	0	0	0	207,100	2,485,000	6,903,000	9,664,000	0	19,259,100
NE	2,965	0	0	0	0	1,450,000	4,142,000	0	5,798,000	1,084,000	12,476,965
ENE	2,965	5,337	0	10,380	53,370	2,071,000	8,283,000	13,810,000	19,330,000	4,352,000	47,918,052
E	3,558	3,558	0	0	32,020	444,800	8,283,000	11,040,000	3,865,000	1,601,000	25,272,936
ESE	2,965	0	0	16,610	53,370	444,800	1,245,000	15,240,000	12,190,000	0	29,192,745
SE	2,965	0	0	2,076	5,337	44,480	6,532,000	15,240,000	0	0	21,826,858
SSE	0	0	14,830	0	0	0	5,226,000	17,420,000	1,524,000	0	24,184,830
S	0	0	0	0	0	0	3,919,000	19,600,000	15,300,000	4,678,000	43,497,000
SSW	0	0	0	0	0	0	1,306,000	17,420,000	15,240,000	23,610,000	57,576,000
SW	0	0	0	8,303	26,690	0	1,306,000	2,177,000	0	1,960,000	5,477,993
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	3,843,000	3,843,000
WNW	0	0	0	0	0	0	0	1,423,000	1,992,000	2,562,000	5,977,000
NW	0	0	0	0	0	0	0	0	0	1,281,000	1,281,000
NNW	0	0	0	0	0	0	414,200	5,526,000	3,868,000	0	9,808,200
totals	15,418	8,895	14,830	37,369	170,787	4,662,180	48,111,200	131,321,000	96,502,000	44,971,000	325,814,679

Table 4.12-6 Estimated Milk Production (gallons/yr)
(Page 1 or 1)

Distribution within 80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	1,313,000	1,459,000	2,042,000	0	4,814,000
NNE	0	0	0	0	0	54,700	656,500	1,823,000	2,553,000	0	5,087,200
NE	783	0	0	0	0	382,900	1,094,000	0	1,532,000	286,400	3,296,083
ENE	783	1,410	0	2,742	14,100	547,000	2,188,000	3,647,000	5,106,000	1,150,000	12,657,035
E	940	940	0	0	8,460	117,500	2,188,000	2,918,000	1,021,000	423,000	6,677,840
ESE	783	0	0	4,387	14,100	117,500	329,000	4,026,000	3,221,000	0	7,712,770
SE	783	0	0	548	1,410	11,750	1,726,000	4,026,000	0	0	5,766, 491
SSE	0	0	3,917	0	0	0	1,380,000	4,602,000	402,600	0	6,388,517
S	0	0	0	0	0	0	1,035,000	5,177,000	4,042,000	1,236,000	11,490,000
SSW	0	0	0	0	0	0	345,100	4,602,000	4,026,000	6,236,000	15,209,100
SW	0	0	0	2,193	7,050	0	345,100	575,200	0	517,700	1,447,243
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	1,015,000	1,015,000
WNW	0	0	0	0	0	0	0	376,000	526,300	676,700	1,579,000
NW	0	0	0	0	0	0	0	0	0	338,400	338,400
NNW	0	0	0	0	0	0	109,400	1,460,000	1,022,000	0	2,591,400
totals	4,072	2,350	3,917	9,870	45,120	1,231,350	12,709,100	34,691,200	25,493,900	11,879,200	86,070,079

Table 4.12-7 Estimated Meat Production (Kg/yr)
(Page 1 of 1)

Distribution within 80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	1,449,000	1,610,000	2,254,000	0	5,313,000
NNE	0	0	0	0	0	60,370	724,500	2,012,000	2,829,000	0	5,625,870
NE	2,001	0	0	0	0	422,600	1,207,000	0	1,697,000	248,000	3,576,601
ENE	2,001	3,601	0	7,002	36,010	605,100	2,420,000	4,025,000	5,635,000	1,062,000	13,795,714
E	2,401	2,401	0	0	21,610	300,100	2,420,000	3,227,000	1,130,000	1,080,000	8,183,512
ESE	2,001	0	0	11,200	36,010	300,100	840,300	2,506,000	2,005,000	0	5,700,611
SE	2,001	0	0	1,400	3,601	30,010	1,074,000	2,506,000	0	0	3,617,012
SSE	0	0	10,000	0	0	0	859,100	2,864,000	250,600	0	3,983,700
S	0	0	0	0	0	0	644,300	3,222,000	2,506,000	1,055,000	7,427,300
SSW	0	0	0	0	0	0	214,800	2,864,000	2,506,000	3,866,000	9,450,800
SW	0	0	0	5,602	18,010	0	214,800	358,000	0	381,200	977,612
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	2,120,000	2,120,000
WNW	0	0	0	0	0	0	0	785,100	1,099,000	1,413,000	3,297,100
NW	0	0	0	0	0	0	0	0	0	706,600	706,600
NNW	0	0	0	0	0	0	120,700	1,612,000	1,128,000	0	2,860,700
totals	10,405	6,002	10,000	25,204	115,241	1,718,280	12,188,500	27,591,100	23,039,600	11,931,800	76,636,132

Table 4.12-8 Estimated Meat Production (lbs/yr)
(Page 1 of 1)

Distribution within 80 km (50 mi)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	3,194,000	3,549,000	4,969,000	0	11,712,000
NNE	0	0	0	0	0	133,100	1,597,000	4,437,000	6,237,000	0	12,404,100
NE	4,411	0	0	0	0	931,700	2,662,000	0	3,742,000	546,700	7,886,811
ENE	4,411	7,939	0	15,440	79,390	1,334,000	5,336,000	8,874,000	12,420,000	2,341,000	30,412,180
E	5,293	5,293	0	0	47,640	661,600	5,336,000	7,115,000	2,490,000	2,382,000	18,042,826
ESE	4,411	0	0	24,700	79,390	661,600	1,853,000	5,524,000	4,419,000	0	12,566,101
SE	4,411	0	0	3,088	7,939	66,160	2,367,000	5,524,000	0	0	7,972,598
SSE	0	0	22,050	0	0	0	1,894,000	6,313,000	552,400	0	8,781,450
S	0	0	0	0	0	0	1,420,000	7,102,000	5,524,000	2,326,000	16,372,000
SSW	0	0	0	0	0	0	473,500	6,313,000	5,524,000	8,523,000	20,833,500
SW	0	0	0	12,350	39,700	0	473,500	789,200	0	840,400	2,155,150
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	4,673,000	4,673,000
WNW	0	0	0	0	0	0	0	1,731,000	2,423,000	3,115,000	7,269,000
NW	0	0	0	0	0	0	0	0	0	1,558,000	1,558,000
NNW	0	0	0	0	0	0	266,200	3,553,000	2,487,000	0	6,306,200
totals	22,937	13,232	22,050	55,578	254,059	3,788,160	26,872,200	60,824,200	50,787,400	26,305,100	168,944,916

Table 4.12-9 Collective Population Effective Dose Equivalents to All Ages (Person-Sieverts) (Page 1 of 1)

(Liquid And Gas Release Pathways)

Annual Population Dose Equivalent (All Ages - All Pathways) Within 80 km (50 mi) (Person-Sievert)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	2.39E-06	2.67E-07	1.04E-07	3.38E-08	2.80E-06
NNE	0	0	0	0	0	0	6.57E-07	5.81E-07	9.69E-08	3.46E-07	1.68E-06
NE	0	0	0	0	0	1.39E-08	3.07E-07	5.78E-09	5.83E-07	1.40E-06	2.31E-06
ENE	0	0	0	0	0	7.43E-09	1.32E-06	3.70E-06	6.82E-06	6.52E-07	1.25E-05
E	0	0	0	0	0	2.23E-08	4.54E-07	2.84E-06	4.30E-07	3.19E-09	3.75E-06
ESE	0	0	0	0	0	1.82E-08	5.71E-06	1.40E-05	5.20E-08	0	1.98E-05
SE	0	0	0	0	0	0	3.63E-07	2.31E-06	2.82E-09	1.85E-10	2.67E-06
SSE	0	0	0	0	0	1.55E-07	1.01E-07	2.01E-06	1.50E-08	1.49E-08	2.29E-06
S	0	0	0	0	0	0	1.73E-07	9.60E-06	1.06E-06	1.14E-05	2.23E-05
SSW	0	0	0	0	0	0	7.98E-08	5.59E-07	5.10E-07	1.02E-06	2.16E-06
SW	0	0	0	0	0	0	1.14E-07	5.86E-08	3.16E-09	1.62E-08	1.92E-07
WSW	0	0	0	0	0	0	0	3.96E-08	6.47E-09	2.92E-09	4.90E-08
W	0	0	0	0	0	0	0	0	4.74E-09	6.90E-07	6.95E-07
WNW	0	0	0	0	0	0	0	2.28E-08	5.38E-08	9.39E-08	1.71E-07
NW	0	0	0	0	0	0	0	0	0	1.42E-08	1.42E-08
NNW	0	0	0	0	0	0	1.16E-07	3.04E-07	3.53E-08	7.43E-09	4.62E-07
Ring Totals=	0	0	0	0	0	2.17E-07	1.18E-05	3.63E-05	9.77E-06	1.57E-05	7.38E-05
Cum. Totals =	0	0	0	0	0	2.17E-07	1.20E-05	4.83E-05	5.81E-05	7.38E-05	

Table 4.12-10 Collective Population Effective Dose Equivalents to All Ages (Person-Rem) (Page 1 of 1)

(Liquid And Gas Release Pathways)

Annual Population Dose Equivalent (All Ages - All Pathways) Within 80 km (50 mi) (Person-Rem)

Sector	0-1.6 km (0-1 mi)	1.6-3.2 km (1-2 mi)	3.2-4.8 km (2-3 mi)	4.8-6.4 km (3-4 mi)	6.4-8.0 km (4-5 mi)	8.0-16 km (5-10 mi)	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Totals
N	0	0	0	0	0	0	2.39E-04	2.67E-05	1.04E-05	3.38E-06	2.80E-04
NNE	0	0	0	0	0	0	6.57E-05	5.81E-05	9.69E-06	3.46E-05	1.68E-04
NE	0	0	0	0	0	1.39E-06	3.07E-05	5.78E-07	5.83E-05	1.40E-04	2.31E-04
ENE	0	0	0	0	0	7.43E-07	1.32E-04	3.70E-04	6.82E-04	6.52E-05	1.25E-03
E	0	0	0	0	0	2.23E-06	4.54E-05	2.84E-04	4.30E-05	3.19E-07	3.75E-04
ESE	0	0	0	0	0	1.82E-06	5.71E-04	1.40E-03	5.20E-06	0	1.98E-03
SE	0	0	0	0	0	0	3.63E-05	2.31E-04	2.82E-07	1.85E-08	2.67E-04
SSE	0	0	0	0	0	1.55E-05	1.01E-05	2.01E-04	1.50E-06	1.49E-06	2.29E-04
S	0	0	0	0	0	0	1.73E-05	9.60E-04	1.06E-04	1.14E-03	2.23E-03
SSW	0	0	0	0	0	0	7.98E-06	5.59E-05	5.10E-05	1.02E-04	2.16E-04
SW	0	0	0	0	0	0	1.14E-05	5.86E-06	3.16E-07	1.62E-06	1.92E-05
WSW	0	0	0	0	0	0	0	3.96E-06	6.47E-07	2.92E-07	4.90E-06
W	0	0	0	0	0	0	0	0.00E+00	4.74E-07	6.90E-05	6.95E-05
WNW	0	0	0	0	0	0	0	2.28E-06	5.38E-06	9.39E-06	1.71E-05
NW	0	0	0	0	0	0	0	0	0	1.42E-06	1.42E-06
NNW	0	0	0	0	0	0	1.16E-05	3.04E-05	3.53E-06	7.43E-07	4.62E-05
			0	0							
Ring Totals=	0	0	0	0	0	2.17E-05	1.18E-03	3.63E-03	9.77E-04	1.57E-03	7.38E-03
Cum. Totals =	0	0	0	0	0	2.17E-05	1.20E-03	4.83E-03	5.81E-03	7.38E-03	

Table 4.12-11 Summary of 50 Mile Population for All Age Groups –All Airborne Pathways (Page 1 of 1)

Skin Person-Sv (Person-Rem)	Gonads Person-Sv (Person-Rem)	Breast Person-Sv (Person-Rem)	Lung Person-Sv (Person-Rem)	Red Bone Marrow Person-Sv (Person-Rem)	Bone Surface Person-Sv (Person-Rem)	Thyroid Person-Sv (Person-Rem)	Effective Dose Equivalent Person-Sv (Person-Rem)
8.21E-05	4.37E-07	4.40E-07	5.88E-04	3.28E-06	4.67E-05	3.84E-07	7.38E-05
8.21E-03	4.37E-05	4.40E-05	5.88E-02	3.28E-04	4.67E-03	3.84E-05	7.38E-03

Table 4.12-12 Annual Dose Equivalents to Nearest Resident (Adult)
(Page 1 of 1)

