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WASTE ISOLATION PILOT PLANT

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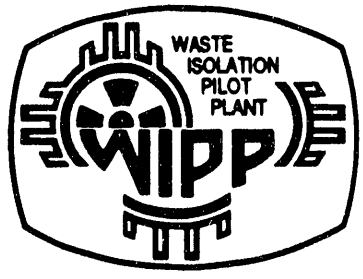
APPENDICES C through J

VOLUME V

MARCH 1990



Prepared for the
Department of Energy
Under Contract DE-AC04-86AL31950

Westinghouse Electric Corporation
Waste Isolation Division
Carlsbad, New Mexico

MASTER

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APPENDIX C

CLOSURE AND POST-CLOSURE PLANS

A description of the WIPP facility in terms of its long-term isolation capabilities is addressed in the Closure and Post-Closure Plans. This closure plan is in accordance with the requirements of 40 CFR Part 265, Subpart G, and NMHWMR 206.C.2.

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1.0 SITE AND FACILITY DESCRIPTION

1.1 PURPOSE OF THE FACILITY

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) facility intended to demonstrate the technical and operational principles involved in the permanent isolation of defense-generated transuranic waste. To accomplish this mission, the WIPP is designed to achieve two primary objectives in research and development. First, the WIPP is to perform scientific investigations into the behavior of salt rock and into the interactions between the rock and radioactive wastes in a variety of forms, under a variety of conditions. Second, the WIPP will demonstrate the safe and efficient handling, transport and emplacement of radioactive mixed waste in an actual, full-scale disposal facility. This demonstration is scheduled to continue for up to five years, when the performance of the WIPP will be reviewed. The full design capacity of the WIPP will not be utilized until sufficient operational and scientific data have been accumulated to ensure that permanent isolation of radioactive mixed waste in salt is protective of human health and the environment.

1.2 REGULATORY STATUS UNDER RCRA

Much of the waste to be emplaced in the WIPP will contain hazardous constituents or exhibit properties regulated under the Resource Conservation and Recovery Act (RCRA). Such "mixed" waste currently is regulated in 17 states and territories. The State of New Mexico has not yet revised its authorized RCRA program to include mixed waste, but is expected to do so by the end of 1989. The DOE nevertheless intends to comply with all state and federal hazardous waste regulations. This closure plan responds to the requirements of 40 CFR Part 265, Subpart G and NMHWMR 206.C.2.

1.3 LOCATION

The WIPP is in Eddy County in southeastern New Mexico, 26 miles east of Carlsbad (Figure 1-1). The site occupies 16 sections covering an area of approximately 10,240 acres in Township 22 south, Range 31 east.

1.4 LAND USE

There is little private land within 30 miles of the WIPP site. Most of the land is owned by the federal government or the State of New Mexico.

The dominant land use around the site is grazing. There are numerous active oil and gas wells and several potash mining operations in the area. (Areas used for oil and gas production also support grazing.) The only agricultural land within 30 miles is irrigated farmland along the Pecos River, near the municipalities of Carlsbad and Loving. Little, if any, dry-land farming takes place within the area.

1.5 GENERAL FACILITY DESCRIPTION

The WIPP facility is composed of surface buildings, four shafts, and a series of underground storage rooms and tunnels (Figure 1-2). The surface buildings house the site personnel and equipment needed for WIPP operations and research activities. The shafts connect the surface facilities to the underground area and make it possible to lower waste to its destination, as well as to transport personnel, equipment, mined salt, and fresh air. Each shaft has a designated function. The underground facility, about 100 acres in size, provides both a storage area for isolating radioactive mixed wastes and a separate scientific field for conducting experiments, the two activities defined as the WIPP mission.

Continuous mining equipment is used to excavate the bedded salt in which the underground facilities are located. This excavation carves out a series of rooms for storing waste. The mining activities take place 2,150 feet below the surface, close to the middle of the salt bed. The salt bed itself, nearly 2,000 feet

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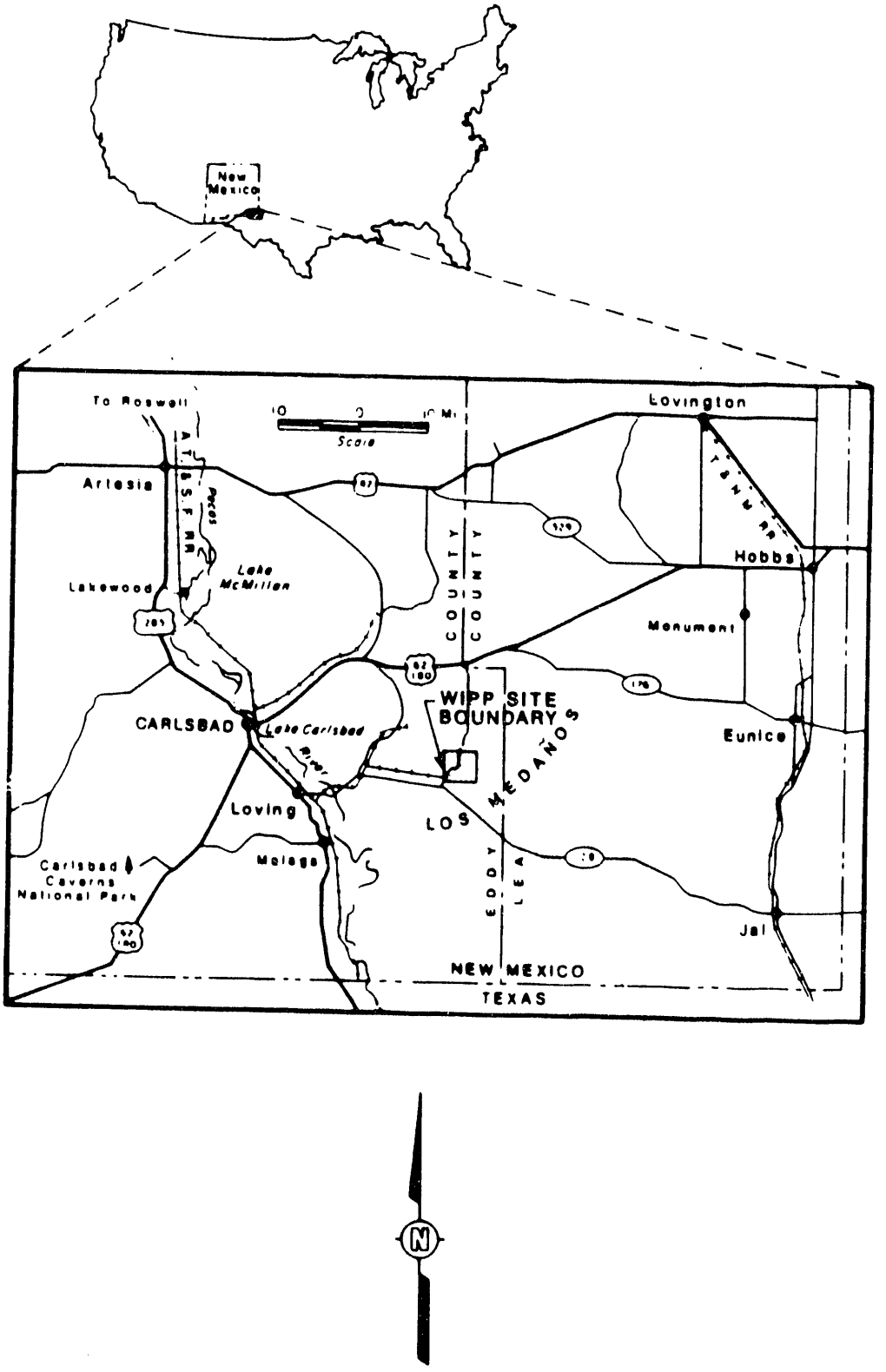

FIGURE 1-1 WIPP SITE LOCATION

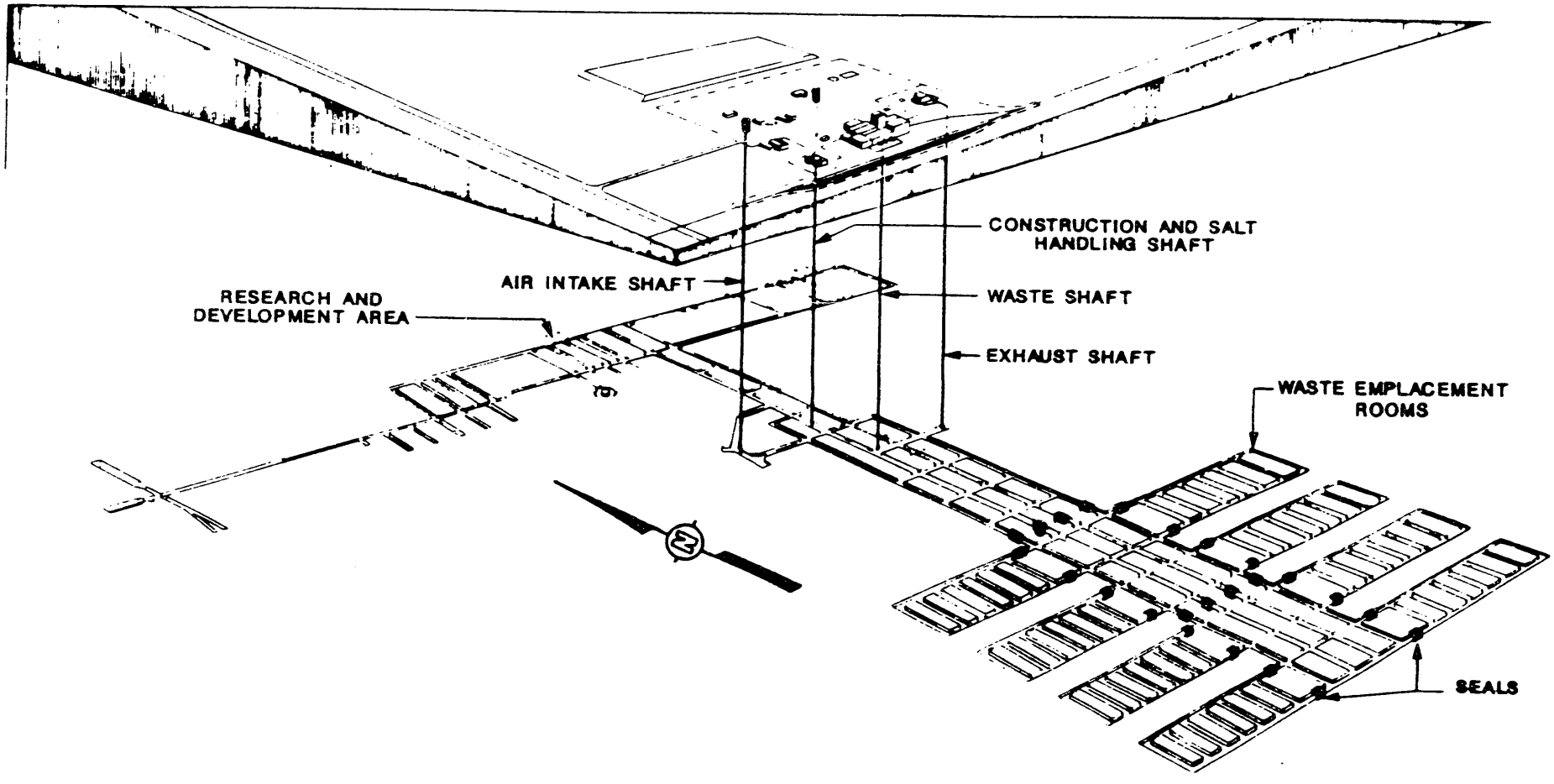

FIGURE 1-2 WASTE ISOLATION PILOT PLANT REPOSITORY

thick, is called the Salado Formation and is composed of relatively pure evaporites, mainly rock salt. The salt bed has remained essentially stable and virtually unaffected by earthquake or faulting activity since its deposition about 225 million years ago. The salt in which the underground facility is mined will very slowly "flow" and eventually encapsulate the buried waste, with the very small amount of saturated brine included in the salt assisting in the recrystallization process.

