4.0 ENVIRONMENTAL PROGRAM INFORMATION

Reported in this section are the environmental stewardship programs for the Nevada Test Site (NTS). These programs are under the purview of the Environment, Safety and Health Division (ESHD) of the U.S Department of Energy (DOE), National Nuclear Security Administration Nevada Operations Office (NNSA/NV) for environmental management and compliance, field investigations for impact assessment, ecosystem management, pollution prevention (P2), waste minimization, science, and technology development.

4.1 ROUTINE RADIOLOGICAL ENVIRONMENTAL MONITORING PLAN

The NNSA/NV manages the NTS in a manner that meets evolving NNSA missions and responds to the concerns of affected and interested individuals and agencies. The Routine Radiological Environmental Monitoring Plan (RREMP) addresses compliance with DOE Orders and other drivers requiring routine effluent monitoring and environmental surveillance on the NTS. The RREMP describes the objectives and design elements for all media: air, water, soil, biota, and direct radiation sources. Existing and historical site information and regulatory requirements were reviewed and site characteristics, transport and exposure pathways, regulatory requirements, and historical data evaluated to support the monitoring designs. Both onsite and offsite monitoring objectives are addressed under the RREMP.

The RREMP identifies the requirements for radiological monitoring on and off the NTS and focuses on the need to ensure that the public and the environment are protected, that compliance with the letter and the spirit of the law is achieved, and that good land stewardship is practiced. The monitoring plan uses a decision-based approach to identify the environmental data that are collected and provides Quality Assurance, Analysis, and Sampling Plans, which ensure that defensible data are generated.

AIR MONITORING

Environmental monitoring includes the activities of environmental surveillance, effluent monitoring, and operational monitoring. For air monitoring, the principal difference among these three activities is the placement of the air sampling equipment. Environmental surveillance targets ambient air, but not specific facilities; while effluent and operational monitoring target facilities or activities. Effluent monitoring is directed at the measurement of a specific emission point, while operational monitoring is used to assess total emissions from an operating facility. The rationale, supporting the design of the air monitoring network for the NTS, addresses these types of monitoring and is discussed thoroughly in the RREMP.

The objective for the air monitoring network is to monitor all NTS radionuclide emissions above some reasonable lower limit, such that no significant emission source that contributes to calculable offsite exposures is ignored and to ensure that the NTS is in full compliance with the requirements of the Clean Air Act. The regulatory driver for this network includes Title 40 Code of Federal Regulations (CFR) 61, "National Emission Standards for Hazardous Air Pollutants (NESHAPs): Radionuclides," Subpart H – "National Emission Standards for Emission of Radionuclides Other Than Radon From Department of Energy Facilities." Other drivers include DOE Order 5400.1 – "General Environmental Protection Program," DOE Order 5400.5 – "Radiation Protection of the Public and the Environment," and DOE/EH-0173T – "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance." These documents prescribe dose limits and air monitoring requirements.

To comply with the regulations listed above, a combination of approaches is used:

- Evaluating operational contributions through measurement of particulate-in-air and tritium-in-air emissions from such sources as the Radioactive Waste Management Sites (RWMSs) in Areas 3 and 5, and the Waste Examination Facility.
- Monitoring air at locations on the NTS known to be contaminated with radionuclides in order to evaluate the behavior of radionuclide emissions from those locations.
- Calculation of tritium in air based on the amounts of tritium in surface waters, confirmed through the observed behavior of tritium in air near tritium sources.
- Modeling particulate emissions in air using a soil resuspension model, based on the observed behavior of particulate emissions in air and confirmed by particulate air monitoring data in selected offsite locations.
- Calculating an effective dose equivalent for each specific emission source at the NTS, using the CAP88-PC model as prescribed by NESHAPs, to provide dose calculations for all populated locations within 80 km (50 mi) (the location of the general public is assessed annually).

During the year 2000, no point sources qualified for offsite monitoring under NESHAPs requirements (capable of emitting $\geq$1 percent of the standard); however, point sources are continually evaluated for this potential. Accidental releases from facilities such as U-1a, Area 27, or the Device Assembly Facility will be monitored through the ambient monitoring network.

SURFACE WATER

The objectives of the routine radiological monitoring program for surface water are to determine (1) if concentrations of radionuclides in surface water bodies at the NTS and its vicinity are a threat to public health and the environment, and (2) if permitted facilities are in compliance with permit discharge limits.

The surface water sample locations on the NTS include the E Tunnel containment ponds and nine sewage lagoons; offsite locations include nine natural springs. The criteria for selection were based on the monitoring objectives. Water sources have been selected based on potential for exposing the public, onsite biota, or the environment to significant levels of radionuclides, or requirements for monitoring under existing state discharge permits. The sources are as follows:

- Discharge from E Tunnel is collected in containment ponds and monitored under the current state permit.
- The nine sewage lagoons at the NTS receive effluents from sewage treatment plants permitted by the state (Bechtel Nevada [BN] 1997). Radionuclide monitoring of these lagoons is required under the current state permit.

- Several offsite springs have been historically monitored and will continue to be monitored under this program. Six of the historically monitored springs are included in this plan; three springs not previously monitored will be added to the program; one for semiannual and two for annual sampling. These springs are discharge sites for the local and regional aquifers, for which the upgradient direction may be the underground testing area on Pahute Mesa. The offsite springs chosen for the monitoring network are therefore used as groundwater monitoring points in this hydrologic system. Continued monitoring will document and track trends in groundwater quality downgradient of the underground nuclear test sites on the NTS. Radionuclide levels at all these surface water sources mentioned above have consistently been below the Derived Concentration Guides listed in DOE Order 5400.5 over recent years (DOE 1990b).

GROUNDWATER

The characteristics of regional and local groundwater regimes at the NTS and the sources of radionuclides with potential impacts on groundwater are presented in Chapters 7.0 and 8.0 of this report. Groundwater is monitored onsite and offsite to comply with several regulatory drivers.

The objectives of the routine radiological monitoring program for groundwater include:

- **Water Supply Well Monitoring:** Determine if onsite water supply wells are impacted from radionuclides originating from NNSA operations on the NTS.

- **Permitted Facilities Monitoring:** Determine if there are groundwater impacts from surface and shallow vadose zone sources of radionuclides on the NTS.

- **Aquifer Monitoring:** Determine if groundwater at the NTS and its vicinity is further degraded as a result of the expansion of the radionuclide plumes associated with the underground test areas.

- **Water-level Information:** Determine the potential impact of demand for groundwater around the NTS on the long-term availability of water.