(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition; Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	3.51E-13	2.53E-13	2.97E-13	2.37E-13	2.16E-13	6.57E-13	2.50E-13	2.56E-13
	(mrem)	3.51E-11	2.53E-11	2.97E-11	2.37E-11	2.16E-11	6.57E-11	2.50E-11	2.56E-11
Grd. Plane direct	(mSv)	2.39E-05	9.63E-08	9.73E-08	7.81E-08	7.68E-08	1.87E-07	8.12E-08	8.89E-08
	(mrem)	2.39E-03	9.63E-06	9.73E-06	7.81E-06	7.68E-06	1.87E-05	8.12E-06	8.89E-06
Inhalation	(mSv)	0	9.90E-10	1.11E-09	1.10E-04	2.75E-08	4.17E-07	1.06E-09	1.32E-05
	(mrem)	0	9.90E-08	1.11E-07	1.10E-02	2.75E-06	4.17E-05	1.06E-07	1.32E-03
Ingestion -Vegetables	(mSv)	0	2.99E-08	2.98E-08	2.97E-08	8.53E-07	1.30E-05	2.97E-08	8.84E-07
	(mrem)	0	2.99E-06	2.98E-06	2.97E-06	8.53E-05	1.30E-03	2.97E-06	8.84E-05
- Leafy Vegetables	(mSv)	0	4.84E-09	4.82E-09	4.81E-09	1.38E-07	2.11E-06	4.81E-09	1.43E-07
	(mrem)	0	4.84E-07	4.82E-07	4.81E-07	1.38E-05	2.11E-04	4.81E-07	1.43E-05
- Milk	(mSv)	0	9.56E-10	9.53E-10	9.51E-10	2.73E-08	4.17E-07	9.50E-10	2.83E-08
	(mrem)	0	9.56E-08	9.53E-08	9.51E-08	2.73E-06	4.17E-05	9.50E-08	2.83E-06
- Meat	(mSv)	0	2.31E-10	2.30E-10	2.29E-10	6.58E-09	1.01E-07	2.29E-10	6.83E-09
	(mrem)	0	2.31E-08	2.30E-08	2.29E-08	6.58E-07	1.01E-05	2.29E-08	6.83E-07
Sum Total	(mSv)	2.39E-05	1.33E-07	1.34E-07	1.10E-04	1.13E-06	1.62E-05	1.18E-07	1.44E-05
	(mrem)	2.39E-03	1.33E-05	1.34E-05	1.10E-02	1.13E-04	1.62E-03	1.18E-05	1.44E-03

Table 4.12-13 Annual Dose Equivalents to Nearest Resident (Teen)
(Page 1 of 1)

(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition; Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	3.51E-13	2.53E-13	2.97E-13	2.37E-13	2.16E-13	6.57E-13	2.50E-12	2.56E-13
	(mrem)	3.51E-11	2.53E-11	2.97E-11	2.37E-11	2.16E-11	6.57E-11	2.50E-10	2.56E-11
Grd. Plane direct	(mSv)	2.39E-05	9.63E-08	9.73E-08	7.81E-08	7.68E-08	1.87E-07	8.12E-08	8.89E-08
	(mrem)	2.39E-03	9.63E-06	9.73E-06	7.81E-06	7.68E-06	1.87E-05	8.12E-06	8.89E-06
Inhalation	(mSv)	0	1.18E-09	1.32E-09	1.31E-04	3.28E-08	4.97E-07	1.26E-09	1.57E-05
	(mrem)	0	1.18E-07	1.32E-07	1.31E-02	3.28E-06	4.97E-05	1.26E-07	1.57E-03
Ingestion -Vegetables	(mSv)	0	5.45E-08	5.42E-08	5.42E-08	1.55E-06	2.37E-05	5.42E-08	1.61E-06
	(mrem)	0	5.45E-06	5.42E-06	5.42E-06	1.55E-04	2.37E-03	5.42E-06	1.61E-04
- Leafy Vegetables	(mSv)	0	4.78E-09	4.75E-09	4.75E-09	1.36E-07	2.08E-06	4.75E-09	1.41E-07
	(mrem)	0	4.78E-07	4.75E-07	4.75E-07	1.36E-05	2.08E-04	4.75E-07	1.41E-05
- Milk	(mSv)	0	1.86E-09	1.85E-09	1.85E-09	5.29E-08	8.08E-07	1.85E-09	5.49E-08
	(mrem)	0	1.86E-07	1.85E-07	1.85E-07	5.29E-06	8.08E-05	1.85E-07	5.49E-06
- Meat	(mSv)	0	2.05E-10	2.04E-10	2.04E-10	5.85E-09	8.93E-08	2.04E-10	6.07E-09
	(mrem)	0	2.05E-08	2.04E-08	2.04E-08	5.85E-07	8.93E-06	2.04E-08	6.07E-07
Sum Total	(mSv)	2.39E-05	1.59E-07	1.60E-07	1.31E-04	1.85E-06	2.74E-05	1.43E-07	1.76E-05
	(mrem)	2.39E-03	1.59E-05	1.60E-05	1.31E-02	1.85E-04	2.74E-03	1.43E-05	1.76E-03

Table 4.12-14 Annual Dose Equivalents to Nearest Resident (Child)
(Page 1 of 1)

(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition; Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	3.51E-13	2.53E-13	2.97E-13	2.37E-13	2.16E-13	6.57E-13	2.50E-13	2.56E-13
	(mrem)	3.51E-11	2.53E-11	2.97E-11	2.37E-11	2.16E-11	6.57E-11	2.50E-11	2.56E-11
Grd. Plane direct	(mSv)	2.39E-05	9.63E-08	9.73E-08	7.81E-08	7.68E-08	1.87E-07	8.12E-08	8.89E-08
	(mrem)	2.39E-03	9.63E-06	9.73E-06	7.81E-06	7.68E-06	1.87E-05	8.12E-06	8.89E-06
Inhalation	(mSv)	0	9.30E-10	1.05E-09	1.03E-04	2.58E-08	3.92E-07	9.97E-10	1.24E-05
	(mrem)	0	9.30E-08	1.05E-07	1.03E-02	2.58E-06	3.92E-05	9.97E-08	1.24E-03
Ingestion -Vegetables	(mSv)	0	5.36E-08	5.33E-08	5.31E-08	1.52E-06	2.33E-05	5.31E-08	1.58E-06
	(mrem)	0	5.36E-06	5.33E-06	5.31E-06	1.52E-04	2.33E-03	5.31E-06	1.58E-04
- Leafy Vegetables	(mSv)	0	3.52E-09	3.51E-09	3.50E-09	1.00E-07	1.53E-06	3.50E-09	1.04E-07
	(mrem)	0	3.52E-07	3.51E-07	3.50E-07	1.00E-05	1.53E-04	3.50E-07	1.04E-05
- Milk	(mSv)	0	1.82E-09	1.82E-09	1.81E-09	5.20E-08	7.94E-07	1.81E-09	5.39E-08
	(mrem)	0	1.82E-07	1.82E-07	1.81E-07	5.20E-06	7.94E-05	1.81E-07	5.39E-06
- Meat	(mSv)	0	1.54E-10	1.53E-10	1.53E-10	4.39E-09	6.71E-08	1.53E-10	4.55E-09
	(mrem)	0	1.54E-08	1.53E-08	1.53E-08	4.39E-07	6.71E-06	1.53E-08	4.55E-07
Sum Total	(mSv)	2.39E-05	1.56E-07	1.57E-07	1.03E-04	1.78E-06	2.63E-05	1.41E-07	1.42E-05
	(mrem)	2.39E-03	1.56E-05	1.57E-05	1.03E-02	1.78E-04	2.63E-03	1.41E-05	1.42E-03

Table 4.12-15 Annual Dose Equivalents to Nearest Resident (Infant)
(Page 1 of 1)

(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition; Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	3.51E-13	2.53E-13	2.97E-13	2.37E-13	2.16E-13	6.57E-13	2.50E-13	2.56E-13
	(mrem)	3.51E-11	2.53E-11	2.97E-11	2.37E-11	2.16E-11	6.57E-11	2.50E-11	2.56E-11
Grd. Plane direct	(mSv)	2.39E-05	9.63E-08	9.73E-08	7.81E-08	7.68E-08	1.87E-07	8.12E-08	8.89E-08
	(mrem)	2.39E-03	9.63E-06	9.73E-06	7.81E-06	7.68E-06	1.87E-05	8.12E-06	8.89E-06
Inhalation	(mSv)	0	7.30E-10	8.19E-10	8.09E-05	2.02E-08	3.07E-07	7.82E-10	9.73E-06
	(mrem)	0	7.30E-08	8.19E-08	8.09E-03	2.02E-06	3.07E-05	7.82E-08	9.73E-04
Ingestion -Vegetables	(mSv)	0	0	0	0	0	0	0	0
	(mrem)	0	0	0	0	0	0	0	0
- Leafy Vegetables	(mSv)	0	0	0	0	0	0	0	0
	(mrem)	0	0	0	0	0	0	0	0
- Milk	(mSv)	0	7.61E-09	7.58E-09	7.56E-09	2.17E-07	3.32E-06	7.56E-09	2.25E-07
	(mrem)	0	7.61E-07	7.58E-07	7.56E-07	2.17E-05	3.32E-04	7.56E-07	2.25E-05
- Meat	(mSv)	0	0	0	0	0	0	0	0
	(mrem)	0	0	0	0	0	0	0	0
Sum Total	(mSv)	2.39E-05	1.05E-07	1.06E-07	8.10E-05	3.14E-07	3.81E-06	8.95E-08	1.00E-05
	(mrem)	2.39E-03	1.05E-05	1.06E-05	8.10E-03	3.14E-05	3.81E-04	8.95E-06	1.00E-03

Table 4.12-16 Annual Dose Equivalents to Nearby Business (Adult)
(Page 1 of 1)

Location: Nearby Business [Potato Cellar – SW, assumed 4 km (2.5 mi)]
(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition; 2000 hrs /yr Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.10E-13	1.51E-13	1.78E-13	1.42E-13	1.29E-13	3.92E-14	1.50E-13	1.53E-13
	(mrem)	2.10E-11	1.51E-11	1.78E-11	1.42E-11	1.29E-11	3.92E-12	1.50E-11	1.53E-11
Grd. Plane direct	(mSv)	1.11E-05	4.47E-08	4.51E-08	3.63E-08	3.56E-08	8.69E-08	3.76E-08	4.13E-08
	(mrem)	1.11E-03	4.47E-06	4.51E-06	3.63E-06	3.56E-06	8.69E-06	3.76E-06	4.13E-06
Inhalation	(mSv)	0.00E+00	5.93E-10	6.66E-10	6.57E-05	1.64E-08	2.49E-07	6.34E-10	7.89E-06
	(mrem)	0.00E+00	5.93E-08	6.66E-08	6.57E-03	1.64E-06	2.49E-05	6.34E-08	7.89E-04
Ingestion -Vegetables	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
- Leafy Vegetables	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
- Milk	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
- Meat	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
Sum Total	(mSv)	1.11E-05	4.53E-08	4.58E-08	6.57E-05	5.20E-08	3.35E-07	3.83E-08	7.93E-06
	(mrem)	1.11E-03	4.53E-06	4.58E-06	6.57E-03	5.20E-06	3.35E-05	3.83E-06	7.93E-04

-- No exposure pathway assumed for receptor group.

Table 4.12-17 Annual Dose Equivalents to Maximum Site Boundary (Adult)
(Page 1 of 1)

Location: Maximum Site Boundaries – NNE at 1.1 km (0.68 mi) based on D/Q; SW at 1.0 km (0.63 mi) based on depleted χ/Q.
(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition; 2000 hrs /yr Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	2.03E-12	1.46E-12	1.71E-12	1.37E-12	1.25E-12	3.78E-12	1.45E-12	1.48E-12
	(mrem)	2.03E-10	1.46E-10	1.71E-10	1.37E-10	1.25E-10	3.78E-10	1.45E-10	1.48E-10
Grd. Plane direct	(mSv)	1.56E-04	6.25E-07	6.34E-07	5.08E-07	4.99E-07	1.22E-06	5.29E-07	5.77E-07
	(mrem)	1.56E-02	6.25E-05	6.34E-05	5.08E-05	4.99E-05	1.22E-04	5.29E-05	5.77E-05
Inhalation	(mSv)	0	5.72E-09	6.43E-09	6.34E-04	1.59E-07	2.42E-06	6.13E-09	7.64E-05
	(mrem)	0	5.72E-07	6.43E-07	6.34E-02	1.59E-05	2.42E-04	6.13E-07	7.64E-03
Ingestion -Vegetables	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
- Leafy Vegetables	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
- Milk	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
- Meat	(mSv)	-	-	-	-	-	-	-	-
	(mrem)	-	-	-	-	-	-	-	-
Sum Total	(mSv)	1.56E-04	6.30E-07	6.40E-07	6.34E-04	6.58E-07	3.63E-06	5.35E-07	7.70E-05
	(mrem)	1.56E-02	6.30E-05	6.40E-05	6.34E-02	6.58E-05	3.63E-04	5.35E-05	7.70E-03

-- No exposure pathway assumed for receptor group.