1.6 FACILITY SURFACE STRUCTURES

The principal surface structure at the WIPP is the Waste Handling Building. It is approximately 230 feet wide, 575 feet long, and 50 feet high (except for a 125-foot high bay area). The building has separate areas for the receipt, inventory, inspection, and transfer of radioactive mixed wastes through separate airlocks to a common waste shaft. It also contains offices, change rooms, a health-physics laboratory, and equipment for ventilation and air filtration. Safety equipment and measures for controlling radiation exposures are included in the design of the building.

The Underground Personnel Building contains support facilities for personnel working underground in construction and waste-handling operations. This building is approximately 100 feet wide, 150 feet long, and 14 feet high.

Other surface structures include the Administration Building (36,000 square feet); the Disposal Area Exhaust Filtration Building (10,000 square feet); the Vehicle Maintenance Building (2,300 square feet); a building containing a warehouse and shops (18,000 square feet); the emergency power plant (10,000 square feet); the water pumphouse; and the sewage treatment plant.

A 17-acre area near the facility is used to store salt mined from the repository. The maximum height of the pile is approximately 60 feet.

1.7 FACILITY UNDERGROUND STRUCTURES

The four shafts to the underground area are a disposal area exhaust shaft; a waste handling shaft; a construction exhaust/salt handling shaft; and a ventilation supply/service shaft. With the exception of the construction exhaust/ shalt handling shaft (which is steel-lined), the shafts are lined with concrete down to the top of the Salado salt.

The underground structures are on a single mined level about 2,150 feet below the surface, laid out in a conventional "room-and-pillar" arrangement. They include two separate mined areas: approximately 100 acres for the disposal of transuranic mixed wastes, and approximately 12 acres for research and development in rock mechanics and mine design. The tunnels that connect these areas to each other and to the shafts occupy about 30 acres. The underground areas are developed using continuous mining machines, rather than blasting. The mined salt is transported by underground hauling machines and conveyors to the salt handling shaft for removal from the mine.

Underground workshops, warehouses, and equipment storage areas are provided for the mining and salt transport equipment used in underground construction. An underground ventilation system supplies air to both the construction and the waste disposal areas; separate exhausts are installed for each area. Safety equipment and measures for the control of radiation exposure are included in the design of the underground facilities.

1.8 SECURITY SYSTEMS

Operations at the WIPP include a security program designed to protect the facility against deliberate acts of vandalism, arson, sabotage, and the unauthorized removal of radioactive materials or plant equipment. Security is provided by the following:

- Design and arrangement of plant features to provide physical barriers that control or impede the access of personnel and vehicles to the plant and site.

- Pre-employment investigations of all employees.

In general, all buildings and equipment are designed with safety and security as primary concerns. Protection from acts of violence, theft, and destruction is enhanced by minimizing and controlling access to protected and restricted areas of the site.

1.8.1 Control of Access

The WIPP is located on a site large enough to provide a controlled-access area between it and the general public. The facility itself is fenced, and access to the fenced area is controlled by security personnel stationed at access points. Access to areas containing radioactive mixed waste is limited to authorized employees and escorted, authorized visitors only. Control over areas adjacent to the fence is provided by periodic security patrols near the perimeter fence.

Access by employees is controlled by personal recognition and identification badges. A card-key system is used to control access to specified restricted areas. Visitors to the protected area are assigned identification badges, signed in, and escorted. All personnel entering the protected area pass security personnel for badge inspection and may be required to submit all packages for inspection both when entering and leaving the facility.

All entrances to the protected area are locked and alarmed or controlled by the security force. Only waste transporters and plant vehicles normally are allowed in the restricted area surrounding the Waste Handling Building. Waste transporters are allowed only in defined waste handling areas. All vehicles, including delivery vehicles, are inspected when entering and leaving the protected area. Employee vehicles are parked in the parking lot outside the protected area.

1.8.2 Site and Equipment Monitoring

Protection against deliberate acts of damage or destruction and theft of radioactive material or plant equipment is provided by monitoring the entrances to the protected area and the fence that encloses the protected area. These monitoring functions at the WIPP are provided by security-guard patrols and by burglar alarms with tamper-indicating devices.

Employees and security personnel are instructed to query persons entering the protected areas who are not recognized, who are improperly badged, or who are unescorted. They will notify their immediate supervisor if there is cause for suspicion.

1.8.3 Facilities and Equipment

The fence enclosing the protected area is lighted and regularly patrolled; all gates are fitted with locks and alarms. Security personnel making routine patrols follow procedures to check locks, alarms, and the perimeter fence.

The centers for security and emergency communication are the central monitor and control room and the main guard station, both of which are in the Administration Building. These areas, staffed 24 hours a day, contain the equipment for sounding alarms. All alarms are tested regularly, and records are maintained of test results and any required action.

1.9 TRAFFIC PATTERNS

Several U.S. and New Mexico highways are within 30 miles of the WIPP site. Within ten miles of the site are portions of New Mexico Highways 31 and 128; both are two-lane roads with bituminous surfaces. New Mexico 128 connects the community of Jal with New Mexico 31, which provides access to Loving

and Carlsbad. Near the WIPP site, New Mexico 128 is used primarily by ranchers, potash miners and employees of gas companies. New Mexico 31 connects U.S. Highway 62-180 (the main artery between Carlsbad and Hobbs) with U.S. Highway 285. Because this highway provides access to several mining operations, Route 31 is used primarily by potash miners.

Numerous dirt roads in the area are maintained for ranching, pipeline maintenance and access to oil- and gas-drilling sites. The better roads are surfaced with caliche while others are little more than tracks in the sand.

Rail transportation in Eddy and Lea Counties is provided by the Atchison, Topeka and Santa Fe Railroad and the Texas-New Mexico Railroad. Railroad tracks reach the Duval Corporation's Nash Draw Mine, the facilities of the International Minerals and Chemical Corporation, and the Kerr-McGee plant, all potash-mining operations within five to ten miles from the site.

The two chief commercial airports in the two-county area are the Cavern City Airport near Carlsbad and the Lea County Municipal Field near Hobbs. The nearest air strip, 12 miles north of the site, is privately operated.

2.0 HYDROGEOLOGIC CONDITIONS

The geology of the WIPP site and the surrounding area have been studied extensively for many years. The U.S. Geological Survey historically has had an interest in the area because of its potash, oil and gas resources. The area has come under additional study because of its deep bedded salt formation and suitability for long-term management of radioactive waste, which ultimately led to its selection as the WIPP site. The Final Environmental Impact Statement (FEIS) (DOE, 1980) and WIPP Geological Characterization Report (Powers et al., 1978) thoroughly describe both local and regional hydrogeology and are the major source of information for this summary.

2.1 GEOLOGY

The WIPP site is a topographically monotonous, slightly hummocky plain covered with caliche and sand. It is near a drainage divide that is almost free of drainage patterns but separates two major and actively developing solution-erosion features.

The waste-emplacement areas of the WIPP are about 2,150 feet deep, near the middle of a thick sequence (from 500 to 4,100 feet beneath the surface) of relatively pure evaporite strata containing primarily rock salt and anhydrite (Figure 2-1). The Salado Formation, richest in rock salt and nearly 2,000 feet thick, contains the salt layers in which the wastes are to be emplaced. The disposal horizon is hydrologically isolated by at least 1,300 feet of evaporites, mainly rock salt, from the overlying nonevaporite formation, and by nearly 2,000 feet of anhydrite and rock salt from the underlying nonevaporite formations.

The Delaware Basin, in which the site is located, has long been tectonically stable. Major tectonic activity and basin subsidence ended about 225 million years ago. Since then, regional eastward tilting has been the main geologic movement near the site. No surface faulting is known at the site.

Tectonic faulting and warping of pre-Permian rocks near the site seem to have predated Permian evaporite deposition. Deformation of the evaporites has occurred primarily in the Castile Formation beneath the Salado and is most intense in a belt on the inner edge of the buried Capitan Reef eight miles north of the site. Drilling into highly thickened salt sections and salt structures in the Castile has occasionally encountered artesian brine flows. An anticline (of lesser magnitude than those commonly associated with brine flows) on the Upper Castile is located at the northern edge of Control Zone II (Figure 2-2). Control Zones I and II appear to be in a slight structural trough.

Bedded-salt dissolution near the site is restricted to the Rustler Formation and the top of the Salado Formation. There is no evidence that the resulting adjustment has produced any significant structural irregularities or collapse features in overlying strata. The closest surficial effects from dissolution are at the Nash Draw, the edge of which is four miles northwest of the center of the site. The rocks exposed there are strongly jointed, cavernous, and locally brecciated. No "breccia pipes" or domes are known at the site, even though they have been the subject of intensive investigations.