Water Supply Wells

Groundwater is the only local source of drinking water at the NTS and the surrounding area. The state permit for the NTS includes four drinking water supply systems that consist of ten potable water wells. These wells are sampled to determine compliance with the Safe Drinking Water Act (SDWA) and Nevada Revised Statutes (NRS), which include standards for radionuclides. In addition to the water supply wells onsite, the network will include offsite water supply and existing monitoring wells selected based on the following criteria:

- Select point-of-use water supply wells downgradient of the NTS (in the general direction of regional groundwater flow). Current site knowledge eliminates the possibility of transport of radionuclides from source areas to wells upgradient of the NTS, or opposite to the general direction of regional groundwater flow.

- Select wells close to the NTS boundary and in close proximity to the underground testing areas.

- Give preference to community wells.

- Give preference to high-yield, high-volume wells.
- Give preference to wells with appropriate construction/condition.
- Select wells where access is possible.
- Consult with Community Environmental Monitoring Programs to ensure that the concerns of local communities are addressed.

Permitted Facilities Wells

Five wells located at three facilities require routine groundwater monitoring under the terms of permits issued by the state of Nevada. These facilities are the Area 5 RWMS (RWMS-5), the Area 23 Infiltration Basin, and the Area 12 E Tunnel pond.

The Pit 3 Mixed Waste Disposal Unit located in the RWMS-5, currently under Resource Conservation and Recovery Act (RCRA) Interim Status, maintains compliance with Title 40 CFR 264/265 by monitoring three wells around the RWMS-5.

To comply with the groundwater protection requirements of the state General Permit GNEV93001, a monitoring well was installed (SM-23-1) in 1996 for the Area 23 Infiltration Basin.

Water Pollution Control Permit NEV96021, in compliance with the provisions of the Federal Water Pollution Control Act and NRS, allows NNSA/NV and the Defense Threat Reduction Agency to manage and operate a system for the treatment and disposal of waste water discharging from the portal of E Tunnel in Area 12 of the NTS. The effluent from the portal is conveyed into six earthen impoundments for disposal by means of infiltration.

Groundwater from the five permitted wells is sampled for the necessary constituents and at the required frequency as stated in the permit.

Aquifer Monitoring

The RREMP includes an interim effort to identify existing wells and boreholes (called point-of-opportunity wells), that are located downgradient of the Corrective Action Units (CAUs) and/or are in the regional aquifer. Point-of-opportunity wells located within CAUs have been screened based on the following criteria for their inclusion in the proposed network:

- Select point-of-opportunity wells downgradient of source areas.
- Give preference to wells within 1,000 m (3,280 ft) of underground tests, which are located below or within two cavity radii of the water table.
- Select wells accessing relevant hydrostratigraphic units within structural blocks having an upgradient source or sources.
- Give priority to wells in those transmissive units which also contain most of the underground test locations.

Wells screened have been further scrutinized to select those which would be most cost-effective to monitor, with the following construction criteria:

- Give priority to wells with immediate access to the aquifer.
- Give priority to wells with diameters already appropriate for sampling.
- Give priority to wells that are already completed (developed, casing exists, etc.).

Point-of-opportunity wells are existing wells which, according to the present level of understanding, appear to be at appropriate locations and completed in appropriate hydro-stratigraphic units. It is important to note that the groundwater monitoring in the RREMP is an interim program until the final CAU postclosure monitoring network can be designed and implemented.

Hot wells, also referred to as source-term characterization wells, are those used to sample groundwater from within or near the cavities produced by underground nuclear tests that were conducted below the water table. These groundwater samples are used to define the hydrologic source term (the type and concentration of radionuclides dissolved in groundwater, or potentially available to groundwater). Source term information fulfills the requirement in DOE Order 5400.1 to monitor the effects of NNSA/NV activities on the environment. This monitoring allows estimates to be made of the rate of radionuclide migration from the underground nuclear tests.

In addition to wells monitored for potential releases, water-level measurements will be performed for each sampling event at all wells if practical (e.g., no downhole pump in well). There are wells onsite and offsite that are monitored only for water levels by the U.S. Geological Survey (USGS). Data from these wells are analyzed for trends, impacts of water usage, and used to calibrate groundwater flow models.

VADOSE ZONE MONITORING (VZM)

The vadose zone is being monitored at three general types of sites on the NTS: RWMSs (Areas 3 and 5); RCRA closure sites (Area 23 Hazardous Waste Landfill and U-3fi); and permitted sanitary landfills (U-10c Landfill and the Area 6 Hydrocarbon Landfill) in addition to, or in lieu of, groundwater monitoring for the purpose of protecting groundwater resources. VZM at these sites generally consists of monitoring changes in soil moisture.

VZM offers many advantages over groundwater monitoring including detecting potential problems long before groundwater resources would be impacted, allowing corrective actions to be made early, and being less expensive than groundwater monitoring.

VZM at the RWMSs is driven by DOE Orders and conducted to confirm Performance Assessment (PA) assumptions regarding the hydrologic conceptual models including soil water contents, and upward and downward flux rates. VZM at RCRA closure sites and sanitary landfills is driven entirely by agreements with the Nevada Division of Environmental Protection (NDEP). Vadose zone monitoring at all NTS sites is also conducted to:

- Demonstrate negligible infiltration of precipitation into zones of buried waste
- Detect changing trends in performance
- Establish baseline levels for long term monitoring.

Compliance at the RWMSs is achieved by demonstrating that PA assumptions are valid, and that there is negligible infiltration of precipitation into zones of buried waste. Compliance at the RCRA sites and sanitary landfills is achieved by demonstrating that soil moisture levels remain within limits agreed to with NDEP.

At the RWMSs, VZM is conducted by measuring all the water balance components at several locations to account for some spatial variability, and to apply that water balance to an entire RWMS using a concept of surrogate sampling. This type of VZM is not leak detection, it is performance monitoring.

Water balance measurements activities include:

- Meteorological monitoring to measure precipitation (the driving force for downward flow), and to calculate potential evapotranspiration (the driving force for upward flow),
- Lysimeters (weighing and drainage) to measure infiltration, soil water redistribution, bare-soil evaporation, evapotranspiration, and deep drainage.
- Neutron logging through access tubes to measure infiltration, soil water redistribution, and to monitor a large spatial area (in some locations to depths of hundreds of feet).
- Automated vadose zone monitoring systems with *in situ* sensors (time domain reflectometry probes, and heat dissipation probes) to measure soil water content and soil water potential over a large spatial area, but usually to a limited depth.
- Soil-gas sampling for tritium to confirm PA assumptions and transport coefficients.