Table 4.12-18 Annual Dose Equivalents to Maximum Hypothetical Resident (Adult)
(Page 1 of 1)

Location: Maximum Site Boundaries – NNE at 1.1 km (0.68 mi) based on D/Q; SW at 1.0 km (0.63 mi) based on depleted χ/Q.
(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition, Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	8.91E-12	6.41E-12	7.52E-12	6.00E-12	5.48E-12	1.66E-11	6.34E-12	6.50E-12
	(mrem)	8.91E-10	6.41E-10	7.52E-10	6.00E-10	5.48E-10	1.66E-09	6.34E-10	6.50E-10
Grd. Plane direct	(mSv)	6.83E-04	2.74E-06	2.78E-06	2.23E-06	2.19E-06	5.34E-06	2.32E-06	2.53E-06
	(mrem)	6.83E-02	2.74E-04	2.78E-04	2.23E-04	2.19E-04	5.34E-04	2.32E-04	2.53E-04
Inhalation	(mSv)	0	2.51E-08	2.82E-08	2.78E-03	6.96E-07	1.06E-05	2.69E-08	3.35E-04
	(mrem)	0	2.51E-06	2.82E-06	2.78E-01	6.96E-05	1.06E-03	2.69E-06	3.35E-02
Ingestion -Vegetables	(mSv)	0	8.52E-07	8.49E-07	8.47E-07	2.43E-05	3.71E-04	8.47E-07	2.52E-05
	(mrem)	0	8.52E-05	8.49E-05	8.47E-05	2.43E-03	3.71E-02	8.47E-05	2.52E-03
- Leafy Vegetables	(mSv)	0	1.38E-07	1.37E-07	1.37E-07	3.94E-06	6.01E-05	1.37E-07	4.08E-06
	(mrem)	0	1.38E-05	1.37E-05	1.37E-05	3.94E-04	6.01E-03	1.37E-05	4.08E-04
- Milk	(mSv)	0	2.73E-08	2.72E-08	2.71E-08	7.78E-07	1.19E-05	2.71E-08	8.07E-07
	(mrem)	0	2.73E-06	2.72E-06	2.71E-06	7.78E-05	1.19E-03	2.71E-06	8.07E-05
- Meat	(mSv)	0	6.58E-09	6.56E-09	6.54E-09	1.88E-07	2.87E-06	6.54E-09	1.95E-07
	(mrem)	0	6.58E-07	6.56E-07	6.54E-07	1.88E-05	2.87E-04	6.54E-07	1.95E-05
Sum Total	(mSv)	6.83E-04	3.79E-06	3.83E-06	2.78E-03	3.21E-05	4.62E-04	3.36E-06	3.68E-04
	(mrem)	6.83E-02	3.79E-04	3.83E-04	2.78E-01	3.21E-03	4.62E-02	3.36E-04	3.68E-02

Table 4.12-19 Annual Dose Equivalents to Maximum Hypothetical Resident (Teen)
(Page 1 of 1)

Location: Maximum Site Boundaries – NNE at 1.1 km (0.68 mi) based on D/Q; SW at 1.0 km (0.63 mi) based on depleted χ/Q.
(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition, Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	8.91E-12	6.41E-12	7.52E-12	6.00E-12	5.48E-12	1.66E-11	6.34E-12	6.50E-12
	(mrem)	8.91E-10	6.41E-10	7.52E-10	6.00E-10	5.48E-10	1.66E-09	6.34E-10	6.50E-10
Grd. Plane direct	(mSv)	6.83E-04	2.74E-06	2.78E-06	2.23E-06	2.19E-06	5.34E-06	2.32E-06	2.53E-06
	(mrem)	6.83E-02	2.74E-04	2.78E-04	2.23E-04	2.19E-04	5.34E-04	2.32E-04	2.53E-04
Inhalation	(mSv)	0	3.00E-08	3.35E-08	3.31E-03	8.31E-07	1.26E-05	3.20E-08	3.92E-04
	(mrem)	0	3.00E-06	3.35E-06	3.31E-01	8.31E-05	1.26E-03	3.20E-06	3.92E-02
Ingestion -Vegetables	(mSv)	0	1.55E-06	1.55E-06	1.55E-06	4.43E-05	6.76E-04	1.55E-06	4.59E-05
	(mrem)	0	1.55E-04	1.55E-04	1.55E-04	4.43E-03	6.76E-02	1.55E-04	4.59E-03
- Leafy Vegetables	(mSv)	0	1.36E-07	1.36E-07	1.36E-07	3.88E-06	5.93E-05	1.36E-07	4.03E-06
	(mrem)	0	1.36E-05	1.36E-05	1.36E-05	3.88E-04	5.93E-03	1.36E-05	4.03E-04
- Milk	(mSv)	0	5.30E-08	5.27E-08	5.27E-08	1.51E-06	2.31E-05	5.27E-08	1.57E-06
	(mrem)	0	5.30E-06	5.27E-06	5.27E-06	1.51E-04	2.31E-03	5.27E-06	1.57E-04
- Meat	(mSv)	0	5.85E-09	5.82E-09	5.82E-09	1.67E-07	2.55E-06	5.82E-09	1.73E-07
	(mrem)	0	5.85E-07	5.82E-07	5.82E-07	1.67E-05	2.55E-04	5.82E-07	1.73E-05
Sum Total	(mSv)	6.83E-04	4.51E-06	4.56E-06	3.31E-03	5.29E-05	7.79E-04	4.10E-06	4.46E-04
	(mrem)	6.83E-02	4.51E-04	4.56E-04	3.31E-01	5.29E-03	7.79E-02	4.10E-04	4.46E-02

Table 4.12-20 Annual Dose Equivalents to Maximum Hypothetical Resident (Child)
(Page 1 of 1)

Location: Maximum Site Boundaries – NNE at 1.1 km (0.68 mi) based on D/Q; SW at 1.0 km (0.63 mi) based on depleted χ/Q.
(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition, Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	8.91E-12	6.41E-12	7.52E-12	6.00E-12	5.48E-12	1.66E-11	6.34E-12	6.50E-12
	(mrem)	8.91E-10	6.41E-10	7.52E-10	6.00E-10	5.48E-10	1.66E-09	6.34E-10	6.50E-10
Grd. Plane direct	(mSv)	6.83E-04	2.74E-06	2.78E-06	2.23E-06	2.19E-06	5.34E-06	2.32E-06	2.53E-06
	(mrem)	6.83E-02	2.74E-04	2.78E-04	2.23E-04	2.19E-04	5.34E-04	2.32E-04	2.53E-04
Inhalation	(mSv)	0	2.36E-08	2.65E-08	2.62E-03	6.55E-07	9.94E-06	2.53E-08	3.15E-04
	(mrem)	0	2.36E-06	2.65E-06	2.62E-01	6.55E-05	9.94E-04	2.53E-06	3.15E-02
Ingestion -Vegetables	(mSv)	0	1.53E-06	1.52E-06	1.52E-06	4.35E-05	6.64E-04	1.52E-06	4.51E-05
	(mrem)	0	1.53E-04	1.52E-04	1.52E-04	4.35E-03	6.64E-02	1.52E-04	4.51E-03
- Leafy Vegetables	(mSv)	0	1.00E-07	1.00E-07	9.97E-08	2.86E-06	4.37E-05	9.97E-08	2.97E-06
	(mrem)	0	1.00E-05	1.00E-05	9.97E-06	2.86E-04	4.37E-03	9.97E-06	2.97E-04
- Milk	(mSv)	0	5.20E-08	5.18E-08	5.16E-08	1.48E-06	2.26E-05	5.16E-08	1.54E-06
	(mrem)	0	5.20E-06	5.18E-06	5.16E-06	1.48E-04	2.26E-03	5.16E-06	1.54E-04
- Meat	(mSv)	0	4.40E-09	4.38E-09	4.36E-09	1.25E-07	1.91E-06	4.36E-09	1.30E-07
	(mrem)	0	4.40E-07	4.38E-07	4.36E-07	1.25E-05	1.91E-04	4.36E-07	1.30E-05
Sum Total	(mSv)	6.83E-04	4.45E-06	4.48E-06	2.62E-03	5.08E-05	7.47E-04	4.02E-06	3.67E-04
	(mrem)	6.83E-02	4.45E-04	4.48E-04	2.62E-01	5.08E-03	7.47E-02	4.02E-04	3.67E-02

Table 4.12-21 Annual Dose Equivalents to Maximum Hypothetical Resident (Infant)
(Page 1 of 1)

Location: Maximum Site Boundaries – NNE at 1.1 km (0.68 mi) based on D/Q; SW at 1.0 km (0.63 mi) based on depleted χ/Q.
(Annual Liquid & Gaseous Effluents with 30 Years Soil Deposition, Full Year Occupancy)

Source		Skin	Gonads	Breast	Lung	Red Bone Marrow	Bone Surface	Thyroid	Effective Dose Equivalent
Cloud Immersion	(mSv)	8.91E-12	6.41E-12	7.52E-12	6.00E-12	5.48E-12	1.66E-11	6.34E-12	6.50E-12
	(mrem)	8.91E-10	6.41E-10	7.52E-10	6.00E-10	5.48E-10	1.66E-09	6.34E-10	6.50E-10
Grd. Plane direct	(mSv)	6.83E-04	2.74E-06	2.78E-06	2.23E-06	2.19E-06	5.34E-06	2.32E-06	2.53E-06
	(mrem)	6.83E-02	2.74E-04	2.78E-04	2.23E-04	2.19E-04	5.34E-04	2.32E-04	2.53E-04
Inhalation	(mSv)	0	1.85E-08	2.08E-08	2.05E-03	5.13E-07	7.78E-06	1.98E-08	2.47E-04
	(mrem)	0	1.85E-06	2.08E-06	2.05E-01	5.13E-05	7.78E-04	1.98E-06	2.47E-02
Ingestion -Vegetables	(mSv)	0	0	0	0	0	0	0	0
	(mrem)	0	0	0	0	0	0	0	0
- Leafy Vegetables	(mSv)	0	0	0	0	0	0	0	0
	(mrem)	0	0	0	0	0	0	0	0
- Milk	(mSv)	0	2.17E-07	2.16E-07	2.16E-07	6.19E-06	9.46E-05	2.16E-07	6.42E-06
	(mrem)	0	2.17E-05	2.16E-05	2.16E-05	6.19E-04	9.46E-03	2.16E-05	6.42E-04
- Meat	(mSv)	0	0	0	0	0	0	0	0
	(mrem)	0	0	0	0	0	0	0	0
Sum Total	(mSv)	6.83E-04	2.98E-06	3.02E-06	2.05E-03	8.89E-06	1.08E-04	2.56E-06	2.56E-04
	(mrem)	6.83E-02	2.98E-04	3.02E-04	2.05E-01	8.89E-04	1.08E-02	2.56E-04	2.56E-02

Table 4.12-22 Maximum Annual Gaseous & Liquid Radiological Impacts
(Page 1 of 1)

Category	Dose Equivalent	Location
Maximum Effective Dose Equivalent (Hypothetical Resident)	4.46E-01 μSv 4.46E-02 mrem	Site Boundary (NNE for D/Q) (SW for χ/Q depleted)
Maximum Thyroid Committed Dose Equivalent (Hypothetical Resident)	4.10E-03 μSv 4.10E-04 mrem	Site Boundary (NNE for D/Q) (SW for χ/Q depleted)
Maximum Organ (Lung) Committed Dose Equivalent (Hypothetical Resident)	3.31E+00 μSv 3.31E-01 mrem	Site Boundary (NNE for D/Q) (SW for χ/Q depleted)

Table 4.12-23 Annual Total Effective Dose Equivalent (All Sources)
(Page 1 of 1)

Location	Fixed Sources	Gas & Liquid Effluents	TEDE
Site Boundary (N - fixed; NNE Eff.) (mSv)	0.0171	7.70E-05	0.0172
[2000 hrs/yr] (mrem)	1.71	7.70E-03	1.72
Nearest Business (mSv) (SW 4.2 km (2.5 mi))	4.04E-19	7.93E-06	7.93E-06
[2000 hrs/yr] (mrem)	4.04E-17	7.93E-04	7.93E-04
Nearest Resident (Teen) (mSv)	<1E-19	1.76E-05	1.76E-05
(8.0 km (5 mi) Max Sec NNE)			
[8766 hrs/yr] (mrem)	<1E-17	1.76E-03	1.76E-03
Hypothetical Max Resident (Teen) (mSv)	0.075	4.46E-04	0.0754
(N, NNE Site Boundary)			
[8766 hrs/yr] (mrem)	7.50	4.46E-02	7.54

Table 4.12-24 Estimated EREF Occupational Dose Equivalent Rates
(Page 1 of 1)

Area or Component	Dose Rate, mSv/hr (mrem/hr)
Plant general area (excluding Separations Building)	< 0.0001 (< 0.01)
Separations Building – Cascade Halls	0.0005 (0.05)
Separations Building – UF_6 Handling	0.001 (0.1)
Empty used UF_6 shipping cylinder	0.1 on contact (10.0) 0.010 at 1 m (3.3 ft) (1.0)
Full UF_6 Shipping cylinder	0.05 on contact (5.0) 0.002 at 1 m (3.3 ft) (0.2)

Table 4.12-25 Estimated Annual EREF Occupational (Individual) Exposures
(Page 1 of 1)

Position	Annual Dose Equivalent	Reported Experience at Urenco, Capenhurst, UK (averages 2003 -2007)*
General Office Staff	< 0.05 mSv (< 5.0 mrem)	(Not reported)
Typical Operations & Maintenance Technician	1 mSv (100 mrem)	0.32 mSv (32 mrem)
Typical Cylinder Handler	3 mSv (300 mrem)	2.55 mSv (255 mrem)

* Average radiation worker dose values derived from the 2003 through 2007 annual Urenco (Capenhurst) Health, Safety and Environmental Reports.