Minor igneous activity, in the form of dikes and possible sills, has occurred in the Delaware Basin, but the closest such feature is about nine miles northwest of the corner of the site and is 35 million years old. The earthquake record in southern New Mexico dates back only to 1923, and seismic instruments have been in place in the state only since 1961. Historical records prior to 1962 indicate that no earthquakes with a modified Mercalli (MM) intensity of V or greater have occurred within 120 miles of the site. The closest were two MM IV events at Carlsbad in 1923 and 1949, and the strongest was the 1931 MM VIII event at Valentine, Texas, about 125 miles away. The closest shock reported since 1961 was a magnitude 2.3 event on January 19, 1978, about ten miles northeast of the site; the largest two were a

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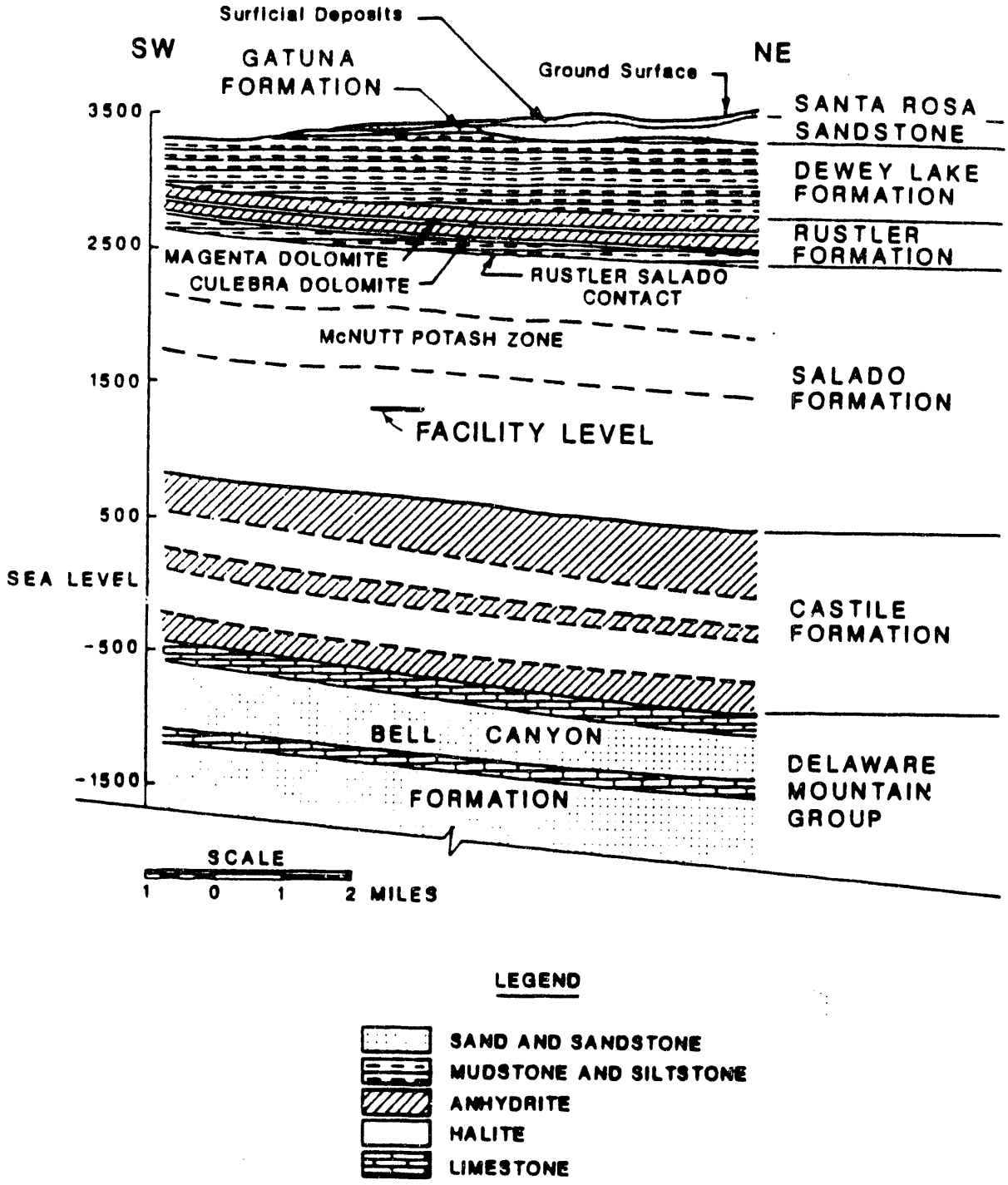

FIGURE 2-1 WIPP SITE GEOLOGY

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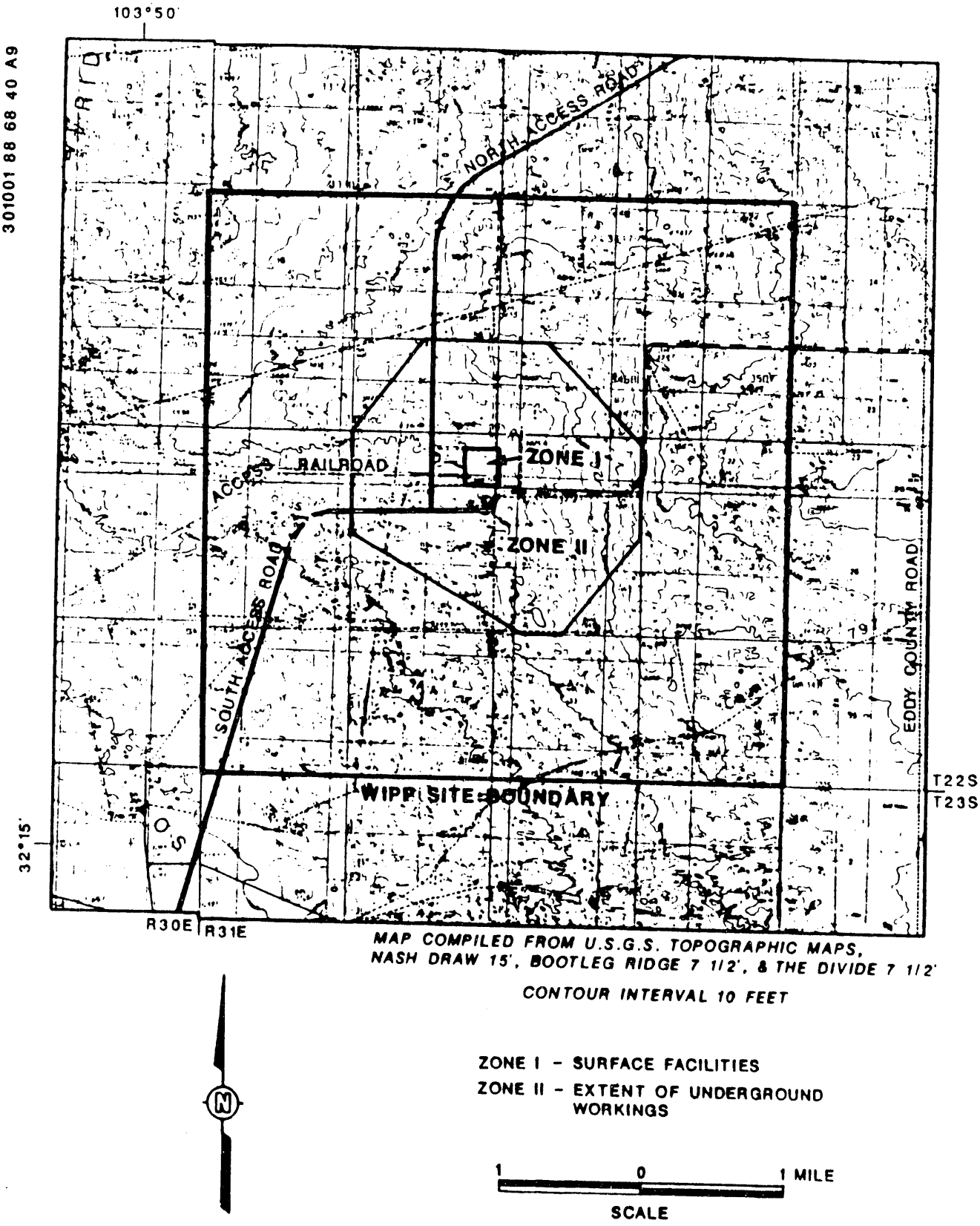

FIGURE 2-2 WIPP PROPERTY BOUNDARIES

magnitude 4.6 earthquake centered almost 180 miles to the southwest in August, 1966, and a magnitude 4.7 earthquake 190 miles east of the site in June, 1978.

The earthquake data show two distinct clusters. Many small events are scattered on the Central Basin platform, just across the New Mexico-Texas border to the east; these are probably caused by the injection of water for oil recovery. A second cluster is southwest of the site in the Rio Grande rift zone, also outside the Delaware Basin in Texas. The remaining recorded earthquakes within 180 miles are scattered sparsely in the Great Plains and the Basin and Range provinces to the north and west.

Analyses of risk from vibratory ground motion at the surface shows that the greatest ground accelerations expected to occur once in 1,000 and 10,000 years are less than or equal to 0.06 g and 0.1 g, respectively. The probabilities of higher values depend mainly on assumptions about the seismic potential of the area near the site.

Mineral resources at the site include caliche, gypsum, salt, sylvite, langbeinite, oil, gas, and distillate. Only potassium salts (sylvite and langbeinite), which occur in strata above the repository, and hydrocarbons (oil, gas, and distillate), which occur in strata below the repository, are of present economic concern. Enormous deposits of caliche, salt, and gypsum elsewhere in the region are more than adequate for future requirements. To a large extent the potash and hydrocarbon resources lie outside Control Zone II, where mining and drilling can be allowed. Langbeinite, gas, and distillate are the only known or probable economic resources under Control Zones I and II.

The site soils are all from the Kermit-Berino Association -- sandy, deep soils from wind-worked mixed sand deposits. The Berino and the Kermit are the only series in Control Zones I and II; both are deep, noncalcareous, yellow-red, red, or light-colored sands. They occur on gently sloping terrain and have a slight water-erosion potential and a very high wind-erosion potential.

2.2 HYDROLOGY

2.2.1 Surface Water Hydrology

The WIPP is located within the Pecos River basin. The Pecos River headwaters are northeast of Santa Fe, and the river flows to the south through eastern New Mexico and western Texas to the Rio Grande. The Pecos River has an overall length of about 500 miles, a maximum basin width of about 130 miles, and a total drainage area of about 44,535 square miles (about 20,500 square miles are noncontributing).