This strategy provides an accurate estimate of the RWMS water balance including any drainage through the RWMS waste covers, and therefore, potential recharge. Based on these data, as well as other work (Tyler et al., 1996), there is essentially no recharge to the groundwater under current conditions in the valleys of the NTS (including the RWMSs), and all precipitation is effectively returned to the atmosphere by plant transpiration and soil evaporation.

The VZM strategy for the two RCRA closure sites and permitted sanitary landfills is similar to the RWMS strategy and is based on monitoring soil moisture at points of opportunity. At these sites, neutron logging is conducted in boreholes that were originally drilled for site characterization purposes. Neutron logging at these sites provides data to confirm that there is negligible infiltration of precipitation into zones of buried waste.

A summary of some selected NTS VZM data can be found in Chapter 8.0.

BIOTA MONITORING

Historical radionuclide studies on the NTS focused on man-made transuranics and showed declining concentrations in plants and animals over time (DOE 1992), although some plant and animal samples still contain measurable levels (EG&G/EM 1993; U.S. Environmental Protection Agency [EPA] 1996). These past studies indicate that significant radionuclide damage to plants and animals on the NTS would occur only during atmospheric nuclear testing. Given the current NNSA/NV project and land use policy, it is unlikely that NTS radionuclide contamination poses a significant threat to biota, although data to confirm this conclusion have yet to be taken. Past studies, although limited in scope and area, indicate that radionuclides in NTS plants and animals posed no significant threat of radiation exposure to the offsite public. Current NTS land use precludes the harvest of plants or plant parts (e.g., pine nuts, wolf berries) for direct consumption by humans. Therefore, the primary potential exposure pathway of radionuclides in NTS plants to the public is through ingestion of game animals. Game animals (e.g., mourning doves, chukar, rabbits as surrogates for Deer) may eat contaminated plants, seeds, or soil or they may drink contaminated water on the NTS and then travel offsite where they are subsequently hunted by the public for food. The expected public dosage via these pathways from NTS biota are well below established dose limits.

Offsite plants and animals, namely crops and livestock in neighboring communities, have also been monitored for years to document possible radionuclide exposure to the public (EPA 1978; EPA 1996). The only possible current pathway for radiation exposure through crops is their uptake of radionuclides from soil which was contaminated during past atmospheric tests. There are several communities to the north and east of the NTS (e.g., Rachel, Alamo, Hiko) that have received radioactive fallout in the past from these tests. Recent radioanalysis of selected fruits and vegetables from these communities has shown levels of tritium, strontium, and plutonium near or below detection limits (EPA 1996). Livestock or game animals within the same downwind fallout areas could ingest contaminated forage and then be consumed by humans. Strontium levels in the bones of deer, cattle, and bighorn sheep sampled in 1993 off the NTS were above detection limits, but have consistently decreased in samples since the early 1960s since cessation of aboveground testing (EPA 1996). The edible portions of these offsite animals historically contain nondetectable levels of radionuclides. However, strontium levels in milk from pasture-fed cows sampled from neighboring Nevada ranches have been periodically measured at levels above detection limits (EPA 1996).

Given the assumption that there exists no significant risk to plants, animals, or the public through the food chain from radionuclide contamination, it is still expedient to include biota samples within the framework of this monitoring at the NTS for the following reasons:

- Some level of biota monitoring is needed to comply with DOE Order 5400.1.
- Biota monitoring data are needed to validate the integrity of land buffers.
- Biota data will be needed to address current and future land-use issues.

The NTS Biota monitoring effort is designed for radiological monitoring of NTS plants and animals and focused on sampling those sites having the highest known concentrations of radionuclides in other media. The intent is to concentrate monitoring efforts at sites where the likelihood for radionuclides to enter plants and game animals is the highest on the NTS, including:

- Runoff areas or containment ponds associated with underground or tunnel test areas.
- Plowshare sites.
- Atmospheric test areas.
- Atmospheric safety experiment sites.

A control site for each contaminated site will be selected and will have similar biological and physical features, but will have no history of radionuclide contamination from NNSA/NV activities above worldwide levels of fallout. Measurements from the control sites will be used to document radionuclide levels in biota from areas believed to be uncontaminated by past and ongoing NNSA/NV activities and representative of background levels.

NTS Chukar Sampling Sites

In the past, the Nevada Division of Wildlife (NDOW) has requested, and has been granted, permission to trap and remove chukar from the NTS. The chukar are then released in areas open to public hunting. Chukar are trapped by the NDOW at one to three of the numerous natural springs on the NTS. Chukar trapped at these springs are not expected to be contaminated, but they will be sampled from these springs for radiological analysis on a routine basis. In 2000, attempts were made to trap Chukar, but were unsuccessful.

DIRECT RADIATION MONITORING

Direct radiation monitoring is used to detect radiation exposures caused by sources that emit X rays, gamma rays, charged particles, and/or neutrons. Such monitoring can be done in real time by use of appropriate survey meters or by pressurized ion chambers (PICs) to obtain exposure rate and by various types of solid-state dosimeters to obtain total exposure.

The objective of onsite Thermoluminescent Dosimeter (TLD) and PIC monitoring is to assess the state of the NTS's external radiation environment, detect changes in that environment, and measure gamma radiation levels near and in contaminated areas on the NTS. The onsite monitoring program will be used for trend analysis, in conjunction with fly-over data and demarcation studies, and to comply with DOE Orders. The data from environmental TLDs may also be used during future facility siting decisions.

4.2 POLLUTION PREVENTION AND WASTE MINIMIZATION PROGRAM

When economically feasible, source reduction is the preferred method of handling waste, followed by reuse and recycling, treatment, and, as a last resort, land disposal. The NNSA systematic approach to source reduction is achieved by performing pollution prevention opportunity assessments (PPOAs). The objective of a PPOA is to identify methods to reduce energy consumption and/or eliminate waste streams via a planned and documented procedural process. Subsequently, the technical and economical feasibility of options are evaluated, and the most feasible option is selected for implementation. Options include product substitution, process change (i.e., use of alternate equipment or procedure), and onsite and offsite recycling. When selecting which PPOA to perform, the goal is to reduce or eliminate the volume and/or toxicity of waste.