(Urenco, 2003) (Urenco, 2004) (Urenco, 2005) (Urenco, 2006) (Urenco, 2007)

Table 4.12-26 Annual Average Effluent Air Concentrations at Critical Receptors (Page 1 of 1)

Location	Annual Average Depleted χ/Q (Sec/m^3)	Isotope	Annual Average Release Rate (uCi/sec)	Annual Average Release Rate (MBq/sec)	Average Airborne Concentration (uCi/m^3)	Average Airborne Concentration (MBq/m^3)
Maximum Site Boundary (SW)	3.98E-06	U-234	4.08E-06	1.51E-07	1.62E-11	6.01E-13
		U-235	1.88E-07	6.96E-09	7.48E-13	2.77E-14
		U-236	2.60E-08	9.62E-10	1.03E-13	3.83E-15
		U-238	4.07E-06	1.51E-07	1.62E-11	6.00E-13
Nearest Resident (8 km (5 mi) NNE)	1.57E-07	U-234	4.08E-06	1.51E-07	6.41E-13	2.37E-14
		U-235	1.88E-07	6.96E-09	2.95E-14	1.09E-15
		U-236	2.60E-08	9.62E-10	4.08E-15	1.51E-16
		U-238	4.07E-06	1.51E-07	6.39E-13	2.37E-14
Maxi Off-site Business (4 km (2.5 mi) SW)	4.12E-07	U-234	4.08E-06	1.51E-07	1.68E-12	6.23E-14
		U-235	1.88E-07	6.96E-09	7.74E-14	2.87E-15
		U-236	2.60E-08	9.62E-10	1.07E-14	3.97E-16
		U-238	4.07E-06	1.51E-07	1.68E-12	6.21E-14

Table 4.12-27 30 Years Accumulative Soil Concentrations at Critical Receptors (Page 1 of 1)

Location	Annual Average Deposition D/Q ($1/m^2$)	Isotope	Annual Average Release Rate (uCi/yr)	Annual Average Release Rate (MBq/yr)	30 Year Soil deposition (uCi/m^2)	30 Year Soil deposition (MBq/m^2)
Maximum Site Boundary (NNE)	1.64E-08	U-234	128.77	4.769	6.34E-05	2.35E-06
		U-235	5.93	0.220	2.92E-06	1.08E-07
		U-236	0.82	0.030	4.03E-07	1.49E-08
		U-238	128.47	4.758	6.32E-05	2.34E-06
Nearest Resident (8 km (5 mi) NE)	5.75E-10	U-234	128.77	4.769	2.22E-06	8.23E-08
		U-235	5.93	0.220	1.02E-07	3.79E-09
		U-236	0.82	0.030	1.41E-08	5.24E-10
		U-238	128.47	4.758	2.22E-06	8.21E-08
Maximum Off-site Business (4 km (2.5 mi) SW)	1.17E-09	U-234	128.77	4.769	4.52E-06	1.67E-07
		U-235	5.93	0.220	2.08E-07	7.71E-09
		U-236	0.82	0.030	2.88E-08	1.07E-09
		U-238	128.47	4.758	4.51E-06	1.67E-07

Table 4.12-28 Accident Criteria Chemical Exposure Limits by Category
(Page 1 of 1)

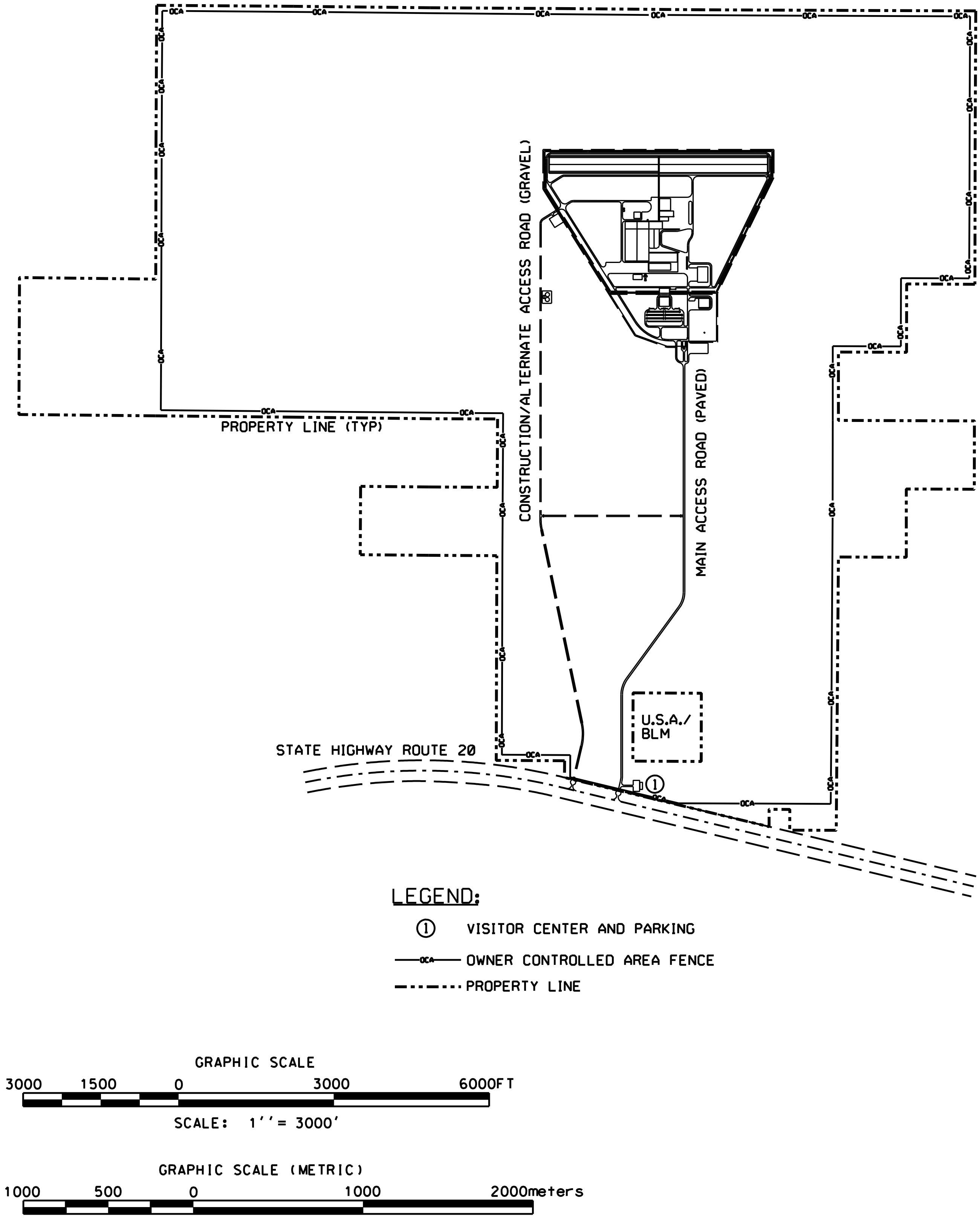
	High Consequence (Category 3)	**Intermediate Consequence (Category 2)**
Worker (in the room)	> 216 mg UF_6/m^3 > 139 mg HF/m^3	> 28 mg UF_6/m^3 > 78 mg HF/m^3
Outside Controlled Area (30-minute exposure)	> 28 mg HF/m^3 > 21 mg U Intake	> 0.8 mg HF/m^3 > 4.06 mg U Intake
Environment (outside Restricted Area)	Not Applicable	> 5.47 mg U/m^3

Table 4.12-29 Causes of Injuries at Capenhurst (2003-2007)
(Page 1 of 1)

Main Causes of Injury at UCL 2003-2007	Number	Percent of Total
Vehicles	1	**0.8%**
Slip, trip, fall on same level	16	**13.1%**
Chemical	6	**4.9%**
Impact, striking or falling objects	30	**24.6%**
Minor electric shock	1	**0.8%**
Handling tools, equipment or other items	45	**36.9%**
Lifting, pushing or pulling	3	**2.5%**
Slip when changing level	7	**5.7%**
Trap in Door	2	**1.6%**
Bending (no lifting)	2	**1.6%**
Dust in eye	2	**1.6%**
Manual handling of loads	5	**4.1%**
Loud Noise	1	**0.8%**
Over-stretching	1	**0.8%**
Total	**122**	**100%**

Sources: (Urenco, 2003; Urenco, 2004; Urenco, 2005; Urenco, 2006; Urenco, 2007)

FIGURES



NOTE:
SEE FIGURE 4.12-2 FOR ENLARGED FACILITY LAYOUT.

Figure 4.12-1 **Rev. 0**

Site Plan

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

Figure 4.12-2, Facility Layout for Eagle Rock Enrichment Facility, contains Security-Related Information Withheld from Disclosure under 10 CFR 2.390

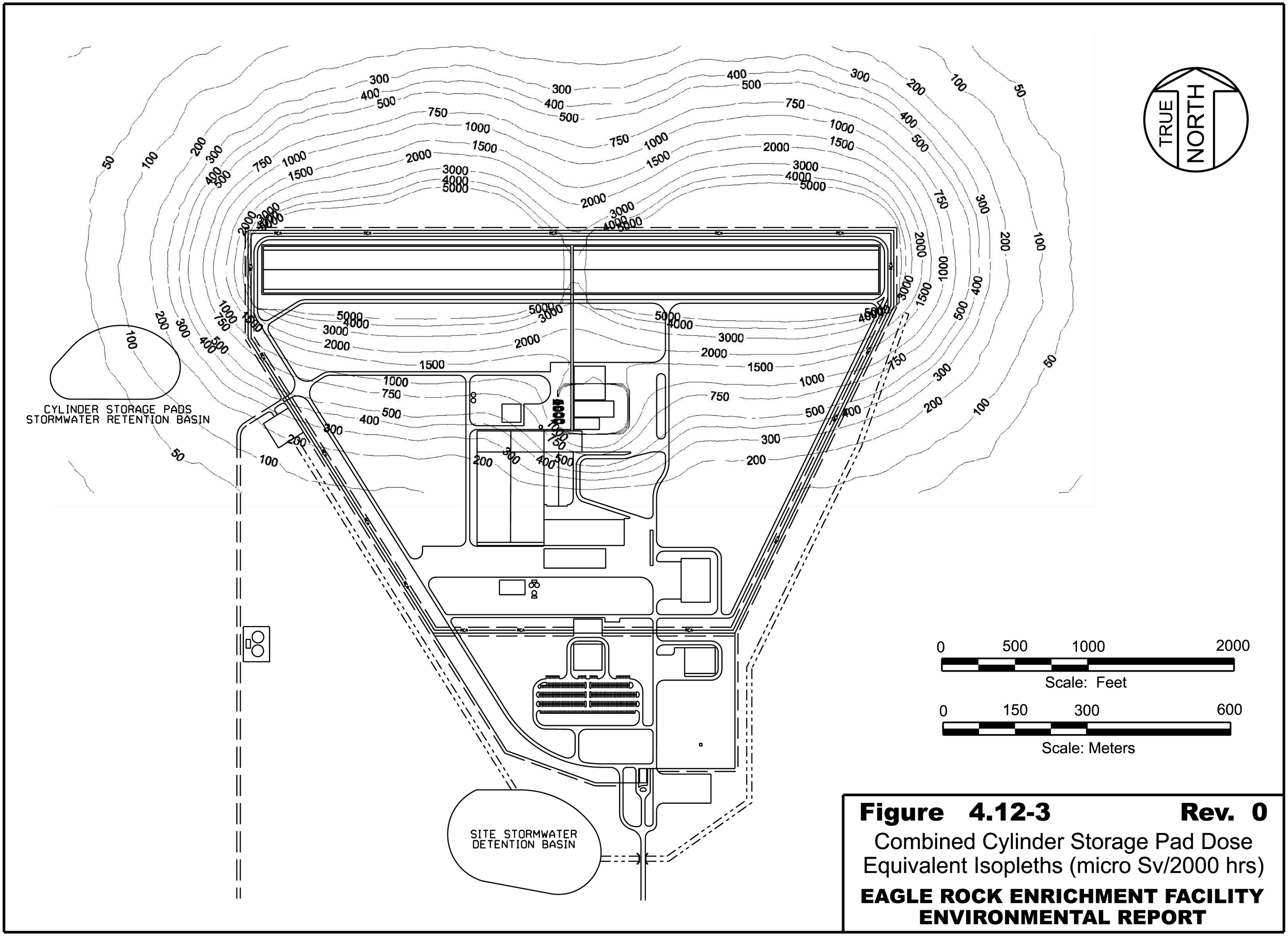


Figure 4.12-3 **Rev. 0**

Combined Cylinder Storage Pad Dose Equivalent Isopleths (micro Sv/2000 hrs)