The Pecos River is generally perennial, except in the reach below Anton Chico and between Fort Sumner and Roswell, where the low flows percolate into the stream bed. The main stem of the Pecos River and its major tributaries have low flows and the streams are frequently dry. About 75 percent of the total annual precipitation and 60 percent of the annual flow result from intense local thunderstorms between April and September. The principal tributaries of the Pecos River, in downstream order, are the Gallinas River, Salt Creek, Rio Hondo, Rio Felix, Eagle Creek, Rio Penasco, the Black River, and the Delaware River.

The mean annual precipitation in the region is about 12 inches, and the mean annual runoff is 0.1 - 0.2 inch. The maximum recorded 24-hour precipitation at Carlsbad is 5.12 inches, in August, 1916. The six-hour, 100-year precipitation event for the site is 3.6 inches and is most likely to occur during the summer. More than 90 percent of the mean annual precipitation at the WIPP site is lost by evapotranspiration.

There are no perennial streams or surface-water impoundments at the WIPP site. At its nearest point, the Pecos River is about 14 miles southwest of the center of the site. Laguna Gatuna, Laguna Tonto,

Laguna Plata, and Laguna Toston are more than ten miles north of the site, at elevations of 3,450 feet or higher; thus, surface runoff from the site would not flow toward any of them. To the west and northwest, Red Lake, Lindsey Lake, Laguna Grande de la Sal are found at elevations of 3,000 to 3,300 feet. The nearest of these, Laguna Grande de La Sal, is about eight miles from the WIPP site; its water is not potable because of its high salt content.

2.2.2 Ground Water Hydrology

The WIPP site is located in the Pecos Valley section of the Great Plains physiographic province in the north central part of the Delaware basin. Ground water within the Delaware basin is predominantly of poor quality for most uses. The only large quantities of potable ground water are found west of and along the Pecos River. To the west of the Pecos River, many rock units of the basin crop out and the soluble salts have been leached from the Ochoan evaporites. Recharge from precipitation on adjacent outcrop areas has flushed the salts, and fresh ground water is now present in the permeable formation.

From outcrop areas west of the Pecos River, ground water moves eastward. The shallow aquifers cut by the Pecos River discharge to the river either directly or to the river channel alluvium. The Capitan Limestone is the oldest permeable formation cut by the river. Ground water in permeable formations older than the Capitan is not directly affected by the river.

East of the Pecos River, thick beds of evaporites are present at depth in the Rustler, Salado, and Castile Formations, and brines are common in the underlying permeable Bell Canyon Formation. Ground water in the deep rock units east of the river is predominantly brackish to saline in quality. The major use of the ground water in the central and eastern Delaware Basin is for oil-field flooding. The Capitan aquifer supplies most of the water for this use.

The near-surface aquifers east of the Pecos River are limited in extent, and the water present usually contains more than 3,000 milligrams per liter of total dissolved solids. These shallow aquifers are recharged from precipitation on outcrop areas or from overlying formations. The direction of migration of the ground water is not uniform but is generally to the south or southwest, eventually reaching the Pecos River.

At the WIPP site, the Bell Canyon and Rustler Formations contain saline water. The permeabilities and rates of ground water movement are very low. Little development of ground water has occurred in the site area.

The Salado Formation, which contains the waste storage horizon (Figure 1-3) is defined as an aquiclude and is hydrologically isolated from water-bearing units of the Rustler Formation overlying it. Underneath, the Castile Formation, also an aquiclude, isolates the Salado Formation from water-bearing units in the Bell Canyon and deeper formations. Aquifers present above the Salado in the site area occur under confined conditions and are either limited in a real extent or yield less than 2 gal/min to wells. Any significant circulation of fluids within the Salado is precluded by the near-impermeability of the evaporite beds. Dissolution of the Salado beds, based on the geologic evidence, will progress at such slow rates that the formation may be considered hydrologically stable.

3.0 DESCRIPTION OF THE HAZARDOUS WASTE MANAGEMENT UNITS

The WIPP storage horizon is located about 2,150 feet below the surface in the Salado Formation. The facility is expected to begin receiving waste in late 1988. Contact-handled transuranic (CH TRU) wastes will be received first; remote-handled transuranic (RH TRU) wastes will be added a few months later. During normal operation, the WIPP can handle 500,000 cubic feet per year of CH TRU waste and 10,000 cubic feet per year of RH TRU waste on a two-shift-per-day basis, with one shift for waste handling and the other for underground construction. Most of the CH TRU waste will be in 55-gallon drums and modular metal boxes. The RH waste will be packed in steel canisters and transported to the WIPP in shielded shipping casks.

The WIPP is designed for an operating life of about 25 years. The facility is designed to facilitate retrieval of all CH and RH TRU waste emplaced during the first five years of operations if monitoring data indicate the permanent isolation of the waste is not possible.

3.1 CH TRU WASTE STORAGE AREA

The storage horizon provides space for about 6.3×10^6 cubic feet of contact-handled transuranic (CH TRU) material. This area also includes the four main entries and the cross-cuts that provide access and ventilation for these storage rooms.

The main entries link the shaft pillar/service area with the storage rooms and are separated by pillars. All entries are 12 feet high; one is 25 feet wide and the remaining three are 14 feet wide. The storage rooms are about 13 feet high by 33 feet wide by 300 feet long, separated by 100-foot wide pillars.

During the first five years of operations, wastes will be retrievable. Storage rooms will not be backfilled until a formal decision is made to permanently emplace the waste. If emplacement operations continue after the end of the demonstration period, wastes will be covered with a mixture of crushed salt and bentonite. Where only a few barrels are emplaced in one shift, backfilling will occur at the end of the shift. The backfill equipment has a finite length of waste stack over which it can place backfill material. If large amounts of waste are to be emplaced during a shift, it will be necessary to backfill around the waste during the shift so that the number of exposed containers is minimized.

During the demonstration period, clearance is allowed so that salt creep closure minimally hinders retrieving the waste containers during this period. The drums and boxes can be recovered during this period by reversing the emplacement operations. CH TRU waste containers being recovered will be checked for damage and contamination, and will be overpacked when required. The salt removed from around the containers will be checked for contamination, packaged in CH TRU containers if required, and treated as CH TRU waste for removal from the site. A more detailed discussion of the closure activities that will be implemented upon retrieval of the waste will be submitted as a revision of this closure plan at an appropriate time. This closure plan addresses only the closure activities necessitated by permanent isolation of the waste.

3.2 RH TRU WASTE STORAGE AREA

The walls of the CH TRU waste storage rooms and entries are utilized for storing remote-handled transuranic (RH TRU) waste material prior to the storage of CH TRU waste in these rooms or entries. The RH TRU waste is emplaced horizontally in the pillars of the waste storage area.

Entries, rooms, and panels are excavated as needed during the plant life in order to maintain a reserve of storage rooms, establish ventilation, or stockpiled salt for backfilling. The amount of storage in each room is limited by thermal, structural and physical considerations of equipment and design.

Emplacement is based on thermal output and designed not to exceed ten kilowatts per acre. Emplacement based on current designs of physical equipment will require a distance of approximately eight feet between centers for RH TRU waste canisters.

The RH TRU waste canisters are to be stored in horizontal holes six feet deeper than the length of the canister. Shielding is provided in the space between the canister and the room. RH TRU waste holes used during the retrieval period will include steel sleeves to support the potential need for retrieval.

4.0 PARTIAL CLOSURE ACTIVITIES

Partial closure of the facility will begin at the end of the demonstration period if the decision is made not to retrieve the waste. Partial closure will be a continuing process at the facility; that is, as each room is filled with waste, it will be closed. Similarly, as each panel of rooms is filled, the panel will be sealed. Partial closure activities will meet the performance standards discussed in Section 10.0.

4.1 CLOSURE OF ROOMS

Backfill will be used to close each waste room. According to current plans, backfill material composed primarily of crushed salt will be pneumatically emplaced so as to fill void spaces above and between waste containers as they are emplaced. Mined salt will be transported from the underground salt storage pile to the active waste room using the underground trucks. A minimum opening of 16 inches will be left at the top of the room to provide for circulation of air above the waste and backfill.

4.2 CLOSURE OF PANEL DRIFTS

When waste has been emplaced in all seven rooms which make up each panel, the panel will be closed. The seals will be constructed in the entry drifts to each panel. The strategy behind panel sealing is to limit any ground water flow into the panel or flow of contaminated brine from a panel through the panel entry. Such a strategy suggests emplacing a seal that becomes virtually identical with the host rock, that is, a salt-based seal. The current sealing concept calls for panel seals in main access drifts and in the panel entries (Figure 1-2). These seals will isolate the disposal area from the shafts, and the panels of waste from one another.

The entry drifts leading from the access drifts to the first storage room are 200 feet long. Current seal design contains provisions for the construction of seals approximately 100 feet long centered in this 200-foot section of each entry drift. The 100-foot length containing the seal will have a cross-section 13 feet high and 14 feet wide (for the exhaust drift) or 20 feet wide (for the intake drift). However, the operating contractor may further modify these dimensions to accommodate equipment. The four main access drifts will retain their original cross-section dimensions in the areas of the planned seals (Bechtel, 1983).

The panel seal design is shown in Figure 5-1. A center or core of quarried or crushed salt is the principal long-term seal component. (Seal materials are discussed in greater detail in Section 6.0.) At this location, the design calls for the rock to be overexcavated just prior to seal emplacement to remove damaged rock. Salt/bentonite mixtures emplaced pneumatically or as pre-formed blocks will be located on either side of the core to perform as short-term seal components. Pressed salt blocks are the exterior components to confine the long-term seal (Stormont, 1988).

4.3 SCHEDULE FOR PARTIAL CLOSURE

The schedule for partial closure depends on the schedule of waste shipment to WIPP. The first five years of WIPP operations have been designated a demonstration period to test mechanisms of waste emplacement and assess repository performance. No backfill material will be used during the demonstration period so as to maintain the retrievability of waste. At the end of the demonstration period, a decision will be made to proceed with waste emplacement or to retrieve the waste already in place and close the facility. [A detailed description of waste retrieval methods is included in the Draft WIPP Final Safety Analysis Report (DOE, 1988).)] If, at the end of the demonstration period, the decision is made to go operational, the approximately 24,000 drums emplaced without backfill during the demonstration period will be removed from the disposal cells and re-emplaced with backfill.

During full operations, it is estimated that 600 to 750 trailers will arrive at the site each year. Each trailer, holding three TRUPACTs, has the capacity to carry approximately nine cubic meters of waste in either 42 drums or six boxes. Therefore, WIPP will have the capacity to receive and emplace 25,000 to 31,000 drums of waste each year, filling up to five rooms per year. If this schedule is followed, up to five rooms will be closed each year, and one panel will be sealed every other year. With an operational life of 20 years after the demonstration period, an average fill rate is approximately three rooms per year (56 rooms filled in 20 years). This schedule would result in a panel being closed (two drifts plugged) on the average of one every three years. Installation of a seal in a panel drift will require approximately six weeks.