Another effective method for source reduction is the coordination of the material exchange program within NNSA/NV and between NNSA/NV and other agencies (e.g., EPA). Unwanted chemicals, supplies, and equipment are posted on the intranet material exchange list so that individuals in need can obtain the items at no cost. These materials are destined for disposal, either as solid or hazardous waste, as a result of process modification, discontinued use, or shelf life expiration. Rather than disposing of these items, the majority of them are provided to other employees for their intended purpose, thus avoiding disposal costs and costs for new purchases. If items are not placed with another user, they can be returned to the vendor to be recycled or reused.

EMPLOYEE AND PUBLIC AWARENESS

As stated in DOE Order 5400.1, chapter III-4c, NNSA/NV's P2 program must include the implementation of an employee awareness program. Employee awareness of P2 issues throughout NNSA/NV is accomplished by dissemination of articles through both electronic mail and NNSA/NV newsletters, the development and maintenance of a P2 intranet website, employee training courses, and participation at employee and community events. These activities are intended to increase awareness of P2 and environmental issues and their role in improving environmental conditions in the workplace and community.

POLLUTION PREVENTION ACTIVITIES

The NNSA/NV demonstrated efforts to deactivate reactive waste, specifically the treatment of waste explosives at the NTS Area 11 Explosive Ordnance Disposal Unit (EODU). Approximately 16.8 kg (37.1 lb) of reactive hazardous waste (waste explosives) were treated at the EODU during calendar year (CY) 2000.

One PPOA was implemented during CY 2000. A process was established to recycle all electronic media (floppy disks, compact disks, backup tapes, magnetic tapes, reel-to-reel tapes, video tapes, audio tapes, etc.). Unused and/or obsolete electronic media is sent to the

Information Systems Department electronic media repository. At the repository, it is sorted between unusable and usable. Usable electronic media is redeployed to personnel with a need for that media. Unusable media is packaged and sent to an offsite vendor. The media is degaussed to remove all information, disassembled, and the parts recycled. Approximately 2.56 metric tons (mt) of material and equipment was sent to an offsite vendor for recycle in CY 2000.

Through the material exchange program, approximately 0.81 mt of materials and equipment were exchanged. Both hazardous and non-hazardous materials were included.

The following activities enhanced employee awareness of P2 practices:

- Earth Day: The week-long event included an exhibit of office products containing post consumed recycled materials in accordance with Affirmative Procurement; handouts of literature on helpful P2 hints; articles published in the Sitelines publication; P2 messages through electronic mail; and distribution of promotional items made from recycled materials as daily reminders regarding the benefits of recycling.

- Holiday and all-occasion card collection: Holiday and all-occasion cards are collected and donated to St. Jude’s Ranch for abused and neglected children. These cards are recycled into new cards. The new cards are then sold in the St. Jude’s Ranch gift shop. Proceeds from the sale help support the children.

- Integrated Safety Management Day: The event included an exhibit of P2 success stories; literature containing P2 holiday tips; literature about composting; and distribution of promotional items made from recycled materials as daily reminders regarding the benefits of recycling.

- Family Day at the NTS: The event included an exhibit of the various P2 and Waste Minimization activities performed at the NTS; literature containing P2 tips; literature about composting; and distribution of promotional items made from recycled materials as daily reminders regarding the benefits of recycling.

- Publication of various P2 articles: Another means of employee communication includes dissemination of articles through both electronic mail and NNSA/NV newsletters with the intent of increasing employee awareness of environmental issues and their role in improving environmental conditions in the workplace and community.

- P2 Website: An intranet P2 website has been on-line since April 1998. Information found on the website includes, but is not limited to: points of contact, management commitment, P2 Program Plan, P2 success stories, employee suggestions, material exchange program, list of people interested in car pooling, and current P2 activities.

- Training: Management and employees are instructed in P2 and waste minimization policies and practices during classroom training courses (e.g., Hazardous Waste Site General Worker Operator and Emergency Response, Waste Management for the Generator, Rad Worker II, and General Employee Orientation).

VOLUME AND TOXICITY REDUCTION

Table 4.1 is an overview of the estimated RCRA hazardous waste and toxicity reduction through implementation of P2, waste minimization, material exchange, and recycling activities during CY 2000. These activities eliminated an estimated 102.3 mt of RCRA hazardous waste.

RECYCLING ACTIVITIES

Through recycling, hazardous and solid waste disposal can be significantly reduced or eliminated, reducing costs associated with disposal, shipping, and labor. Table 4.2 lists the recycling activities that occurred at NNSA/NV.

4.3 HAZARDOUS MATERIALS SPILL CENTER (HSC)

Biological monitoring at the HSC is required for certain types of chemicals under the Center's Environmental Assessment. These chemicals have either not been tested before, have not been tested in large quantities, or have uncertain modeling predictions of downwind air concentrations. In addition, the NNSA's ESHD has requested that BN monitor (downwind) any test which may impact plants or animals outside the experimental area.

A document entitled "Biological Monitoring Plan for Hazardous Materials Testing at the Liquefied Gaseous Fuels Spill Test Facility on the Nevada Test Site" (BN 1996) has been prepared that describes the conduct of field surveys used to determine test impacts on plants and animals and verify that the spill program complies with pertinent state and federal environmental protection legislation. The monitoring plan calls for the establishment of three control transects and three treatment transects, which have similar environmental and vegetational characteristics, at three distances from the chemical release point. BN biologists review spill test plans to determine if field monitoring along the treatment transects is required as per the monitoring plan criteria.

BN reviewed chemical spill test plans for one experiment: REOP-CHLOREP Special Equipment and Techniques Mercury Workshop. Biota monitoring was not conducted for any of the chemical tests at the HSC during 2000. No baseline monitoring was conducted at established control-treatment transects near the HSC due to insufficient funding.

4.4 RADIOACTIVE WASTE MANAGEMENT SITES

DISPOSAL ACTIVITIES

The Areas 3 and 5 RWMSs, at the NTS, are designed and operated for disposal of low-level waste (LLW) from onsite, NNSA offsite, and other offsite generators and mixed waste from onsite. All generators of waste streams must first request to dispose of waste, submit an application for specific waste streams, meet NTS Radioactive Waste Acceptance Criteria, and receive approval for disposal by NNSA/NV. Waste Acceptance criteria are based on how well the site is predicted to perform as described in Performance Assessment/Composite Analysis documents. Environmental Monitoring collects data to determine if performance is as expected and to meet regulatory compliance requirements. Disposal consists of placing waste in various sealed containers in the unlined pits and trenches. Soil backfill is pushed over the containers in a single lift, approximately 2.4 m (8 ft) thick, as rows of containers reach approximately 1.2 m (4 ft) below original grade.