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

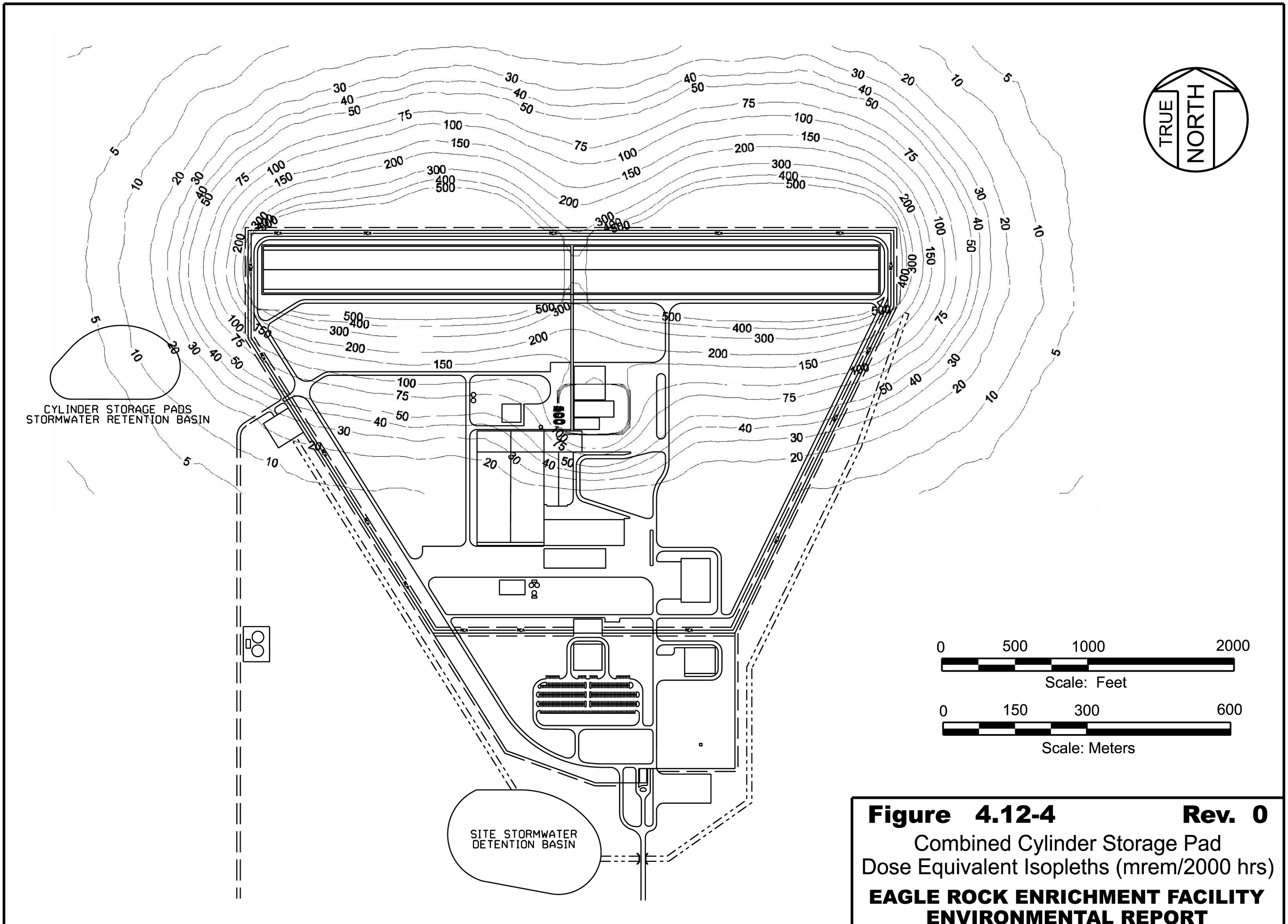


Figure 4.12-4 **Rev. 0**

Combined Cylinder Storage Pad
Dose Equivalent Isopleths (mrem/2000 hrs)

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

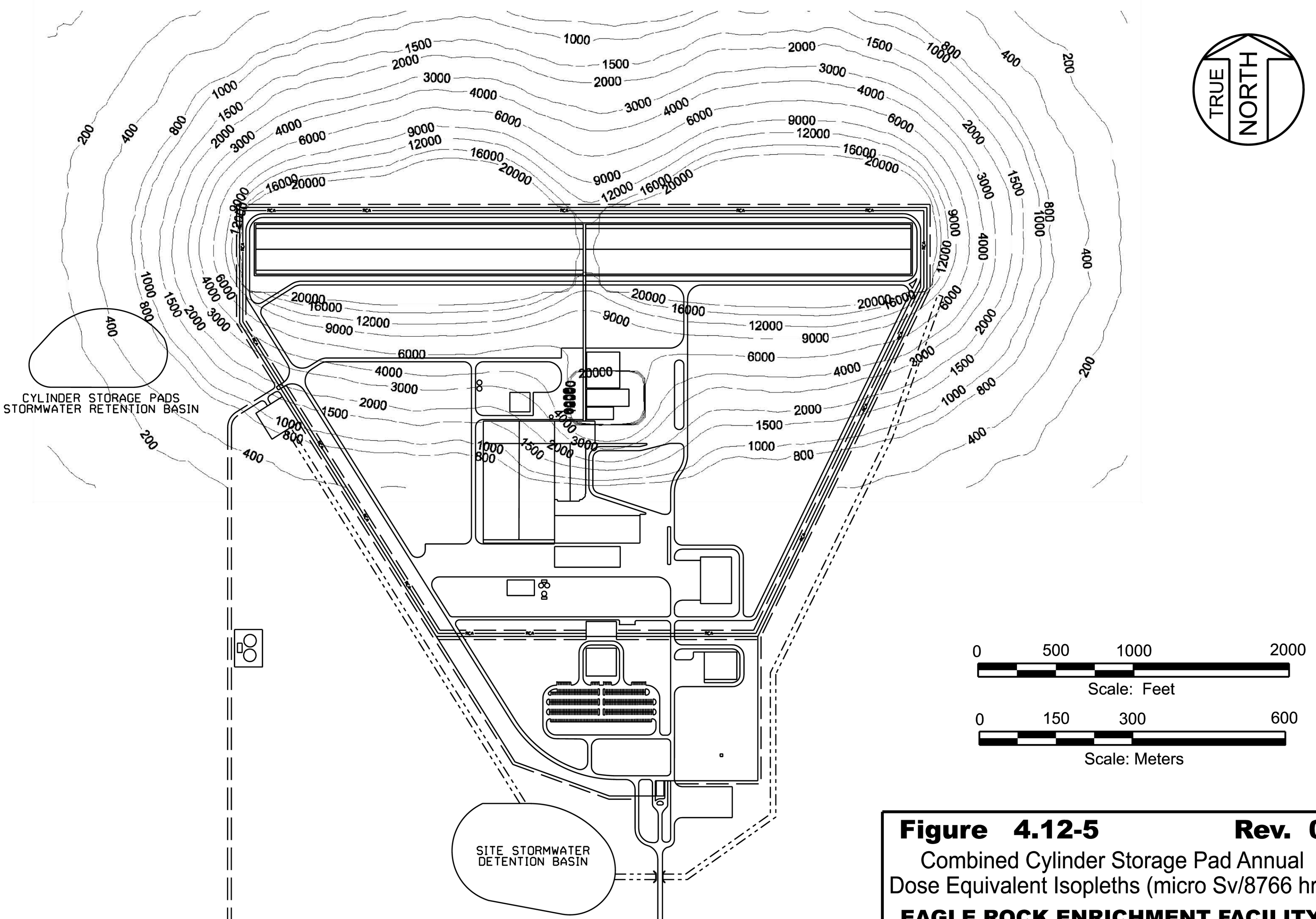


Figure 4.12-5 Rev. 0

Combined Cylinder Storage Pad Annual Dose Equivalent Isopleths (micro Sv/8766 hrs)

EAGLE ROCK ENRICHMENT FACILITY
ENVIRONMENTAL REPORT

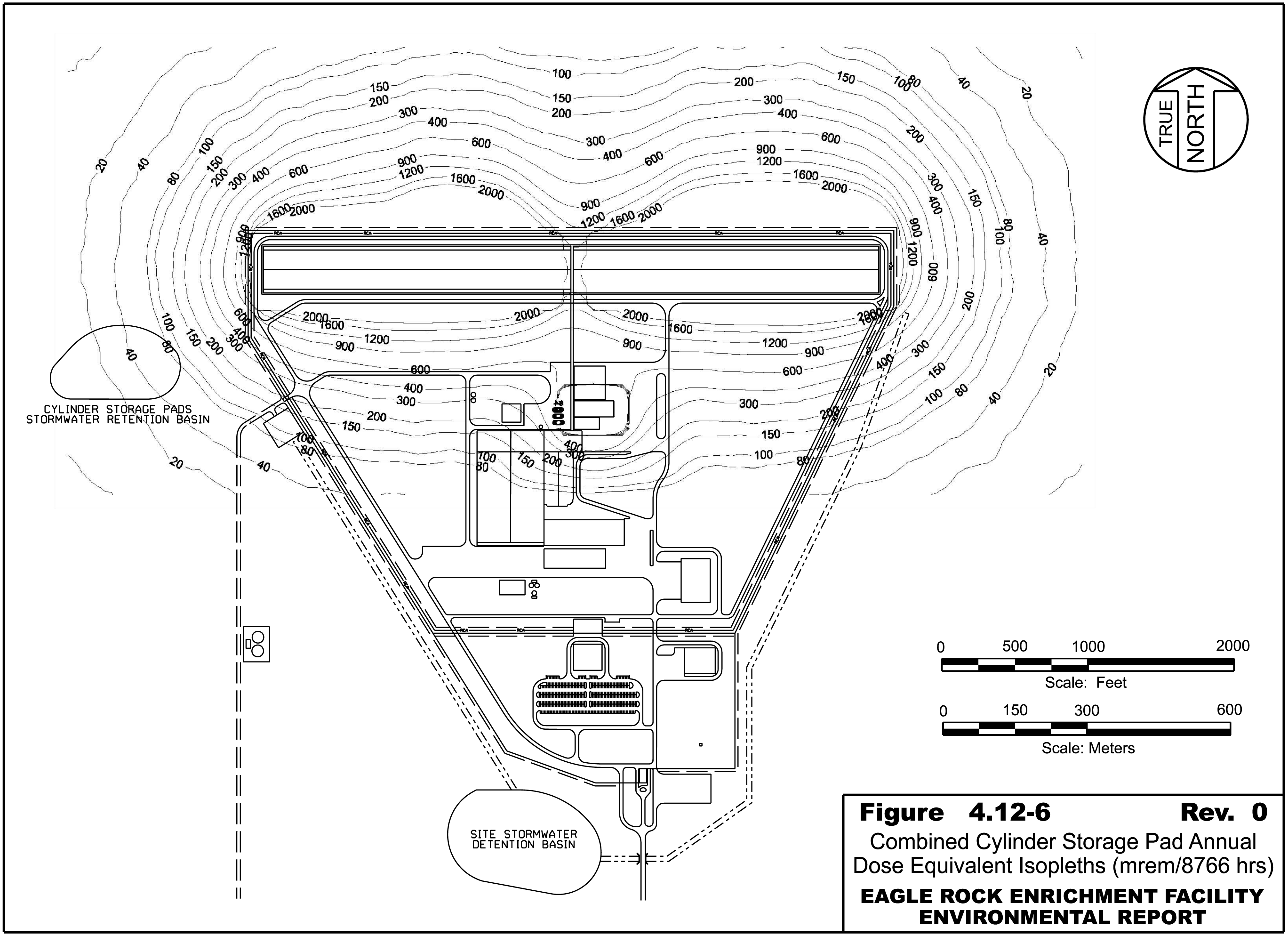


Figure 4.12-6 **Rev. 0**

Combined Cylinder Storage Pad Annual Dose Equivalent Isopleths (mrem/8766 hrs)

EAGLE ROCK ENRICHMENT FACILITY ENVIRONMENTAL REPORT

4.13 WASTE MANAGEMENT IMPACTS

Solid waste generated at the Eagle Rock Enrichment Facility (EREF) will be disposed of at licensed facilities designed to accept the various waste types. Approximately 57,300 kg/yr (126,000 lbs/yr) of industrial waste including miscellaneous trash, filters, resins, and paper will be generated annually by the EREF. It will be collected and disposed of by a licensed solid waste disposal contractor. It could be disposed of at the Bonneville County Peterson Landfill that accepted 81,647 MT (90,000 tons) of waste in 2007 and will maintain this yearly waste capacity for the next 80 years. The impact of the additional waste from the EREF is very small in that it represents less than one-tenth of one percent of the Peterson Hill annual landfill capacity. Radioactive waste will be collected in labeled containers in each Restricted Area and transferred to the Solid Waste Collection Room for inspection. Suitable waste will be volume-reduced and all radioactive waste disposed of at a licensed LLW disposal facility. Hazardous and some mixed wastes will be collected at the point of generation, transferred to the Solid Waste Collection Room, inspected, and classified. Any mixed waste that may be processed to meet land disposal requirements may be treated in its original collection container and shipped as LLW for disposal. There will be no on-site disposal of solid waste at the EREF. Waste Management Impacts for on-site disposal, therefore, need not be evaluated. On site storage of depleted UF_6 (DUF_6) Cylinders will minimally impact the environment. A pathway assessment for the temporary storage of DUF_6 on the Full Tails Cylinder Storage Pad is provided in Section 4.13.3.2, DUF_6 Cylinder Storage.

EREF will generate approximately 2,530 kg (5,580 lbs) of Resource Conservation and Recovery Act (RCRA) hazardous wastes per year and 50 kg (110 lbs) per year of mixed waste. Under Idaho regulations, (IDA, 2008) EREF will be considered a small quantity generator (SQG) if it accumulates less than 1,000 kg (2,200 lbs) but more than 100 kg (220 lbs) of hazardous waste per month. As an SQG, EREF will be required to file an annual report to the state and to pay an annual fee. Since the EREF plans to ship all hazardous wastes off-site within the allowed timeframe, 180 days, no further permitting as a Treatment, Storage and Disposal facility will be necessary and the impacts for such systems need not be evaluated.

4.13.1 Waste Descriptions

Descriptions of the sources, types and quantities of solid, hazardous, radioactive and mixed wastes generated by EREF during construction and operation are provided in Section 3.12, Waste Management.