4.4 DECONTAMINATION

All waste containers transferred underground will have been monitored for surface contaminants. Unless a spill or accident occurs underground, no containers, equipment, or salt will require decontamination. In case of a spill or accident which results in a release of contaminants, the procedures outlined in the site Emergency Plan (WP 12-7) to contain, remove, and decontaminate the spill will be followed. No additional decontamination measures will be required as part of partial closure activities.

5.0 MAXIMUM EXTENT OF OPERATIONS

Operations at the WIPP entail receiving, unloading, and transferring radioactive and radioactive-mixed waste from the surface facilities to the underground storage rooms. The maximum inventory of waste which can be emplaced at the WIPP over its 25-year operating life is 6.3 million cubic feet. During the initial five-year demonstration period, the WIPP will receive approximately 24,000 drums of CH TRU waste. This quantity represents four rooms with 6,000 drums of waste per room. These rooms will be backfilled as described in Section 4.0 if a final decision for permanent waste emplacement is made by DOE. During full-scale operation, the WIPP may receive approximately three TRUPACT II shipments of waste (i.e., 126 drums) per day. The maximum capacity of each storage room is 8,000 drums. Each storage panel consists of eight rooms. Waste will also be emplaced in storage room entries before the panel drifts are backfilled and sealed. Each closed panel will contain approximately 85,000 drums of CH TRU waste. The total inventory of RH TRU waste over the 25-year period is approximately 5,000 canisters. An exact schedule for receipt of this waste at WIPP has not yet been finalized because the RH waste processing facility at Oak Ridge National Laboratory has not yet been constructed.

6.0 REPOSITORY SEALS

Seal systems, consisting of shaft seals (bulkheads, fill), borehole seals, and panel seals (bulkheads and fill) will be installed in the WIPP facility to help assure the performance standards in 40 CFR 264.601 will be met and to minimize any maintenance of the facility during the post-closure period. Backfill material emplaced with waste in each room is not considered part of the seal system and is not discussed here.

The approaches to preliminary seal design and performance goals for WIPP are summarized below and are described in more detail by Stormont (1988). The general approach taken in the preliminary design concepts for shaft and borehole seals at WIPP is to limit the inflow of ground water from formations above the facility level until the host rock and the backfill encapsulate the waste because of salt consolidation. Other sources of water, such as saturated interbeds near the facility horizon or from the host salt itself, may also enter the repository following decommissioning. Although these water sources are volumetrically less significant, the seal system will be designed to limit inflows and expulsion of contaminated brines through shafts upon pressurization due to host formation consolidation. Seals will be emplaced throughout the facility to separate areas of the facility should human intrusion occur at some time greater than 100 years following decommissioning. Boreholes will be sealed; however, no boreholes penetrate the facility itself and are unlikely to cause significant flow paths unless substantial dissolution of the host formation can occur between the facility and the nearest boreholes. Thus, borehole seals provide some additional assurance that dissolution will be minimized.

6.1 SEAL LOCATIONS AND DESIGNS

Current conceptual designs for the seal system at WIPP call for seals to be emplaced in shafts, boreholes, and at panel entrances within the facility. Seals may also be required in boreholes drilled from the repository into the host rock.

Shaft Seals

The key shaft seal locations include:

- The Rustler Formation, including clastic, carbonate, and anhydrite units lying stratigraphically above the facility horizon
- The Salado Formation, the host formation for WIPP and bedded salt lying stratigraphically above the facility horizon.

As shown in Figure 6-1, the shaft seal design calls for major intervals of crushed salt fill, two composite bulkhead components, and a seal component at the base of the shaft. In addition to the salt fill, bentonite/sand or bentonite/salt fill may be emplaced in claystone, anhydrite, or other units which are unlikely to experience creep closure and consolidation and may undergo fracturing or separation due to creep of adjacent salt units.

The composite seal components will be placed at the top of the Salado Formation and at about 500 meter depth. The upper component is designed to limit any downward flow from the overlying Rustler Formation both immediately after emplacement and in the long term. The lower bulkhead component is designed to separate the deeper salt shaft fill that is expected to consolidate within 100 years of decommissioning from overlying salt fill that may not. The consolidated fill can be considered part of an "undisturbed" host rock in any human intrusion scenario which is assumed to occur only 100 years or more after decommissioning. These composite bulkhead components also provide structural strength to the shaft seal system. The shaft seal rests on a concrete base, designed for structural strength as well as a seal against flow up the shaft that may occur as the facility consolidates and occluded brines (if any) become pressurized.

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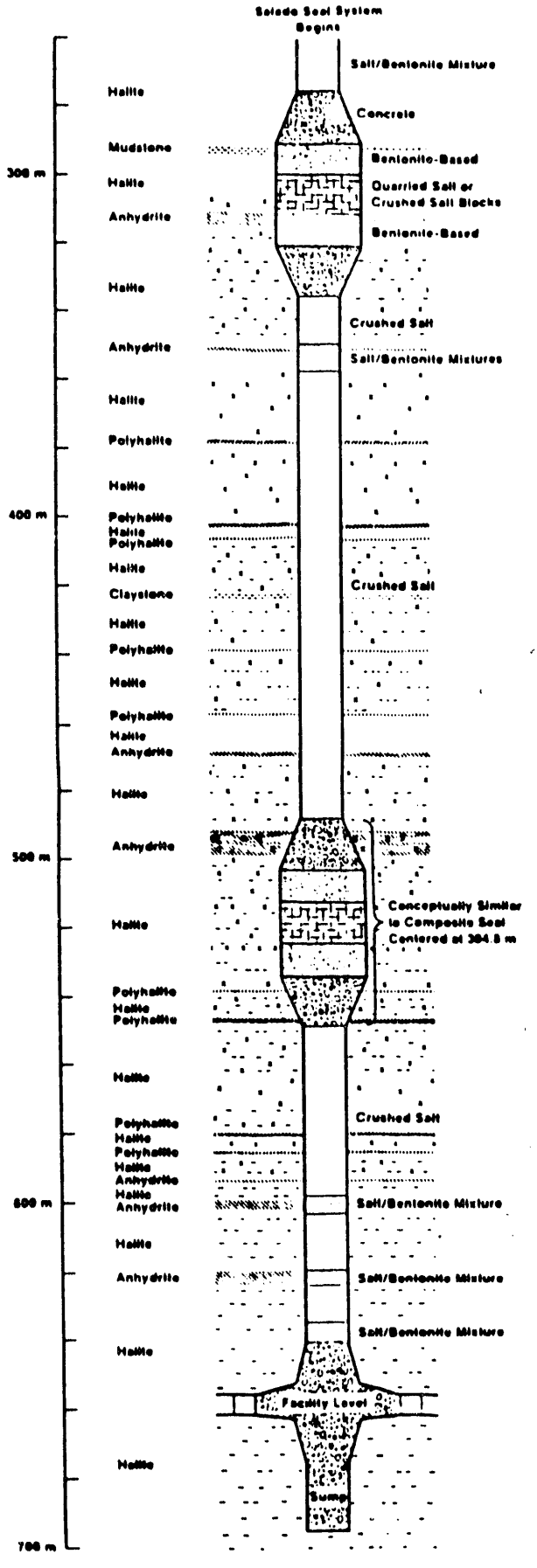

REFERENCE: STORMONT, 1988

FIGURE 6-1 DESIGN CONCEPTS FOR SEALING THE SALADO

Shaft seals in the Rustler Formation below the Magenta Dolomite consists of concrete bulkheads, probably with additional grouting at the seal/host interface, and bentonite-based components. The design goal of the Rustler Formation seals is to limit downward flow of ground water and to reestablish the low permeability of units penetrated by the shaft. The design emphasizes seals that will be effective immediately after decommissioning to limit any ground water from reaching crushed salt placed in the lower shaft or facility backfills and preventing complete consolidation of these fills.

No specific seal designs for units lying above the Magenta Dolomite have been developed. Because the transmissivities of the upper units penetrated by the shafts are relatively high and probably cannot be effectively sealed, simple backfill, perhaps with added clay to reduce the permeability of the fill itself, may be emplaced.

Panel Seals

Panel seals will be emplaced throughout the facility at the entrances to waste panels and in access drifts (Figure 1-2). Current conceptual designs include overexcavating these openings for the emplacement of composite bulkhead seals containing quarried (intact) salt blocks and bentonite-based materials (Figure 6-2). The panel seals are expected to provide hydrologic barriers that operate soon after decommissioning as well as in the long-term. These seals will prevent inflow of water through the shafts from reaching waste stored in the panel and will prevent the expulsion of occluded brine from the panel and fill that may be pressurized upon consolidation of the facility and backfill. The seals may be designed to cut off seams and interbeds overlying and underlying the facility horizon should these be significant sources of brine near the facility. The bulkhead-type design will also help limit deformation of the host horizon which may fracture or cause fractures in adjacent beds and seams which would increase the permeability of these units.

Nonwaste Room Seals

Nonwaste rooms will be backfilled as part of the seal system at WIPP. The backfill will consist of crushed salt that will be emplaced at as high density as possible. The backfill will help provide redundancy to the seal system, limit deformation of the host and adjacent stratigraphic units due to creep closure of the openings, reduce the time necessary to reestablish a consolidated or "undisturbed" state at the repository horizon, and provide a means to dispose of excavated salt.

Borehole Seals

Borehole seals are expected to have some degree of resistance to ground water flow, although the performance requirements of these seals are unlikely to be as rigorous as those for shaft and panel seals. The borehole seals will consist of cementitious grout designed for the host rock (salt and nonsalt units) into which it will be emplaced. The grout is expected to limit ground water flow sufficiently in the short term, and may, even upon degeneration with time, provide a limited resistance to ground water flow that will be satisfactory for boreholes that do not intersect the facility.

6.2 SEAL MATERIALS

The key candidate seal materials for WIPP are salt [crushed, pressed blocks or quarried (intact)], bentonite + salt or bentonite + sand, and cementitious materials (concrete, grout). Considerable evidence from experimental and analytical studies suggests these materials can be used to achieve the design goals for WIPP seals.