Waste disposal at the RWMS-5 has occurred in a 37-hectare (92-acre) portion of the site, referred to as the LLW Management Unit (LLWMU), since the early 1960s. The LLWMU consists of 23 landfill cells (pits and trenches) and 13 Greater Confinement Disposal (GCD) boreholes. Four of the GCD boreholes were used to dispose of transuranic (TRU) waste and are no longer active; five contain LLW and are no longer active; and the remaining four have not been backfilled with soil. Of the 23 landfill cells, 5 are open for disposal of LLW, one is an active mixed waste disposal unit, and one is used for disposal of asbestos-form LLW. The remaining 15 landfill cells are covered and no longer active (14 contain low-level radioactive waste and 1 contains TRU waste). In CY 2000, the RWMS-5 received 312 shipments containing 346,664 cubic feet of LLW and 2 shipments containing 40 cubic feet of Mixed LLW (MLLW) for disposal.

Key documents in place that are necessary for disposal operations to occur are as follows:

- A Disposal Authorization Statement (DAS) was issued in December 2000 for RWMS-5.
- Performance Assessment for the RWMS-5 at the NTS, Nye County, Nevada, Revision 2.1, January 1998.
- Composite Analysis for the RWMS-5 at the NTS, Nye County, Nevada. February 2000.
- NTS Waste Acceptance Criteria (NTSWAC) Revision 3 - December 2000.
- Integrated Closure and Monitoring Plan (ICMP) for the Areas 3 and 5 RWMS's at the NTS, October 2000.
- Auditable Safety Analysis (ASA) for the Areas 3 and 5 RWMSs August 2000.

Waste disposal cells within the Area 3 RWMS (RWMS-3) are subsidence craters resulting from underground nuclear testing. Disposal operations began in the late 1960's. Of the seven craters within the RWMS-3, three are active, two are closed, and two are not in use. In CY 2000, the RWMS-3 received 275 shipments containing 378,596 cubic feet of LLW for disposal.

Key documents in place that are necessary for disposal operations to occur are as follows:

- A DAS was issued in October 20, 1999 for the RWMS-3.
- Performance Assessment/Composite Analysis for the RWMS-3 at the NTS, Nye County, Nevada, Revision 2.0, September 1997. This document was revised in response to the DAS conditions and submitted to the DOE Headquarters for review and approval. The document is currently under review.

The NTSWAC, ICMP, and ASA are the same as described for RWMS-5.

STORAGE ACTIVITIES

The RWMS-5 stores LLW, MLLW, TRU, and Mixed TRU (MTRU) waste for characterization to determine treatment and disposal options. TRU and MTRU waste is being characterized for disposal at Waste Isolation Pilot Plant in New Mexico. LLW and MLLW is being characterized to determine treatment and disposal options. In Fiscal Year (FY) 2000 and the first quarter of FY 2001, 11,487 cubic feet of LLW waste was disposed of onsite, and 1041 cubic feet of MLLW was disposed of onsite. In the first quarter of FY 2001, 9.2 cubic feet of MLLW was shipped offsite for treatment and disposal.

The NNSA/NV assesses the long-term performance of LLW disposal sites by conducting a PA. A PA is a systematic analysis of the potential risks posed by a waste disposal site to the public and to the environment.

4.5 HISTORIC PRESERVATION

In 2000, five cultural resource surveys, one inventory project and six historical evaluations were conducted at the NTS . The five surveys were undertaken to determine if significant sites or structures were located within proposed project areas, covering an area of 200 acres. No new sites were identified as a result of these surveys. The inventory project, meeting the requirements of the National Historic Preservation Act, Section 110, was conducted at Cane Spring as a continuation of investigations at spring sites on the NTS. This research indicates that initial occupation of the spring by Native Americans began as early as 10,000 B.C., with historic occupation of the site into the 1920s. The Cane Spring site has been determined to be eligible for the National Register of Historic Places (NRHP) and the technical report summarizing the work there was finalized in 2000. Five historical evaluations were conducted at facilities where buildings have been identified to be demolished under the NNSA/NV Environmental Management Deactivation and Decommissioning (D&D) Program. Three of the facilities were built for the ROVER program, an endeavor to develop nuclear rocket engines that began in the 1950s and ended in the 1970s. These are the Reactor Maintenance Assembly and Disassembly (RMAD) facility, Test Cell A Facility and Test Cell C Facility. The fourth was the Pluto Disassembly Building associated with development of nuclear propulsion for aircraft. The fifth survey was of the Super Kukla Facility where activities supported the weapons testing programs from 1964 to 1979. Historical evaluation reports were completed for all five facilities and they were determined eligible to the NRHP for their association with important events in our history. After consultations with the Nevada State Historic Preservation Office (NSHPO) and the National Park Service, a decision was made to conduct work to mitigate the adverse effects from the demolition of buildings at these facilities. Historic American Engineering Record documentation is in progress for the primary RMAD building, the test cells at Test Cell A and C, the Pluto Disassembly Building, and the primary building at the Super Kukla facility. The sixth historical evaluation focused on the nuclear testing remains from the APPLE - 2 atmospheric test. The survey identified 15 structures, buildings and features, establishing the APPLE - 2 historic district. This district has been determined eligible to the NRHP with the results presented in a technical report. Also, the technical report on the Frenchman Flat historic district was finalized in 2000. All determinations of eligibility were made through consultation between NNSA/NV and the NSHPO.

The field aspect of the program to monitor the historic properties on the NTS was initiated in 2000. The purpose of this program is to determine if NRHP eligible sites are being adversely affected by natural and human activities. Eleven sites were examined and all the sites retained their integrity.

Since 1990, the NNSA/NV has been involved in consultations with Native American tribal groups in Nevada, California, Arizona and Utah, who have historical ties to NTS land. The three major groups are the Western Shoshone, the Southern Paiute, and the Owens Valley Paiute. In 2000, a draft book manuscript was prepared that summarizes the decade of ethnographic research with these people.

4.6 UNDERGROUND TEST AREA PROJECT

The Underground Test Area (UGTA) Project is the largest project in the Environmental Restoration Division and addresses groundwater contamination resulting from past underground nuclear testing conducted in shafts and tunnels by the NNSA/NV on the NTS.

From 1951 to 1992, more than 800 underground nuclear tests were conducted at the NTS. Most of these tests were conducted hundreds of feet above the groundwater table; however, over 200 of the tests were in proximity of, or within, the water table. This underground testing was limited to specific areas of the NTS including Pahute Mesa, Rainier Mesa/Shoshone Mountain, Frenchman Flat, and Yucca Flat.