4.13.2 Waste Management System Description

Descriptions of the EREF waste management systems are provided in Section 3.12.

4.13.3 Waste Disposal Plans

4.13.3.1 Radioactive and Mixed Waste Disposal Plans

Solid radioactive wastes are produced in a number of plant activities and require a variety of methods for treatment and disposal. These wastes, as well as the generation and handling systems, are described in detail in Section 3.12, Waste Management.

All radioactive and mixed wastes will be disposed of at off-site licensed facilities. Table 4.13-1, Possible Radioactive Waste Processing/Disposal Facilities, summarizes the facilities that may be used to process or dispose of EREF radioactive or mixed waste.

Idaho is a member of the Northwest Interstate Compact on Low Level Radioactive Waste Management and, as such, is entitled to dispose of low level radioactive waste at the facility operated by U.S. Ecology, a subsidiary of American Ecology, near Richland, Washington. This site is licensed to accept Class A, B and C low level radioactive waste. It does not accept mixed waste. The disposal site is about 885 km (550 mi) from the EREF.

The Clive, Utah site is owned and operated privately by EnergySolutions of Utah. This low-level waste disposal site is licensed by the State of Utah pursuant to its authority as an agreement state to accept for disposal radioactive waste including byproduct material (Utah, 2008) and certain mixed waste (Utah, 2003). The disposal site is approximately 475 km (295 mi) from the EREF.

The EREF may send wastes that are candidates for volume reduction, recycling, or treatment to EnergySolutions facilities in Oak Ridge, Tennessee that have the ability to volume reduce most Class A low level wastes and to process contaminated oils and some mixed wastes. Other processing vendors may be used to process EREF waste depending on future availability. The Oak Ridge processing facilities are approximately 3,068 km (1,907 mi) from the EREF.

With regard to DUF_6 disposal, DOE has contracted with Uranium Disposition Services, LLC UDS for the construction and operation of DUF_6 conversion facilities in Paducah, Kentucky, and Portsmouth, Ohio. The deconversion facilities will convert the DUF_6 to a more stable and easily stored uranium oxide. This action was taken following the earlier enactment of Section 3113 of the USEC Privatization Act (USC, 2000) and related subsequent legislation, which require that the Secretary of Energy accept for disposal DUF_6 generated by an NRC-licensed facility such as the EREF for a fee. Per conversation with the Paducah, Kentucky Plant Manager on November 26, 2008, the Paducah, Kentucky and Portsmouth, Ohio deconversion facilities are scheduled to begin accepting DUF_6 in September 2010 and May 2010, respectively. Although other options will likely be available to the EREF, AREVA Enrichment Services' (AES's) intention is to transport its DUF_6 to the DOE facilities after temporary on-site storage for conversion and subsequent disposition by the U.S. Department of Energy. The environmental impacts of converting DUF_6 are addressed in Final Environmental Impact Statements for the Paducah and Portsmouth facilities (DOE, 2004c) (DOE, 2004d) (DOE, 2007c) (FR, 2007).

4.13.3.2 DUF_6 Cylinder Temporary Storage

The EREF yields a DUF_6 stream that will be temporarily stored on-site in cylinders before transfer to a DOE deconversion facility and subsequent disposition. The storage containers are referred to as Full Tails Cylinders although any partially filled tails cylinders will be maintained, controlled and dispositioned in the same manner as full tails cylinders. The storage location is designated the Full Tails Cylinder Storage Pad.

The disposition of the DUF_6 Cylinders includes temporary on-site storage of cylinders followed by transport to the new deconversion facilities under construction at the sites of the Paducah Gaseous Diffusion Plant (GDP) and the former Portsmouth GDP as discussed below in ER Section 4.13.3.4, Depleted UF_6 Disposition. AES is committed to ensuring that the storage of DUF_6 on site will not extend beyond the licensed life of the plant and that it will be conducted in a safe, secure, and monitored manner until removed by DOE. In addition, AES will provide financial assurance through a letter of credit to assure adequate funding is in place to safely dispose all DUF_6 Cylinders (see SAR Chapter 10, Decommissioning).

Cylinders placed on the Cylinder Storage Pads normally have no surface contamination due to restrictions placed on surface contamination levels by plant operating procedures. Nonetheless, since they will be stored for a time on the pad, there is the remote possibility of stormwater runoff becoming contaminated with UF_6 or its derivatives. The runoff water will, therefore, be directed to the Cylinder Storage Pad Stormwater Retention Basin that is lined and designed to minimize ground infiltration. The basin is sampled under the site's environmental monitoring plan. The sources of the potential water runoff contamination (albeit unlikely) would be either residual contamination on the cylinders from routine handling, or accidental releases of UF_6 and its derivatives resulting from a leaking cylinder or cylinder valve caused by corrosion, transportation or handling accidents, or other factors. Operational evidence, however, suggests that breaches in cylinders and the resulting leaks are "self-sealing" as described below.

The chemical and physical properties of UF_6 can pose potential health risks, and the material is handled accordingly. Uranium and its decay products emit low-levels of alpha, beta, gamma, and neutron radiation. If UF_6 is released to the atmosphere, it reacts with water vapor in the air to form hydrogen fluoride (HF) and the uranium oxyfluoride compound called uranyl fluoride (UO_2F_2). These products are chemically toxic. Uranium is a heavy metal that, in addition to being radioactive, can have toxic chemical effects (primarily on the kidneys) if it enters the bloodstream by means of ingestion or inhalation. HF is an extremely corrosive gas that can damage the lungs and cause death if inhaled in high concentrations.

A Joint Report of the Organization for Economic Co-operation and Development and the International Atomic Energy Agency (OECD, 2001) states that there is widespread experience with the storage of UF_6 in steel cylinders in open-air storage yards and reports that even without routine treatment of localized corrosion, containers have maintained structural integrity for more than 50 years. The most extreme conditions experienced were in Russian Siberia where temperatures ranged from +40°C to -40°C (+104°F to -40°F) and from deep snow to full sun.

While it is AES's intention to store the full DUF_6 Cylinders temporarily prior to transport to the DOE Deconversion facilities, depleted UF_6 can be safely stored for decades in painted steel cylinders in open-air storage yards. Internal corrosion does not represent a problem. A reaction between the UF_6 and inner surface of the cylinder forms a complex uranium oxyfluoride layer between the UF_6 and cylinder wall that limits access of water moisture to the inside of the cylinder, thus further inhibiting internal corrosion. Moreover, while limiting factors are the external corrosion of the steel containers and the integrity of the "connection" seals, their impact can be minimized with an adequate preventive maintenance program. The three primary causes of external corrosion, all of which are preventable, are: (1) standing water on metal surfaces, (2) handling damaged cylinders, and (3) the aging of cylinder paint.

Standing water problems can be minimized through proper yard drainage, use of support saddles, and periodic inspection. Appropriate labor training and yard access design can minimize handling damage. Aging effects can be minimized through the use of periodic inspection and repainting and the use of quality paint. At the EREF, DUF_6 Cylinders rest on concrete saddles placed on an outdoor storage pad of reinforced concrete. Stormwater runoff from the pad is collected in the Cylinder Storage Pad Stormwater Retention Basin, which has sampling capabilities. The mobile transporter transfers cylinders from the UF_6 Handling Area of the Separations Building to the Full Tails Cylinder Storage Pad. DUF_6 Cylinder transport between the Separations Building and the storage area is discussed in Integrated Safety Analysis Summary Section 3.4.11, Material Handling Processes.

The Material Handling Processes are designed to ensure that the storage and movement of DUF_6 Cylinders is conducted safely in accordance with all applicable regulations to protect the environment. Although AES intends to transport DUF_6 Cylinders to the DOE conversion facilities in a timely and efficient manner after generation and has committed not to extend storage beyond the lifetime of the plant, the ultimate size of the Full Tails Cylinder Storage Pad is based on a conservatively calculated lifetime generation of DUF_6. The concrete pad to be initially constructed on-site for the temporary storage of full DUF_6 Cylinders will only be of a size necessary to hold a few years worth of cylinders. It will be expanded only if necessary. The EREF will establish and maintain an active cylinder management program that will address storage conditions, monitor cylinder integrity through routine inspections for breaches, and perform maintenance and repairs to cylinders and the Full Tails Cylinder Storage Pad, as needed.

The Full Tails Cylinder Storage Pad has also been sited to minimize the potential environmental impact from external radiation exposure to the public at the site boundary. The dose equivalent rate from the pad at the site boundary will be below the regulatory limits of 10 CFR 20 (CFR 2008x) and 40 CFR 190 (CFR, 2008f). The direct dose equivalent comes from the gamma-emitting progeny within the uranium decay chain. In addition, neutrons are produced by spontaneous fission in uranium and by the ${}_{9}^{19}F$ (alpha, n) ${}_{11}^{22}Na$ reaction. Thermoluminescent Dosimeters (TLDs) will be distributed along the Owner Controlled Area fence line and at other locations as described in Section 6.1.2, Radiological Environmental Monitoring, to monitor this impact due to photons and ensure that the estimated dose equivalent is not exceeded. Refer to Section 4.12.2, Radiological Impacts, for more detailed information on the impact of external dose equivalents from the Full Tails Cylinder Storage Pad.

Experience in Europe has shown that outdoor UF_6 cylinder storage will have little or no adverse environmental impact when it is coupled with an effective and protective cylinder management program. In 35 years of operation at three different enrichment plants, the European cylinder management program has not resulted in any significant releases of UF_6 to the environment (see ER Section 3.11.1.6, Historical Exposure to Radioactive Materials, for information of the types of releases that have occurred at Urenco plants).

4.13.3.3 Mitigation for Depleted UF_6 Temporary Storage

Since UF_6 is a solid at ambient temperatures and pressures, it is not readily released from a cylinder following a leak or breach. When a cylinder is breached, moist air reacts with the exposed UF_6 solid and iron, resulting in the formation of a dense plug of solid uranium and iron compounds and a small amount of HF gas. This "self-healing" plug limits the amount of material released from a breached cylinder. When a cylinder breach is identified, the cylinder is typically repaired or its contents are transferred to a new cylinder.

AES will maintain an active cylinder management program to maintain optimum storage conditions in the cylinder yard to monitor cylinder integrity by conducting routine inspections for breaches and to perform cylinder maintenance and repairs to cylinders and the storage pad, as needed. The following handling and storage procedures and practices shall be adopted at the EREF to mitigate adverse events, by either reducing the probability of an adverse event or reducing the consequence should an adverse event occur:

All filled DUF_6 Cylinders will be stored in designated areas of the storage pad on concrete saddles (or saddles comprised of other suitable material) that do not cause cylinder corrosion. These saddles shall be placed on a stable concrete surface.

The storage array shall permit easy visual inspection of all cylinders.

The DUF_6 Cylinders shall be surveyed for external contamination (wipe tested) prior to being placed on the Full Tails Cylinder Storage Pad or transported off-site. In accordance with 49 CFR 173.443, (CFR, 2008k) the maximum level of removable surface contamination allowed on the external surface of the cylinder shall be no greater than 0.4 Bq/cm^2 (22 dpm/cm^2) (beta, gamma, alpha) on accessible surfaces averaged over 300 cm^2.

Full DUF_6 Cylinder valves shall be fitted with valve guards to protect the cylinder valve during transfer and storage.

Provisions are in place to ensure that full DUF_6 Cylinders do not have the defective valves identified in NRC Bulletin 2003-03, "Potentially Defective 1-Inch Valves for Uranium Hexafluoride Cylinders," (NRC, 2003d) installed.

All full DUF_6 Cylinders shall be abrasive-blasted and coated with a minimum of one coat of zinc chromate primer plus one zinc-rich topcoat or equivalent anti-corrosion treatment.

Only designated vehicles, operated by trained and qualified personnel, will be allowed on the Full Tails Cylinder Storage Pad, Full Feed Cylinder Storage Pad, Full Product Cylinder Storage Pad, and the Empty Cylinder Storage Pad.

Refer to the ISA Summary, Section 3.8, for controls associated with vehicle fires on or near the cylinder pads.

DUF_6 Cylinders shall be inspected for damage prior to placing a filled cylinder on the Full Tails Cylinder Storage Pad.

DUF_6 Cylinders shall be re-inspected annually for damage or surface coating defects. These inspections shall verify that:

- Lifting points are free from distortion and cracking.
- Cylinder skirts and stiffener rings are free from distortion and cracking.
- Cylinder surfaces are free from bulges, dents, gouges, cracks, or significant corrosion.
- Cylinder valves are fitted with the correct protector and cap, the valve is straight and not distorted, 2 to 6 threads are visible, and the square head of the valve stem is undamaged.
- Cylinder plugs are undamaged and not leaking.
- If inspection of a DUF_6 Cylinder reveals significant deterioration (i.e., leakage, cracks, excessive, distortion, bent or broken valves or plugs, broken or torn stiffening rings or skirts, or other conditions that may affect the safe use of the cylinder), the contents of the affected cylinder shall be transferred to another undamaged cylinder and the defective cylinder shall be discarded. The root cause of any significant deterioration shall be determined and, if necessary, additional inspections of cylinders shall be made.
- Proper documentation on the status of each DUF_6 Cylinder shall be available on site, including content and inspection dates.
- Cylinders containing liquid depleted UF_6 shall not be transported.