Salt

Salt represents an available, inexpensive, simple sealing material that will be compatible with the host rock (salt) in many of the seal zones at WIPP. Crushed salt consolidates under compressive stress with decreased porosity and permeability. The creep closure of the host formation appears satisfactory to

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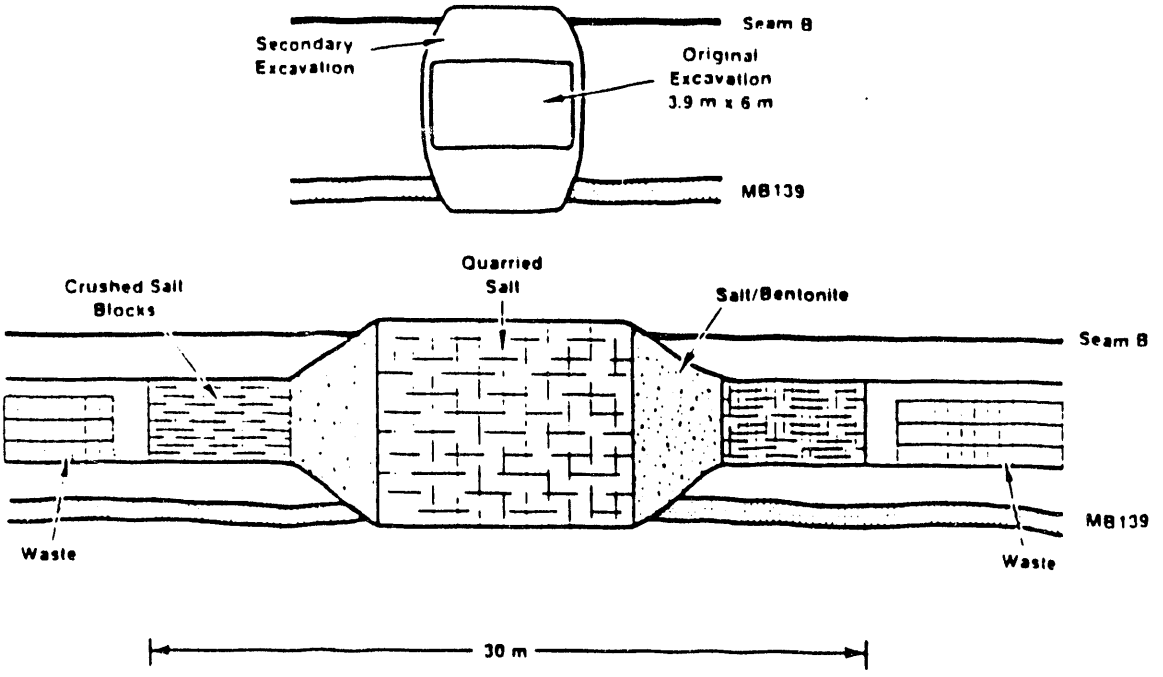


REFERENCE: STORMONT, 1988

6-2 CROSS-SECTIONAL VIEW OF PANEL SEALS

reduce the porosity of crushed salt to five percent or less, at which point the crushed material becomes hydrologically comparable to intact salt. The time required to reestablish an "undisturbed" condition depends on the stress applied, the initial porosity or density of the crushed material, and the presence of a small amount of water (less than about three weight percent). Larger amounts of water, however, may prevent consolidation by filling pore volumes and becoming occluded by the salt, leaving some porosity.

Pressed salt blocks may achieve about 60-85 percent fractional density initially and may be used to enhance the consolidation process. Quarried blocks of intact salt may be more effective but probably somewhat more costly. In general, these options will be utilized when seal components will be required to perform much like intact host rock on a relatively short time frame (e.g., 100 years or less). In most large volume installations, crushed salt compacted mechanically in situ will be used.

Bentonite

Although salt seals will provide excellent long-term sealing functions, including low permeability and longevity, seals containing salt may be ineffective until sufficient time has passed to permit creep of the host Bformation to consolidate the salt. In addition, ground water and brine must not reach unconsolidated salt or the salt may not consolidate and pressurized brine may occur within the facility. In addition, ground water unsaturated with respect to halite must be prevented from extensive contact with salt seals or the host rock to limit the potential for dissolution. For these reasons, other materials are required in the seal system to provide seal functions shortly after decommissioning and to provide redundancy to the seal design. Bentonite-based materials may be the most effective additional candidate seal material.

Bentonite is a complex material containing a substantial proportion of montmorillonite, or swelling clay. When compacted, bentonite displays very low permeability and, upon wetting, can swell to fill voids and fractures both in the bentonite itself and in the surrounding or confining medium, such as rock or adjacent seal components. The swelling capacity of bentonite also helps assure that the seal/host interface will have low permeability and will not act as a preferred path for ground water movement around the seal system.

Bentonite may be emplaced mechanically, pneumatically, or as pre-formed blocks. An inert filler, such as quartz sand may be used (up to about 50 weight percent) with little effect on the swelling capacity or low permeability characteristics of the bentonite. The filler serves partly to limit dispersion and erosion of the bentonite (below) and as an economy measure. Salt may also be used as a filler, and if placed in seal zones that contact halite-unsaturated ground water, may provide a means to saturate any ground water with respect to halite and reduce the capacity of ground waters reaching the seal system to dissolve salt in the host formation or seal system.

Dispersion and piping are means of erosion that may reduce the effectiveness of bentonite seals. Piping may occur if the bentonite seal is subject to high hydraulic gradients and flow velocities. Plastic clays, such as bentonite, are less susceptible to piping than cohesionless materials. Narrow fracture widths, low hydraulic gradients, and a relatively coarse-grained (silt/sand size) ballast material enhance the ability of bentonite to clog flowing fractures, reduce flow rates, and limit piping potential (Meyer and Howard, 1983; Stormont, 1988). Dispersion, the removal of clay grains in suspension in water, may occur with little or no ground water movement. Several factors affect the dispersion potential of clays, such as pore water composition, eroding fluid composition, and the concentration of clay particles present in the eroding fluid. Dispersion is enhanced in clays whose pore water is high in total dissolved solids, particularly if sodium is the major cation (among sodium, calcium, and magnesium). Dispersion of a sodium bentonite should be suppressed in an erosive fluid such as saline ground water likely to occur at WIPP relative to fresh ground waters (Sherard et al., 1976; Arulanandan et al., 1975).

The stability of bentonite under repository conditions has been extensively studied. Under the relatively low temperature conditions of the seal system at WIPP, phase transformations can reasonably be expected to be very slow. The presence of high sodium fluids at WIPP suggests that illitization of illite-smectite mixed layer clay development will not be favored and the bentonite will retain its desirable characteristics at least until salt seals become effective (Krumhansl, 1984).

Cementitious Materials

Cementitious materials, such as grouts and concretes, may possess many favorable properties for sealing, including low hydraulic conductivity, familiar usage in engineering practice, including sealing boreholes, shafts, and fractured rock, and stability under many environmental conditions. Concrete may be utilized as a short-term seal material in shaft seals and perhaps in panel seals that will function at least until consolidation of salt seal components. Grout will be used in all borehole seals, for disturbed rock treatment, if necessary, and for grouting the interface between concrete seals and nonsalt host rock. It is expected that the interface between concrete seals and salt host rock will heal due to creep of the host rock around the stiff, incompressible concrete.

Small scale seal performance tests (SSSPTs) are being used to examine the structural and hydrologic properties of seal materials for WIPP. These tests are ongoing and will not be complete for several years. They are designed to be larger in scale than laboratory tests and smaller than full-scale tests and are being performed to evaluate sealing concepts and designs, including the evaluation of cementitious materials, particularly concretes, salt, and bentonite for use in seals. The initial tests have been performed on specially designed portland cement-based concretes (Stormont, 1988). Conclusions of these initial studies are:

- Temperature increases due to the exothermic hydration reactions in portland cement following emplacement are more pronounced in larger volume seals. The temperature maximum is reached generally in the first few hours following emplacement, although a second peak which generally does not exceed the initial temperature peak occurs 50 or more hours after emplacement. The timing of the peaks following emplacement appears to be independent of the size of the seal.

- The measured radial and circumferential strains are generally compressive. The strain rates are highest early during the curing of the concrete, decreasing either sharply or regularly through the measurement period (up to 180 days).

- Thermal strains in the seals caused by temperature changes during the hydration of the cement was small in the models tested but are larger in larger emplacements. By extrapolation, thermal strain and the shrinkage of the seal accompanying the slowing and completion of hydration reactions in large seal emplacements may cause cracking or separation at the host rock interface if the host rock closure rate is not comparable to the shrinkage rate of the concrete.

- Although the concrete seals were undergoing compressive strains (shrinkage), interface stresses remained in compression. This indicates that creep of the host salt toward the concrete seal is the predominant mechanism that develops strains and pressures in the concrete. Because creep and creep rates in salt are directly affected by temperature, the increased temperature of the concrete during hydration resulted in higher creep rates and higher strain in the salt. This is reflected in higher compression of the concrete during the hydration (heating) cycles in the concrete.

- Strains may eventually stabilize as host rock creep reduces deviatoric stresses, at which time, stresses on the seals would be constant.

A major concern regarding portland cement based materials is their long-term durability in the repository environment. Although laboratory studies and studies of old and ancient cementitious materials show these materials may possess a high degree of stability under a wide variety of conditions, there is presently no means to predict cementitious materials' stability at WIPP. Thus, these materials will not be relied upon for long-term seals, a function better served by salt and probably bentonite.

Asphalt

Asphalt is a readily-available bituminous material with a long history of use and several favorable characteristics, such as low hydraulic conductivity, emplaceability, and possibly stability under some conditions. Stormont (1988) has suggested the use of asphalt in the WIPP seal system to reduce fluid flow behind shaft liners, seal fractured host rock, or seal-host interfaces. At present, asphalt is a possible alternative or redundant seal material.

7.0 FINAL CLOSURE

At the end of the WIPP operation, a decommissioning program will be carried out for the safe permanent disposition of both surface and underground facilities, including closure of remaining hazardous waste management units. These activities are described in the WIPP Final Safety Analysis Report (DOE, in preparation).

7.1 DECONTAMINATION AND DECOMMISSIONING

Present plans call for decontaminating and dismantling the surface facilities and entombing the mines and shafts. All usable equipment and materials will be decontaminated as necessary and removed from the site. Contaminated structural debris and equipment that cannot be decontaminated will be packaged and placed in the mine. Structures will be disassembled after decontamination. Uncontaminated debris and unusable equipment will either be shipped away from the site for disposal or disposed of in the facility's construction debris landfill. The evaporation ponds will be filled.

In the underground areas, all equipment will be moved to the surface, decontaminated if necessary, and either shipped away from the site if usable or handled like unusable debris from the surface facilities. The mine will then be backfilled with salt from the mined-rock pile. The salt will be dried and compacted as densely as possible. Shafts will be plugged in accordance with acceptable borehole-plugging techniques.