The UGTA Project collects data to define groundwater flow rates and direction to determine the nature and location of aquifers (geologic formation of permeable rock containing or conducting groundwater). In addition, project team members gather information regarding the hydrology and geology of the area under investigation. Data from these studies will determine whether or not radionuclides resulting from nuclear testing have moved appreciable distances from the original test location. Numerous surface and subsurface investigations are ongoing to assure that these issues are addressed.

Surface investigations include:

- Evaluating discharges from springs located downgradient of the NTS.
- Assessing surface geology.

Subsurface investigations include:

- Drilling deep wells to access groundwater hundreds to thousands of feet below the surface.
- Sampling groundwater to test for any radioactive contaminants.
- Assessing NTS hydrology and subsurface geology to determine possible groundwater flow direction.

A regional three-dimensional computer groundwater model (International technology [IT] 1996a) has already been developed to identify any immediate risk and to provide a basis for developing more detailed models of specific NTS test areas (designated as individual CAUs. The regional model constituted Phase I of the UGTA project. The CAU-specific models, of which up to four are planned (geographically covering each of the six former NTS testing areas), comprise Phase II. To date, one has been built: Frenchman Flat (IT 1998b). The Yucca Flat models are in progress. The more detailed CAU-specific groundwater-flow and contaminant-transport models will be used to determine contaminant boundaries based on the maximum extent of contaminant migration. The results of the individual CAU groundwater models will be used to refine a monitoring network to ensure public health and safety.

In 2000, the UGTA Project drilled a total of three wells in two different drilling initiatives. Well ER-EC-2A, located offsite just west of the NTS, and south of Pahute Mesa, was completed early in 2000. This was the last in a series of eight hydrogeologic investigation wells drilled in the Western Pahute Mesa - Oasis Valley (WPM-OV) area of Nye County, Nevada (IT 1998a). The goal of the WPM-OV drilling program, initiated in 1999, was to collect subsurface geologic and hydrologic data in a large, poorly characterized area down-gradient from Pahute Mesa, where underground nuclear tests were conducted, and up-gradient from groundwater discharge and withdrawal sites in Oasis Valley northeast of Beatty, Nevada (see Figure 7.3). Data from these wells will allow for more accurate modeling of groundwater flow and radionuclide migration in the region. Some of the wells may also function as long-term monitoring wells.

Hydrological tests and sampling were completed in 2000 at all seven wells drilled under this program (one onsite and six offsite, located just west of the NTS). Groundwater characterization samples were collected from each of these wells, and no man-made radionuclides were detected.

In 2000, the UGTA Project initiated a hydrogeologic investigation well drilling program in the Frenchman Flat CAU in the southeastern portion of the NTS, Nye County, Nevada (IT 2000). The goal of this program is to collect additional subsurface geologic and hydrologic data in the Frenchman Flat CAU, where ten underground nuclear tests were conducted between 1965 and 1971 (DOE 2000) (see Figure 7.5). Data from these wells will allow for more accurate modeling of groundwater flow and radionuclide migration in this former test area. Some of the wells may also function as long-term monitoring wells.

Two new wells were drilled under the Frenchman Flat drilling program during 2000 (Wells ER-5-3 and ER-5-3 #2). These wells were completed in the alluvial and volcanic aquifers, and the regional carbonate aquifer. Preliminary (predevelopement) groundwater characterization samples were collected from each of these wells. No man-made radionuclides were detected in these wells.

4.7 HYDROLOGIC RESOURCES MANAGEMENT PROGRAM

The NNSA's Hydrologic Resources Management Program's (HRMP's) primary responsibility is to acquire hydrologic data and information of groundwater supplies to support ongoing activities and to assist in planning new uses for the NTS. The main objective of this program is to provide a sound technical basis for NTS groundwater use decisions regarding the quality and quanitity of water resources available on and around the NTS on a long-term scale.

The Los Alamos and Lawrence Livermore National Laboratories (LANL and LLNL), the U. S. Geological Survey (USGS), and the Desert Research Institute (DRI) participated in the NNSA/NV HRMP. The HRMP is funded by the Defense Programs of NNSA/NV and supports the national security mission at the NTS through studies of radiochemistry and hydrologic science.

The LANL measured water samples for ^{237}Np and continued the evaluaion of colloidal species as a transport mechanism for plutonium and neptunium.

The USGS measured water levels for NTS wells and continued to devlop a steady-state groundwater model for the Death Valley Region, which includes the NTS.

In FY 2000, the HRMP at LLNL conducted three investigations:

- To develop an understanding of radionuclide movement in the unsaturated zone, LLNL investigated the mobility of fallout radionuclides derived from atmospheric nuclear tests north of the NTS in regions known to be actively recharging groundwater.
- LLNL also devised analytical techniques to image the distribution of beta-emitting radionuclides important to defense and remedial activities which rely on the identification of long-lived radionuclides in glass and soil samples.
- Finally LLNL continued studies of the source of regional groundwater for the NTS by investigating the source and amount of recharge in central Nevada.

In support of the HRMP in 2000 DRI performed the following tasks:

- Temperature and video logging of boreholes.
- Discrete state cell (DSC) modeling of the NTS groundwater flow system.
- Trace element geochemistry of the NTS.

POST-SHOT WELLS

In 2000, the UGTA Program sampled the CHESHIRE post-shot/cavity well U-20n PS#1ddh. In general, preliminary results show expected levels of contamination for post-shot wells.

A multi-agency team consisting of personnel from the USGS, LANL, and LLNL collected fluid samples at U-20n PS#1ddh using a downhole sampling pump. The well accesses the test cavity via perforated 5.5 inch casing. During sample collection, field parameters, including temperature, pH, and conductivity were measured. Samples were then analyzed for ^{3}H, ^{14}C, gross alpha and gross beta.

U-20n PS#1ddh was drilled to support studies of radionuclide migration from the cavity/chimney region of the CHESHIRE underground test that was conducted on Pahute Mesa in February of 1976. Radionuclide migration studies at this site have been intermittent since 1976. Samples collected from the lower zone of U-20n PS#1ddh present a unique opportunity to analyze cavity fluids.

The results of this sampling effort at U-20n PS#1ddh will support the NNSA's continuing efforts to create a long-term monitoring program for wells in or near underground nuclear test cavities. The program objectives are to characterize the hydrologic source term and evaluate the decay and potential migration of radionuclides through monitoring at or near the source.