Site stormwater runoff from the Full Tails Cylinder Storage Pad is directed to a lined retention basin, which will be included in the site environmental monitoring plan. (See ER Section 6.1, Radiological Monitoring)

4.13.3.4 Depleted UF_6 Disposition

As described above, AES is committed to safely and temporarily storing full DUF_6 Cylinders on the EREF site. The disposition of the full DUF_6 Cylinders will utilize the DOE deconversion and disposal facilities. Section 3113(a) of the USEC Privatization Act (PL, 1996) requires DOE, if requested by the operator of a uranium enrichment facility licensed by the NRC, to accept depleted uranium for disposal, for a fee, if it is determined to be low level radioactive waste. The Commission concluded that depleted uranium is, in fact, a form of low-level radioactive waste in a January 2005 Memorandum and Order (NRC, 2005a). In accordance with the Act, therefore, it is the responsibility of DOE to accept the DUF_6 generated by the operation of EREF for disposal.

AES requested DOE to provide an estimate (AREVA, 2008) for the cost of deconversion and disposal of DUF_6 generated by EREF assuming it is initially generated in 2014 and that approximately 7,635 MT is provided annually when full production is achieved. In their response, (DOE, 2008) DOE stated that they would accept, upon request, the DUF_6 generated by the proposed EREF contingent upon the negotiation of an agreement for deconversion and disposal that includes full cost recovery of DOE's expenses. DOE estimated that these costs would range from $3.89/kg to $5.77/kg (FY 2007 dollars) of DUF_6. Deconversion would take place at the two new conversion facilities under construction at the sites of the Paducah Gaseous Diffusion Plant (GDP) and the former Portsmouth GDP in Piketon, Ohio.

4.13.3.5 Converted Depleted UF_6 Disposal

With respect to the disposal of the conversion products, DOE has been on record since 1999 that as much as possible of the depleted uranium oxide produced as a result of the deconversion process will be reused rather than disposed (DOE, 1999). In its 2004 Records of Decision related to the construction and operation of the conversion facilities (DOE, 2004a)(DOE, 2004b), DOE stated in part that the depleted uranium oxide (UO_2) conversion product will be reused to the extent possible or packaged for disposal in emptied cylinders at an appropriate disposal facility.

See also the site-specific Environmental Impact Statements for the two conversion facilities (DOE, 2004c) (DOE, 2004d).

4.13.3.6 Costs Associated with Depleted UF_6 Deconversion and Disposal

By statute, (USC, 2006b) DOE must accept depleted uranium from enrichment facilities licensed by the NRC and the DOE must be reimbursed for its costs, including a pro rata share of its capital costs. DOE's estimate of $3.89 to $5.77 (2007 dollars) (DOE, 2008) per kilogram to convert and dispose of AES's projected DUF_6 inventory is based on AES's projection that the EREF would, upon attainment of full production, generate approximately 7,635 MT of DUF_6 annually. This would amount to about 191,500 MT over the assumed operating life of the facility which, for purposes of conservatively calculating funding assurance for tails disposition, is assumed to be from 2014 to 2044.

Transportation costs from the EREF to the conversion facilities are not included in DOE's estimate. Based on information provided to AES by Transportation Logistics International, a company that moves radioactive cargo including DUF_6, AES estimates that it will cost $8,600 (FY 2008 dollars) to transport one 48Y cylinder of DUF_6 from EREF to the DOE conversion facility at Paducah. AES projects that, taking into account a ramp-up and a ramp-down period that the EREF will generate about 129,500 MT (142,749 tons) of uranium, equivalent to about 191,500 MT (211,097 tons) DUF_6 over the operating life of the facility. It is further assumed for purposes of calculating transportation costs, that the DUF_6 is stored and transported in thick-walled 48Y cylinders, each having a gross weight of about 14.9 MT and, when filled, each containing 12.5 MT DUF_6. This results in the need to transport 15,330 cylinders for the 30 year operation case from EREF to the DOE facility. The rate of $8,600 per cylinder, de-escalated to 2007 dollars using the GNP Implicit Price Deflator, is $8,290. Since each cylinder is assumed to contain 12.5 MT, this is equivalent to $0.65 per kilogram DUF_6.

The DOE deconversion facility will convert the DUF_6 into a more stable chemical form that will be loaded into the depleted uranium tails cylinders. This is assumed to be DUO_2. As a result, there will EREF DUF_6 cylinders that are assumed to be unused and disposed of as Class 1 low-level radioactive waste. The cost of disposing these cylinders as Class A low-level radioactive waste is projected to be approximately $1.32 per Kg DUF_6 (2007 dollars).

The total expected cost for conversion and disposal of the DUF_6 for purposes of funding assurance is, therefore, calculated by conservatively assuming the high end of the DOE range of $5.77 per kilogram DUF_6, adding the transportation cost of $0.65per kg DUF_6, and the cost for disposal of excess cylinders of $1.32 per kg DUF_6 for a total cost of $7.74 per kg DUF_6.

The total estimated costs for deconversion and disposal of DUF_6 is $1,482,210,000 (2007 dollars). A summary of the cost components is provided in Table 4.13-2.

The financial assurance mechanisms that will be established to ensure that adequate funds are available are described in SAR Chapter 10, Decommissioning.

4.13.4 Water Quality Limits

A single-lined Cylinder Storage Pads Stormwater Retention Basin will be used specifically to retain runoff from the Cylinder Storage Pads during precipitation. This basin will also receive treated liquid effluent from the sanitary treatment system. The unlined Site Stormwater Detention Basin will receive rainfall runoff from the balance of the developed plant site. Liquid effluents include stormwater runoff and treated sanitary waste water. There will be no discharges to a Publicly Owned Treatment Works (POTW).

Refer to Section 4.4, Water Resources Impacts, for additional water quality standards and permits and to Section 3.12, Waste Management, for information on systems and procedures to ensure water quality.

4.13.5 Waste Minimization

A high priority will be assigned to minimizing the generation of waste through reduction, reuse, or recycling. The EREF incorporates several waste minimization systems in its operational procedures that aim at conserving materials and recycling important compounds. The EREF will also have in place a Decontamination Workshop designed to remove radioactive contamination from equipment and allow some equipment to be reused rather than treated as waste.

In addition, the EREF process systems that handle UF_6, other than the Product Liquid Sampling System, will operate entirely at subatmospheric pressure to prevent outward leakage of UF_6. Cylinders, initially containing liquid UF_6, will be transported only after being cooled, so that the UF_6 is in solid form, to minimize the potential risk of accidental releases due to mishandling.

The EREF is designed to minimize the consumption of natural and depletable resources. Closed-loop cooling systems have been incorporated in the design to reduce water usage. Power usage will be minimized by efficient design of lighting systems, selection of high-efficiency motors, and use of proper insulation materials.

ALARA controls will be maintained during facility operation to minimize the generation of radioactive waste as directed in 10 CFR 20 (CFR, 2008x). The outer packaging associated with consumables will be removed prior to use in a contaminated area. The use of glove boxes will minimize the spread of contamination and waste generation.

Collected waste such as trash, compressible dry waste, scrap metals, and other candidate wastes will be volume reduced at a centralized waste processing facility that could be operated by a commercial vendor. This facility would further reduce generated waste to a minimum quantity prior to final disposal at a land disposal facility or potential reuse.

4.13.6 Control and Conservation

The features and systems described in this subsection serve to limit, collect, confine, and treat wastes and effluents from the UF_6 enrichment process. A number of chemicals and processes are used in fulfilling these functions. As with any chemical/industrial facility, a wide variety of waste types will be produced. Waste and effluent control is addressed as well as features used to conserve resources.

4.13.6.1 Mitigating Effluent Releases

The equipment and design features incorporated in the EREF are selected to keep the release of gaseous and liquid effluent contaminants as low as practicable, and within regulatory limits. They are also selected to minimize the use of depletable resources. The following equipment and design features limit effluent releases during normal operation:

- Process systems that handle UF_6 operate almost entirely at sub-atmospheric pressures resulting in no outward leakage of UF_6 to any effluent stream.
- The one location where UF_6 pressure is raised above atmospheric pressure (becomes liquid UF_6) is in the piping and cylinders inside the Product Liquid Sampling System sampling autoclave. The piping and cylinders inside the autoclave confine the UF_6. In the event of leakage, the sampling autoclave provides secondary containment of UF_6.
- Cylinders of UF_6 are transported only when cool and when the UF_6 is in solid form. This minimizes risk of inadvertent releases due to mishandling.
- Process off-gas from UF_6 purification and other operations is discharged through desublimers to solidify and reclaim as much UF_6 as possible. Remaining gases are discharged through high-efficiency filters and chemical adsorbent beds. The filters and adsorbents remove HF and uranium compounds left in the gaseous effluent stream.
- Liquids and solids in the process systems collect uranium compounds. When these liquids and solids (e.g., oils, damaged piping, or equipment) are removed for cleaning or maintenance, portions end up in wastes and effluent. Different processes are employed to separate uranium compounds and other materials (such as various heavy metals) from the resulting wastes and effluent. These processes are described in Section 4.13.7, Reprocessing and Recovery System.
- Processes used to clean up wastes and effluents create their own wastes and effluent as well. Control of these is also accomplished by liquid and solid waste handling systems and techniques. In general, careful application of basic principles for waste handling is followed in all of the systems and processes. Different waste types are collected in separate containers to minimize contamination of one waste type with another. Materials that can cause airborne contamination are carefully packaged; ventilation and filtration of the air in the area is provided as necessary. Liquid wastes are confined to piping, tanks, and other containers; curbing, pits, and sumps are used to collect and contain leaks and spills. Hazardous wastes are stored in designated areas in carefully labeled containers; mixed wastes are also contained and stored separately. Strong acids and caustics are neutralized

before entering an effluent stream. Radioactively contaminated wastes are decontaminated insofar as possible to reduce waste volume.

- In addition, following handling and treatment processes to limit wastes and effluent, sampling and monitoring is performed to assure regulatory and administrative limits are met. Gaseous effluent is monitored for HF and radioactive contamination before release; liquid effluent is sampled and/or monitored in liquid waste systems; solid wastes are sampled and/or monitored prior to offsite treatment and disposal. Samples are returned to their source where feasible to minimize input to waste streams.

4.13.6.2 Conserving Depletable Resources

The EREF design serves to minimize the use of depletable resources. Water is the primary depletable resource used at the facility. Electric power usage also depletes fuel sources used in the production of the power. Other depletable resources are used only in small quantities.

At the current state of conceptual design for the proposed EREF, the construction plan has not been developed enough to determine how much of the construction debris would be recycled. As such, there is no plan in place at this time to recycle construction materials. A recycling program will be developed as the design progresses to the final and the construction execution plan proceeds.

During operation, a non-hazardous materials waste recycling plan will be implemented. The recycling plan will start with the performance of a waste assessment to identify waste reduction opportunities and to determine which materials will be recycled. Once the decision has been made regarding which waste materials to recycle, brokers and haulers will be contacted to find an end-market for the materials. Employee training on the recycling program will be performed so that employees will know which materials are to be recycled. Recycling bins and containers will be clearly labeled. Periodically, the recycling program will be evaluated (i.e., waste management expenses and savings, recycling and disposal tonnages) and the results reported to employees.

The cost of disposal of radioactive-contaminated materials necessitates the decontamination and reuse of such materials where practicable. Chemical solutions, such as citric acid, are limited to minimize the volume of mixed waste.

The main feature incorporated in the EREF to limit water consumption is the use of closed-loop cooling systems. Other water conserving measures incorporated into the design and operation of the EREF include:

- The installation of low flow toilets, sinks and showers
- Localized floor washing using mops and self-contained cleaning machines that reduce water usage compared to conventional washing with a hose.

Power usage is minimized by efficient design of lighting systems, selection of high efficiency motors, use of appropriate building insulation materials, and other good engineering practices. The demand for power in the process systems is a major portion of plant operating cost and efficient design of components is, therefore, incorporated throughout the process systems.

4.13.6.3 Prevention and Control of Oil Spills

The EREF will implement a spill control program for accidental oil spills. Its purpose will be to reduce the potential for the occurrence of spills, reduce the risk of injury if a spill occurs, minimize the impact of a spill, and provide a procedure for the cleanup and reporting of spills.

The oil spill control program will be established to comply with the requirements of 40 CFR 112 (CFR, 2008y), Oil Pollution Prevention. As required by Part 112, a Spill Prevention, Control, and Countermeasure (SPCC) plan will be prepared prior to either the start of facility operation or prior to the storage of oil on-site in excess of the quantities established in 40 CFR 112.1(d) (CFR, 2008y). The SPCC Plan will be reviewed and certified by a Professional Engineer and will be maintained on-site.

As a minimum, the SPCC will contain the following information:

- Identification of potential significant sources of spills and a prediction of the direction and quantity of flow that would result from a spill from each such source;
- Identification of the use of containment or diversionary structures such as dikes, berms, culverts, booms, sumps, and diversionary ponds to be used at the facility where appropriate to control discharged oil;
- Procedures for inspection of potential sources of spills and spill containment/diversion structures; and
- Assigned responsibilities for implementing the plan, inspections and reporting.

In addition to preparation and implementation of the SPCC Plan, the facility will comply with the specific spill prevention and control guidelines contained in 40 CFR 112.7 (CFR, 2008aw), such as drainage of rain water from diked areas, containment of oil in bulk storage tanks, above ground tank integrity testing, and oil transfer operational safeguards.