After these operations, the surface will be regraded to approximately its original contours. Markers will be provided for shaft locations and the landfill. If any of the mined-rock pile remains, it will be removed. Electrical power and telephone lines, railroad spurs, and roads may be removed, depending on the future use of the site. If they are removed, the rights-of-way will be regraded to approximately their original contours. Water will be shut off at the original connection point; however, water lines will be removed only where they are not needed for other reasons and where their removal is necessary to restore the natural terrain.

Many aspects of the plant design are intended to facilitate decommissioning and closure. These include the following:

Providing easy access to material and equipment that may eventually be recovered or dismantled.

- Smoothing the surfaces of equipment to make decontamination easier.
- Minimizing small dirt-catching spaces and corners to prevent the accumulation of radioactivity.
- Using modular construction for ease of dismantling.
- Using equipment that can be disassembled without cutting.
- Minimizing the weight of blocks of material that will be moved.
- To the extent possible, using standard equipment that can be used in other applications.

7.2 SITE RESTORATION

After the surface of the site is regraded to approximately its original grade, the disturbed area will be revegetated with species indigenous to the region. Any area sterilized by the salt will be covered with unaffected soil or leach irrigated to remove the excess salinity and allow for successful revegetation. The species used in the revegetation will be selected to allow the site to return to its natural, undisturbed condition.

7.3 RECORD MAINTENANCE AND SITE MARKERS

Provisions for maintaining evidence of the WIPP site, i.e., written record and site markers, are important aspects of the decommissioning of the WIPP facilities. The primary objective of these systems is to ensure continued environmental safety by preventing accidental intrusion into the waste storage area during the near future, i.e., a few hundred years. A secondary objective is to provide long-term records of the nature of the plant during the period when waste hazards will be decreasing significantly, i.e., up to 1,000 years. To meet the first objective, the design of these systems must ensure a life of up to several hundred years. To meet the second objective, these systems must have additional stability and durability.

The final design of record maintenance and site marker systems will be completed prior to decommissioning and will utilize state-of-the-art materials and methodologies. The plan presented in this section is conceptual and may be modified. Three principal components of the conceptual record maintenance and site marker system are: written records, location markers for all shafts, and visible warning monuments.

7.3.1 Written Records

Written documentation of the WIPP will be maintained in both federal and local public document depositories. The media utilized will be state of the art with respect to stability and durability. Normal, printed records will also be maintained. The data and design information included in these records will be selected on the basis of their relevance to environmental safety, e.g., waste characteristics, waste storage area layout, and in accordance with federal, state, and local regulations. Certain information which may be referred to as "plant lifetime" records, e.g., plant building design, method of construction, equipment specifications, is not critical to environmental safety. Separate maintenance of these records will be designed accordingly.

7.3.2 Shaft Location Markers

On-site shaft location markers will consist of permanent surveyor markings that will be appropriately engraved with the elevation and coordinates firmly anchored to the surficial borehole plug. A uniform system of coordinates will be adopted, and the definition of these coordinates will be included in the written records. In order to assist in the location of these markers in the event of burial by deposited sediments or possible slight surficial shifts over time, suitable tracers may be incorporated into the markers. These tracers will pose no significant environmental hazard and will facilitate rapid location of markers.

7.3.3 Site Monuments

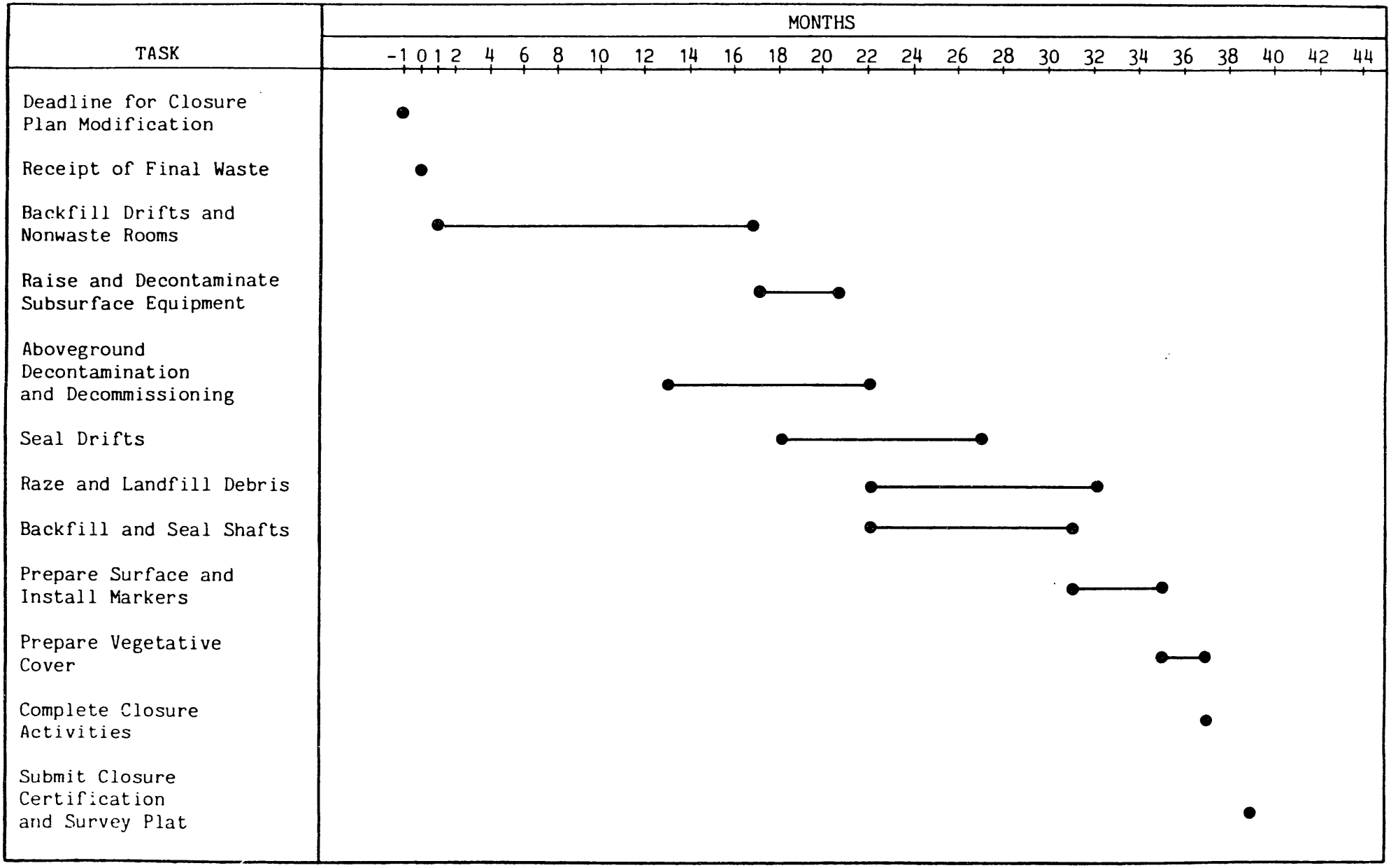
A visible site monument will serve to minimize the possibility of intrusion into the waste storage area during the short term and may be the most durable record of the facility in the very long term. The monument (or monuments) will be designed to be clearly visible from all locations directly underlain by the waste storage area. These areas are most critical with respect to intrusion. The geometric design of the monument and its foundation are dependent on site topography (visibility) and geomorphic processes (erosion and/or deposition). The materials comprising the monument will be selected for durability as related to the local climatic conditions and possible climatic changes. A plaque will be designed to contain the most critical information in a concise format. The information contained on the plaque will be recorded in English and in appropriate symbolic logic notation designed to convey critical information. Inclusion of universally understood "danger" symbols will increase the likelihood of comprehension by virtually all people.

7.4 FINAL CLOSURE SCHEDULE

Table 7-1 is a representation of final closure activities; closure is expected to begin in the year 2013. Final closure activities will, by necessity, require more than 180 days, and an extension to the time allowed for closure is requested pursuant to 40 CFR §265.113. Revisions to the closure plan, if necessary, will be submitted in accordance with 40 CFR §265.112.

TABLE 7-1

CLOSURE SCHEDULE



WIP:6820-SCHED

8.0 GROUND WATER MONITORING

The DOE has prepared a written justification for a waiver from RCRA ground water monitoring requirements. Such a "self-granted" waiver opportunity is provided for by 40 CFR §265.90(c). The waiver justification is based on the hydrologic isolation of the disposal horizon from circulating ground waters. The waiver request currently is maintained at the WIPP facility and will be included in its Part B permit application.

9.0 SUBMITTAL OF DEED NOTATION

Within 60 days of closure certification, deeds, restrictive covenants and/or easements normally examined during a title search will be amended to include a notation that states that hazardous wastes have been disposed on the property and that the property use is restricted under 40 CFR Parts 264 and 265, Subpart G regulations. The notice will also indicate that a survey plat and record of waste have been filed. The DOE will submit a certification to EPA and NMEID stating that the deed notation has been recorded and including a copy of the document in which the notation has been placed.

10.0 CLOSURE PERFORMANCE STANDARDS AND CERTIFICATION

The Closure Plan is designed to meet the following performance standards:

- Minimize future maintenance
- Protect human health and the environment
- Prevent the escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground or surface waters or atmosphere.

Because the WIPP is a federal facility, no closure cost estimates or financial assurance mechanisms are included as per 40 CFR §265.140 (c).

Copies of the closure plan will be maintained at the WIPP facility, Carlsbad, New Mexico.

Upon completion of partial and final closure activities, the DOE will submit to the NMEID and EPA a certification by an independent Professional Engineer, registered in New Mexico, that the closure has been performed in accordance with the specifications of this plan.

The certifying engineer will sign a statement as follows:

> I, (name), a registered Professional Engineer, hereby certify, to the best of my knowledge and belief, that I have made visual inspection(s) at the Waste Isolation Pilot Plant and that closure has been performed in accordance with the approved closure plan.
>
> (Signature, date, state license number, business address, and phone number)

11.0 POST-CLOSURE CARE

The WIPP is classified as a Subpart X miscellaneous unit. The EPA has not promulgated final standards for the various types of units that come under this category; rather, it intends to develop requirements on a case-by-case basis, taking into consideration the design, location and other specific factors of each unique unit. By the time the facility undergoes final closure, the DOE anticipates revisions to this closure plan in response to requirements established through discussion with EPA. The following are the post-closure care requirements that are able to be addressed at this time.