Other accomplishments of the UGTA Program in 2000 include the development, testing and sampling of eight characterization wells in the Western Pahute Meas - Oasis Valley study area. These wells were drilled in 1999 and early 2000 (one onsite and seven offsite, located just west of the NTS). No man-made radionuclides were detected in these wells.

GROUNDWATER QUANTITY

Water levels are monitored annually by the USGS on and around the NTS at approximately 140 measurement locations, including 66 onsite and 74 offsite locations. Results are used in regional and local groundwater models, but are not routinely analyzed for water level trends. However, no significant water level impacts associated with groundwater usage were detected in 2000.

Water usage on the NTS is monitored by both the USGS and BN. Water use at the NTS continues to decline due to the moratorium on nuclear testing instituted in 1992 and was about 8.18×10^{5} m^{3} (216.2×10^{6} gal) in 2000. Data for the 2000 water year for water levels and usage will be reported in the USGS "Water Resources Data Nevada Water Year 2000" report (Jones *et al.*, 2000) and is also available on the USGS website: www.nevada.usgs.gov.

FALLOUT RECHARGE STUDIES

HRMP at LLNL has begun a study of the migration of fallout radionuclides in mountain soils north of the NTS. The high mountain regions of central Nevada, approximately 200 kilometers north of the NTS, have been identified as recharge zones for the regional groundwater flow system (Rose *et al.*, 1999; Davisson *et al.*, 1999). Preliminary results on fallout nuclide distribution in a soil profile from this area (Currant Summit Spring site) indicates that ^{137}Cs has penetrated to at least 12 cm depth, and that its activity profile with depth can not be modeled as a simple exponential function. At least two rate constants are required to describe the cesium soil profile. This phenomenon has been observed previously in studies of plutonium penetration into NTS soils where two different components of plutoniumu-migration have been identified (Shinn *et al.*, 1993). Such behavior may be the result of differential migration of different size particles.

The total amount of ^{137}Cs deposited at the Currant Summit Spring site is 48 nCi/m^2. This value, determined from integration of the ^{137}Cs depth profile, is consistent with other surface deposition measurements for this part of central Nevada. Plutonium is also expected in the soil samples collected from Currant Summit but is not detected by gamma spectroscopy. From the plutonium isotopic composition, it should be possible to determine the relative contributions of local NTS verses global fallout. This may be important if the plutonium depth profile indicates a multi-component migration as described above for cesium. Results are pending. ^{241}Am was not detected by gamma spectrometry in the Currant Summit Spring site soil. It will also be measured by MC-ICP-MS.

The processes by which fallout radionuclides penetrate mountain soils may be similar to those operating in the unsaturated or vadose zone around NTS underground test cavities. Physical and chemical movement may occur during periods of saturated flow from episodic wetting events. Due to greater precipitation and spring snowmelt, such episodic wetting will undoubtedly occur more often in the case of the mountain soil profiles than at the NTS. As such, the radionuclide migration rates defined by fallout studies in such areas should allow limits to be placed on migration rates within the vadose zone at the NTS. In addition, the purpose of this study remains the investigation of how bomb pulse signatures are acquired in the regional groundwater flow system.

RADIOGRAPHY STUDIES OF NUCLEAR DEBRIS

During FY 1998 and FY 1999, HRMP completed work to develop an alpha (α) radiography technique for application to geologic and nuclear melt glass samples (Smith *et al.*, 1999; Eaton and Smith 2000). The results of this work showed that by modifying an existing α-radiography technique, it was possible to spatially resolve areas of high α-activity in melt glasses. The ability to determine where radionuclides are distributed in nuclear melt glass has implications for understanding how radionuclides are released into the environment. Ongoing research involves determining the source of colloidal plutonium, which has been documented to be mobile in fractured volcanic rock aquifers (Kersting *et al.*, 1999). Eaton and Smith (2000) show that a secondary alteration layer of clay (probably smectite) forms on melt glass surfaces, which may be a source of colloidal material. Radiography techniques described here can be subsequently adapted to determine the association of plutonium and colloids.

The success in accurately siting areas of α-activity in thin sections of nuclear melt glass prompted additional research into finding a companion beta (β) radiography application for use with both geologic and melt glass samples. While traditional approaches rely on bulk counting techniques to identify β-emitting isotopes, no method for spatially resolving β-emissions is routinely employed. For the FY 2000 study, HRMP modified an existing β-radiography technique for use with geologic samples, giving a clear and literal picture of the distribution of both high and low β-activities. Both these α- and β-radiography techniques were subsequently applied to nuclear melt glass and geologic samples from the Rainier Test (RT). The RT was chosen for this study because there is a relatively large availability of nuclear melt glass from the RT, and the geology and melt glass from the RT have been extensively studied (e.g., Schwartz *et al.*, 1984; Thompson and Misz 1959).

Polished thin sections were made from each of three melt glass samples and a background volcanic tuff sample. Samples were mounted in epoxy plugs and cut with a precision wafer saw to expose their cross-sectional area before being mounted on circular slides, ground to ~30 µm thickness, and then finished to a high polish. The α-radiography analyses were made using TASTRAK CR-39 detectors, placed directly onto the thin section surface, which were then etched using a sodium hydroxide solution. Refer to Smith *et al.*, (1999) for details of this method.

The beta-radiography method applied in this study was originally developed for use in the biomedical field, where beta-radiography is commonly used to determine the location of beta-emitting isotopes in tissue samples. This technique was modified for use with melt glass in a manner similar to the alpha-radiography.

The results of this study show that the distribution of alpha and beta-emitters in the melt glass samples from the RT is uniformly concentrated in portions of the glass. This distribution suggests that the radionuclides are well mixed in parts of the glass despite the chaotic textures formed during melt glass condensation and cooling of the cavity following the detonation. In addition, the radionuclides appear to be volumetrically incorporated into the melt glass and not randomly distributed onto glass surfaces. The lack of alpha-track stars and significant clustering of alpha-activity indicate that there are no distinct radionuclide sinks or mineralogical controls on siting of alpha-emitting isotopes. These results are in keeping with alpha radiography of other NTS nuclear melt glasses (Smith *et al.*, 1999; Eaton and Smith, 2000). The beta-emitters are also uniformly distributed, although areas of higher beta-activity typically occur toward the center of the melt glass sample where regions of concentrated beta-activity are apparent in the radiography image. This concentration does not correlate with any textural feature and may be the result of bulk compositional differences in the melt glass.