4.13.7 Reprocessing and Recovery Systems

Systems used to allow recovery or reuse of materials are described below. The systems and processes are similar to those used at the National Enrichment Facility (NEF). The primary differences between the EREF and NEF relate to the differences in the configuration of the decontamination areas. The EREF separates the functions involved in the decontamination of plant equipment into four separate rooms: the Mobile Unit Disassembly and Reassembly Workshop, the Vacuum and Pump Dismantling Workshop, the Decontamination Workshop and the Maintenance Facility. The specific functions of these rooms are described in ER 2.1.2.3, Facility Description. For the EREF, the process vacuum pumps will be degassed in the Valve and Pump Dismantling Workshop prior to decontamination; whereas, the NEF degasses these pumps in-place. The EREF does not intend to install a Fomblin Oil Recovery System. The PFPE oil, containing uranic material, will be collected and sent to a low-level radioactive waste facility for treatment and disposal.

4.13.7.1 Decontamination System

The Decontamination Workshop in the TSB will contain the area to break down, strip and decontaminate contaminated equipment and its components. The decontamination systems in the workshop are designed to remove radioactive contamination from contaminated materials and equipment. The only significant forms of radioactive contamination found in the plant are uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4), and uranyl fluoride (UO_2F_2).

The process carried out within the Decontamination Workshop begins with receipt and storage of contaminated pumps, out-gassing, Perfluoropolyether (PFPE) oil removal and storage and pump stripping. Activities for the dismantling and maintenance of other plant components are also carried out. Other components commonly decontaminated besides pumps include valves, piping, instruments, sample bottles, tools, and scrap metal. Personnel entry into the facility will be via a sub-change facility. This area has contamination controls, washing, and monitoring facilities.

The decontamination part of the process consists of a series of steps following equipment disassembly including degreasing, decontamination, drying, and inspection. Items from uranium hexafluoride systems, waste handling systems, and miscellaneous other items are decontaminated in this process with a typical cycle time of one hour for most plant components. Sample bottles and flexible hoses are handled under special procedures due to the difficulty of handling the specific shapes and are addressed separately below.

Criticality is precluded through the control of geometry, mass, and the selection of appropriate storage containers. Administrative measures are applied to uranium concentrations in the Citric Acid Tank, Degreaser Tank, and Rinse Water Tanks in the Equipment Decontamination Cabinet to maintain these controls. To minimize worker exposure, airborne radiological contamination resulting from dismantling is extracted from the work area through the Technical Support Building Gaseous Effluent Ventilation System. Air suits and portable ventilation units are available for further worker protection.

All pipe work and vessels in the Mobile Unit Disassembly and Reassembly Workshop, Valve and Pump Dismantling Workshop, and Decontamination Workshop are provided with design measures to protect against spillage or leakage. Hazardous wastes and materials are contained in tanks and other appropriate containers, and are strictly controlled by administrative procedures. Chemical reaction accidents are prevented by strict control on chemical handling.

4.13.7.2 General Decontamination

Equipment to be decontaminated (i.e., process vacuum pumps) will be removed from the process systems and prepared for decontamination. After being taken offline, the pump flanges are sealed and it is transported to the Mobile Unit Disassembly and Reassembly Workshop and Valve and Pump Dismantling Workshop and stored before being dismantled. Pumps enter through airlock doors either individually or in pairs on pump frames. Valves, piping, flexible hoses, and general plant components are accepted into the Decontamination Workshop either in plastic bags or with the ends sealed.

Pumps waiting to be processed are stored in the pump storage array with sufficient minimum edge spacing to eliminate the possibility of accidental criticality. Pumps are not accepted if there are no vacancies in the array.

Before being broken down and stripped, all pumps are placed in the Valve and Pump Dismantling Workshop, and the local ventilation hose is positioned close to the pump flange. The flange covers are then removed from the pumps. HF and UF_6 fumes from pumps are exhausted via the vent hose, typically over a period of several hours. While in the Valve and Pump Dismantling Workshop, PFPE oil is drained from the pump, and the oil is drained into 5-L (1.3-gal) plastic containers that are labeled so each can be tracked through the process. Prior to removal from the Valve and Pump Dismantling Workshop, the outside of equipment bins, pump frames, and oil containers are monitored for radiological contamination. The various items are then taken to the decontamination system or to the PFPE oil storage array as appropriate. The PFPE oil storage array eliminates the possibility of accidental criticality. The PFPE oil will be sent to a low-level radioactive waste facility for treatment and disposal.

After out-gassing, individual pumps are placed on either of the two hydraulic stripping tables. The pump and motor are stripped to component level using various hydraulic and hand tools. Using the overhead crane or mobile jig truck, the components are placed in bins ready for transportation to the General Decontamination Cabinet in the Decontamination Workshop.

Components requiring degreasing are cleaned manually and then immersed into the Degreaser Tank in the Equipment Decontamination Cabinet. An open top tank with a sloped bottom is used for removing the residual PFPE oil and greases that may inhibit the decontamination process. The sloped bottom construction is provided for draining the tank completely. During the degreasing process, a pump continuously recirculates the tank contents to accommodate sampling for criticality prevention. The tank has a capacity of 800 L (211 gal), and level control with a local alarm is provided to maintain the liquid level. It is furnished with an ultrasonic agitation facility, and a thermostatically controlled electric heater to maintain the temperature at 60°C (140°F). The tank has a ring header and a manual hose to rinse out residual solids/sludge with deionized (DI) water after the batch has been pumped to the Liquid Effluent Collection and Treatment System.

The degreased components are inspected and then transferred to the Citric Acid Tank where decontamination is accomplished by immersing the contaminated component in a citric acid bath. The Citric Acid Tank and pump system have the same components as the Degreaser Tank and are operated and controlled in the same fashion as the Degreaser Tank. In order to minimize uranium concentration, the rinse water from the final Rinse Water Tank is pumped into the second Rinse Water Tank (closer to the Citric Acid Tank), which in turn is pumped into the Citric Acid Tank. This counter-current system eliminates a waste product stream by concentrating the uranics in the Citric Acid Tank. The rinse water transfer pump is linked with a high level alarm on the Citric Acid Tank to prevent overfilling. After approximately 15 minutes, the component is removed from the Citric Acid Tank to be rinsed.

Two open top Rinse Water Tanks with sloped bottoms are provided to rinse excess citric acid from decontaminated components. Each has a liquid capacity of 800 L (211 gal). Both tanks are furnished with ultrasonic agitation, a thermostatically controlled electric heater to maintain the content’s temperature at 60°C (140°F), and a recirculation pump facility to accommodate sampling for criticality prevention. The sloped bottom is provided for draining the tank completely. Fresh DI water is manually added to the final rinse tank as needed. The water from this tank is pumped into the second Rinse Water Tank (closer to the Citric Acid Tank) to minimize uranium concentration. Level control is provided to maintain the rinse water level. A manual spray hose is available for rinsing each tank after it has been emptied.

All components are dried after decontamination. This is performed manually using compressed air inside the cabinet while the components are still in the basket.

Each of the tanks is sampled periodically to determine the condition of the solution and any sludge present. The Citric Acid Tank and Degreaser Tank contents are analyzed for uranium concentration and citric acid concentration. The results of the analysis are compared to administrative limits set for the uranic content and for the pH of the solutions. Spent solutions, consisting of citric acid, degreasing water, and various uranyl and metallic citrates, are transferred to collection tanks in the Liquid Effluent Collection and Treatment System. After monitoring, the Degreaser Tank waste contents are pumped into the Degreaser Water Collection Tank and the Citric Acid Tank waste solution is pumped into the Spent Citric Acid Collection Tank. The solids contents from both tanks are sprayed with fresh DI water and the resultant mixtures are also pumped to their respective destinations. The Rinse Water Tanks are checked for satisfactory pH and uranic levels; unusable water is transferred to an effluent collection tank in the Liquid Effluent Collection and Treatment System. The quantity of contamination remaining is “as low as reasonably achievable.” Components released for unrestricted use do not have contamination exceeding administrative limits. However, if a component’s surface contamination cannot be monitored or if the contamination exceeds administrative limits, then the component is disposed of as low-level radioactive waste. All materials of construction are compatible with the process solutions at operating conditions.

The activities carried out in the Decontamination Workshop give rise to a potentially contaminated gaseous stream, which requires treatment before discharging to the atmosphere. These streams consist of air with traces of UF_6, HF, and uranium particulates (mainly UO_2F_2). Air exhausted from the Equipment Decontamination Cabinet, the Sample Bottle Decontamination Cabinet, and the Flexible Hose Decontamination Cabinet is vented to the Technical Support Building (TSB) GEVS to ensure airborne contamination is controlled. There are local ventilation ports in the Mobile Unit Disassembly and Reassembly Workshop, and the Valve and Pump Dismantling Workshop that operate under vacuum with all air discharging through the TSB GEVS. The TSB GEVS is designed to route these streams to a filter system and to monitor, on a continuous basis, the resultant exhaust stream discharged to the atmosphere. The room itself has HVAC ventilation.

4.13.7.3 Sample Bottle Decontamination

The Decontamination Workshop has a separate area dedicated to sample bottle storage, disassembly, and decontamination, called the Sample Bottle Decontamination Cabinet. Valves are also decontaminated in this cabinet. The decontamination system for valves and sample bottles requires a citric acid rinse and a DI water rinse for both items.

Used sample bottles are weighed to confirm the bottles are empty upon entry into the workshop. The sample bottle valves are loosened outside the cabinet and then are removed once inside the cabinet. A small open container is filled with a citric acid solution. The sample bottles are filled with a clean citric acid solution from this container. Any loose material inside the bottle is dissolved in the solution, which is then poured into a waste tank. The sample bottles are then filled with DI water and left to stand for approximately an hour.

The removed valves are linked together in series before being placed downstream of a pump. The pump is fed from a Citric Acid Tank filled with citric acid solution. Citric acid is then recirculated in a closed loop through the valves for an hour. The citric acid solution is drained to 5-L (1.3-gal) citric acid/uranic wastes containers. The valves are rinsed after the decontamination step using fresh DI water.

The bottles and valves undergo a second DI water rinsing, and then dried manually using heated compressed air and inspected for contamination and rust. The resulting waste solutions from cleaning the bottles and the valves are collected in 5-L (1.3-gal) citric acid/uranic wastes containers. The solutions are then manually transferred to the Citric Acid Tank in the Equipment Decontamination Cabinet. Any liquid spillages / drips are soaked away with paper tissues that are disposed of in the Solid Waste Collection System.

During the process, air from the cabinet vents to the TSB GEVS to ensure that airborne contamination is controlled. The bottles are then put into an electric oven to ensure total dryness, and on removal are ready for reuse. The cleaned components are transferred to a clean workshop for reassembly followed by pressure and vacuum testing.

4.13.7.4 Flexible Hose Decontamination

The decontamination of flexible hoses is performed in a Flexible Hose Decontamination Cabinet. This decontamination cabinet is designed to process only one flexible hose at a time and consists of recirculation loops of citric acid solution and DI water.

The flexible hose is attached in a closed loop downstream of a closed citric acid tank and a recirculation pump. The flexible hose is flushed with a heated citric acid solution. After the citric acid wash, the hose is attached in a closed loop downstream of a closed DI water tank and a pump. It is then rinsed with heated DI water in a recirculation system. Each flexible hose is then dried in the cabinet using heated compressed air. The cleaned, dry flexible hose is then transferred to the Vacuum Pump Rebuild Workshop for reassembly and pressure testing prior to reuse in the plant.

4.13.8 Comparative Waste Management Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the EREF, including an alternative of "no action" i.e., not building the EREF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action," alternative scenarios addressed in Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and GEH deploys their plant using Silex enrichment technology: The waste management impacts would be the same since three enrichment plants would be built and the SWU capacity would be about the same.

Alternative Scenario C - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and LES increases its centrifuge plant capacity: The waste management impacts would be about the same since overall SWU capacity would be about the same.

Alternative Scenario D - No EREF; LES and USEC deploy gas centrifuge plants, USEC phases out the Paducah gaseous diffusion plant (GDP) and USEC increases its centrifuge plant capacity: The waste management impacts would be about the same since overall SWU capacity would be about the same.

TABLES

Table 4.13-1 Possible Radioactive Waste Processing / Disposal Facilities
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Radioactive Waste Processing / Disposal Facility	Acceptable Wastes	Approximate Distance km (mi)
EnergySolutions Clive, Utah	Radioactive Class A Mixed	475 (295)
EnergySolutions Oak Ridge, Tennessee	Radioactive Class A Some Mixed	3,068 (1,907)
U.S. Ecology Richland, Washington	Radioactive Class A, B and C	885 (550)
Depleted UF_6 Conversion Facility Paducah, Kentucky	Depleted UF_6	2,610 (1,622)
Depleted UF_6 Conversion Facility Portsmouth, Ohio	Depleted UF_6	3,002 (1,865)

Table 4.13-2 Summary of Estimated Costs for Disposal of DUF_6 at DOE Deconversion Facilities

Activity	Cost per Kilogram	Total Cost per Activity
Transportation of 191,500 MT DUF_6 in 15,330 48Y cylinders to DOE conversion facilities	$0.65 per kilogram DUF_6	$124,475,000
Conversion/disposal of 191,500 MT DUF_6	$5.77 per kilogram DUF_6	$1,104,955,000
Disposal of unused empty depleted uranium tails cylinders	$1.32 per kilogram DUF_6	$252,780,000
TOTAL (2007 Dollars)	$7.74 per kilogram DUF_6	$1,482,210,000