The volcanic tuff sample was analyzed as a background sample to determine whether the contribution from decay of naturally occurring alpha-emitting isotopes of uranium and thorium in volcanic rock is large enough to bias alpha-activity mapped in the melt glass. Because it took four months to produce the same track density in the volcanic tuff detector, as seen after only one hour of exposure for the melt glass detectors, a minority of the bulk alpha-activity in the melt glass is probably due to natural uranium+thorium decay.

ENVIRONMENTAL ISOTOPE STUDIES

Using stable isotopes that are dissolved in and move conservatively with groundwater HRMP has demonstrated a groundwater flow pathway from recharge points in central Nevada to the Pahute Mesa nuclear testing area on the NTS (Rose *et al.*, 1999, Davisson *et al.*, 1999). Regional isotopic mapping indicates that groundwater moves from the recharge areas southward through deep regionally extensive carbonate aquifers that underlie the Railroad and Kawich Valley and into the Pahute Mesa underground test area (Rose *et al.*, 1999). This is important because knowledge of the groundwater recharge source coupled with its transit time allows predictions of the estimated water flux available to potentially move radiologic contaminants to down-gradient receptors. As part of this investigation, a priority has been to identify the volume and isotopic composition of the recharge occurring at high elevation in central Nevada. In FY 2000 LLNL deployed precipitation gauges at four sampling sites on mountain passes in central Nevada (Austin Summit, Pinto Summit, Little Antelope Summit, and Currant Summit) situated in recharge areas approximately 200 kilometers north of the NTS. Summer and winter precipitation was gauged and analyzed for stable isotopes to determine the isotopic composition of the recharge signature. Springs adjacent to the precipitation station were analyzed for the stable isotope composition of local discharge. Lysimeters were also deployed at the same sites to measure recharge infiltrating the ground. Preliminary analyses indicate winter precipitation from melting of the winter snowpack is recharging the flow-system. Lysimeter samples did not accurately reflect the volume of precipitation and will have to be redesigned before being deployed next year.

4.8 NTS WELL AND BOREHOLE PLUGGING PLAN

Since the late 1950s, approximately 4,000 wells and boreholes have been constructed at the NTS to support uses ranging from water supply wells to large-diameter nuclear device emplacement holes. Most of the existing wells and boreholes were originally constructed to support the Weapons Testing Program.

In 1997, the Nevada Division of Water Resources (DWR) issued revised regulations for water-wells and related drilling, which expanded its regulations to address a category of boreholes that are drilled for purposes other than evaluating or producing water. In March 1998, a letter from the NNSA/NV Manager to the President and General Manager of BN stated that compliance with the revised DWR regulations will achieve the goal of protecting groundwater resources from contamination, as well as satisfy state of Nevada and SDWA objectives. The NNSA/NV tasked BN to develop a plan for the management of all existing wells and boreholes and the construction of new wells and boreholes at the NTS in a manner that procedurally meets state regulations. The result of this effort was the NTS Well and Borehole Management Plan (BN 1999).

This plan discusses the objectives/intent of the DWR regulations and how these objectives will be applied to the management of the existing NTS well and borehole inventory, and the construction and management of future wells and boreholes. The objectives include the prevention of contamination or waste of the groundwater resource during the drilling, construction, or plugging of wells and boreholes; drilling, construction, and plugging programs designed to isolate zones of poor-quality water from zones of good-quality water; isolation of artesian zones; and prevention of surface contamination and unauthorized entry. A detailed strategy and process for plugging of the existing unused wells and boreholes is provided within the plan because open wells and boreholes represent a significant potential risk for impacting the quality of the groundwater resource. The process produces a prioritized list of open NTS wells and boreholes that should be plugged, with corresponding cost estimates and tentative schedules (BN 1999).

During September 2000, seven unused boreholes were plugged in Areas 3 and 5 under this plan. Additional unused or abandoned boreholes will be plugged each fiscal year under this multi-year initiative.

4.9 INDUSTRIAL SITES PROJECT

The Industrial Sites Project includes areas located on the NTS and the Tonopah Test Range that were used to support past testing operations. Over 1,500 of these historic areas, or industrial sites, have been identified, verified, and inventoried for characterization, closure, and/or restoration. Of these, nearly 750 sites have been formally closed. The remaining sites have been grouped according to source of contamination, location, and other technical characteristics. Industrial Sites Project activities focus on the characterization and applicable corrective actions for these sites.

The D&D process is also included under the Industrial Sites Project. This process supports the cleanup of the six remaining surplus facilities transferred from the NNSA/NV Defense Programs to the Environmental Restoration Division. These facilities include the Pluto Facility; Super Kukla Facility; RMAD Facility; Engine Maintenance, Assembly, and Disassembly Facility; Test Cell A; and Test Cell C.

Deactivation is the process used to remove radioactive, chemical, or other hazardous contamination from facilities, structures, soils, or equipment. Methods of deactivation include washing, scraping, or cleaning. Decommissioning involves stabilizing, reducing, or removing radioactive and/or other types of contamination and can consist of dismantling a facility, entombing or covering part or all of the facility, or converting a facility for other uses.

Table 4.1 Pollution Prevention Results, Reduction in Volume and Toxicity of Hazardous Waste - 2000

Activity	Accomplishment	Reduction
Recycle/Reuse	Lead acid batteries shipped offsite to be recycled.	21.38 mt
Recycle/Reuse	Lead scrap metal sold for recycle/use.	16.87 mt
Recycle/Reuse	Sent spent fluorescent light bulbs, mercury lamps, metal hydride lamps, and sodium lamps offsite to be recycled.	6.20 mt
Recycle/Reuse	Bulk used oil was sent off site to be recycled.	54.00 mt
Recycle/Reuse	Hazardous and nonhazardous chemicals, supplies, and equipment were either redistributed for reuse or returned to the vendor for recycling through the material exchange program.	1.13 mt
Recycle/Reuse	Lead tire weights were reused instead of being disposed of as hazardous waste.	0.87 mt
Recycle/Reuse	Rechargeable batteries were sent to an offsite vendor for recycle.	1.74 mt
Source Reduction	Biodegradable corn starch packing peanuts were purchased instead of styrofoam peanuts.	0.10 mt
TOTALS:		**102.29 mt**

Table 4.2 Ongoing Recycling Activities - 2000

Activity	Waste Type	Quantity (Metric Tons)
Mixed Paper	Solid	232.64
Aluminum Cans	Solid	1.13
Food Waste and Grease	Solid	4.21
Electronic Media	Solid	2.56
Lead Tire Weights Reuse	Hazardous	0.96
Material Exchange	Solid/Hazardous	1.13

Frenchman Flat in the Spring (No Date Provided)