11.1 DURATION OF POST-CLOSURE CARE PERIOD

Due to the nature of the radioactive waste emplaced at the WIPP, the DOE intends to maintain the facility as necessary for a period of 30 years after closure. The markers and monuments are expected to remain for up to 1,000 years. Administrative controls established as part of the closure process are intended to prevent deep drilling or mining activities that may allow water intrusion into the facility. Final cover, surveyed benchmarks, and security systems will be inspected and maintained for at least 30 years after closure.

11.2 GROUND WATER MONITORING

The DOE maintains a ground water waiver request at the facility and, in addition, will submit to EPA and NMEID a no-migration petition pursuant to 40 CFR Part 268. These demonstrations, in conjunction with the demonstration required by 40 CFR Part 191 (performance assessment) document the containment of radioactive and hazardous waste within the engineered boundaries of the facility.

11.3 POST-CLOSURE CARE NOTICES

The DOE will submit to the NMEID and EPA a record of the type, location, and quantity of hazardous waste stored within the facility. This record will be filed no later than 60 days after certification of each partial closure and after final closure.

11.4 POST-CLOSURE CERTIFICATION

No later than 60 days after the completion of the post-closure care period, the DOE will submit to the NMEID and EPA a certification stating that post-closure care has been completed in accordance with the approved plan.

APPENDIX D

RCRA GROUND WATER MONITORING WAIVER

The RCRA Ground Water Monitoring Waiver is based on the fact that there are no hydraulic communication pathways between the WIPP repository and any ground waters in the vicinity. The waiver was prepared in accordance with 40 CFR Part 265.90(c).

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1.0 INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) was authorized by the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Public Law 96-164). Its legislative mandate is to provide a research and development facility to demonstrate the safe disposal of radioactive waste resulting from national defense activities and programs. To fulfill this mandate, the WIPP has been designed to: (1) perform scientific investigations of the behavior of bedded salt and the interactions between the salt and radioactive wastes; and (2) demonstrate safe and efficient handling, transport, and emplacement of transuranic (mixed) waste in a fully operational disposal facility.

The WIPP is scheduled to begin receiving contact-handled transuranic waste from various United States Department of Energy (DOE) generator and interim status facilities in October, 1988. Following the initial receipt of transuranic waste, WIPP will undergo a five-year pilot operations period. Although designed to receive wastes over a 25-year period, the full design capacity of the WIPP will not be utilized until operational and scientific data obtained during this pilot operations period indicate that disposal of radioactive mixed waste at the WIPP is protective of human health and the environment. The final outcome of this test period will be a DOE decision as to whether the WIPP will ultimately become the nation's permanent transuranic waste repository.

Substantial quantities of the transuranic waste destined for shipment to the WIPP contain hazardous chemical components which qualify as "hazardous waste" under the Resource Conservation and Recovery Act (RCRA). Therefore, WIPP is a "mixed waste" disposal facility, subject to regulation by the Environmental Protection Agency (EPA) under 40 CFR Part 264, Subpart X (EPA, 1987a). The State of New Mexico does not currently have authority to issue interim status and final RCRA permits for mixed waste facilities. However, because the State is authorized to implement RCRA Subtitle C program requirements, the EPA does not claim authority to regulate mixed waste in New Mexico. The State, the EPA, and DOE are currently engaged in efforts to resolve these jurisdictional problems. A RCRA Part A application was submitted by the DOE to the EPA and the New Mexico Environmental Improvement Division (EID) in July, 1988, to meet part of the requirements for interim status.

Geologic repositories such as the WIPP are defined under RCRA as land disposal facilities. As a result, the ground water monitoring requirements of 40 CFR Part 265, Subpart F (EPA, 1987b), must be addressed, as they are applicable to all interim status land disposal facilities. Under 40 CFR Part 265.90 (c), however, ground water monitoring requirements can be waived by the EPA under certain circumstances.

The EPA refers to the 40 CFR Part 265.90 (c) provision as a "self granted waiver opportunity" (EPA, 1984). A facility that is able to demonstrate a low potential for ground water contamination must maintain documentation meeting specified criteria on-site, to be submitted later for review in its RCRA Part B permit application.

To justify this waiver from interim status ground water monitoring requirements, the following points must be addressed in a waiver request:

(1) The potential for migration of hazardous waste or hazardous waste constituents from the facility to the uppermost aquifer by an evaluation of:

   (i) A water balance of precipitation, evapotranspiration, runoff, and infiltration; and

   (ii) Unsaturated zone characteristics (i.e., geologic materials, physical properties, and depth to ground water); and

(2) The potential for hazardous waste or hazardous waste constituents which enter the uppermost aquifer to migrate to a water supply well or surface water, by evaluation of:

(i) Saturated zone characteristics (i.e., geologic materials, physical properties, and rate of ground water flow); and

(ii) The proximity of the facility to water supply wells or surface water.

Although interim status standards have not been promulgated specifically for Subpart X miscellaneous units, this waiver request demonstrates compliance with the ground water performance standards of 40 CFR Part 264.601 (EPA, 1987a) in addition to the requirements listed above. As a result, this document exceeds the requirements set forth in 40 CFR Part 265.90 (c) for a waiver request. Because the 40 CFR Part 265.90 (c) ground water monitoring waiver requirements were established chiefly for surface land disposal facilities (e.g., landfills, surface impoundments, and waste piles), the DOE will demonstrate compliance with the additional requirements of 40 CFR Part 264.601, as they provide the specific information to evaluate the performance of this unique facility.

This document demonstrates that there is a low potential for the migration of hazardous waste or hazardous waste constituents from the WIPP underground facility via the most likely water-bearing unit to water supply wells (domestic, industrial, or agricultural) or to surface water.

To make this demonstration, the DOE has considered formation permeability and fractures, the location and relationship of water-bearing units with respect to the repository horizon, and the potential for flooding. Also considered are the characteristics of the waste and the chemical composition of ground water in the repository area, as recommended in the EPA's permit guidance for hazardous waste storage and disposal in geologic repositories (EPA, 1988). The facility design and closure are key factors related to the ability of the WIPP to contain waste with a high degree of certainty.

The demonstration provided in this document is formatted as follows:

- Section 2.0 is a waiver request summary. This section describes the overall justification for a ground water monitoring waiver.
- Section 3.0 describes the geographical setting and land use at the WIPP site.
- Section 4.0 provides a general summary of the geologic characteristics of the WIPP area that pertain directly to the ability of WIPP to contain waste.
- Section 5.0 presents local climatological data and describes the water balance at WIPP.
- Section 6.0 describes the hydrologic conditions and ground water quality at the WIPP site.
- Section 7.0 describes facility design related to waste containment.
- Section 8.0 presents waste containment characteristics that assure isolation of wastes in the WIPP environment.
- Section 9.0 presents a general summary that demonstrates that WIPP meets ground water performance standards and the requirements for a ground water monitoring waiver.

2.0 WAIVER REQUEST SUMMARY

During the past ten years, an extensive program of site characterization and validation has been conducted at the WIPP site. The results of these studies have been summarized in numerous publications, including the WIPP "Geological Characterization Report" (Powers et al., 1978); the WIPP Draft "Final Safety Analysis Report" (FSAR) (DOE, 1988a); the WIPP "Environmental Monitoring Plan" (Westinghouse, in preparation); the WIPP "Design Validation Final Report" (DOE, 1986); and "Summary of Site-Characterization Studies Conducted from 1983 Through 1987 at the Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico" (Lappin, 1988). These studies substantiate the conclusion that there is little possibility of migration of waste from the WIPP facility by ground water. This chapter is a brief summary of factors (discussed in more detail in subsequent sections) that have been considered to justify the waiver of ground water monitoring required by 40 CFR Part 265 Subpart F.

The nature of the WIPP site indicates there will be little ground water available to mobilize and transport waste. This waiver request will demonstrate that: (a) very little ground water can come in contact with waste, and (b) there is very little possibility that any contaminated ground water can migrate from the storage horizon to the accessible environment.

Because WIPP is a unique land disposal unit, not the uppermost aquifer (the focus of 40 CFR Part 265 Subpart F), but the nearest water-bearing unit with a relatively high transmissivity (the Culebra Dolomite Member of the Rustler Formation) appears to be the most likely means to transport contaminated ground water to the accessible environment or surface water. The possibility of transport of waste to the Culebra Dolomite Member will be discussed in this report. The WIPP facility horizon is located approximately 2,150 feet below the land surface in the Salado Formation, a bedded salt formation. The thick sequences of predominantly very low to low permeability sediments and evaporites isolate the waste storage horizon from any infiltration from the surface as well as from the overlying water-bearing units (Sections 5, 6, and 7). The facility storage horizon is isolated from the underlying water-bearing formations by about 2,000 feet of sediments and evaporites. It is separated from the overlying Culebra Dolomite Member by about 1,400 feet of evaporites and other sedimentary rocks. All shafts extending to the storage horizon have been designed to eliminate the infiltration of water from the overlying water-bearing units into the facility during the operational life of the facility (DOE, 1988a).

The only source of water available to contact waste disposed in the WIPP is from the very small amounts of trapped Permian brine that have been observed in the host evaporites of the facility horizon (Deal and Case, 1987). The amount of this liquid available appears to be insufficient to consider this brine a significant potential transport medium during operations. Evaporation of the moisture due to the normal mine ventilation will prevent the accumulation of brine sufficient to come in contact with the waste itself. Because free liquids will not be stored in the WIPP facility (Section 8.0), these small amounts of brine are the only source of liquids found in the storage horizon. It will not be possible, therefore, for waste to migrate hydraulically in any water-bearing unit or the accessible environment during the operational period of WIPP.

During the post-operational and post-closure periods at WIPP, other factors relative to waste migration potential must be considered. A preliminary seal design report has been issued that describes various alternatives for sealing the facility and all the shafts, boreholes, and drifts leading to the facility (Stormont, 1988). The seals will limit the inflow of water to the facility from overlying water-bearing units and from precipitation. The seals will also limit the movement of any contaminated brine from the facility through shafts to the accessible environment. At the same time, the salt formation will be closing around the waste containers and closing mined openings due to the creep of the host salt (DOE, 1988a). The natural closure of the salt rooms is expected to be complete within 100 years. This creep closure is

expected to improve the effectiveness of engineered barriers (seals, backfills, etc.) and limit the pore volume in the facility available to brine inflow from any source, such as brine seepage from the host formation or from seepage through seals from overlying water-bearing units (Nowak, 1988).

At some point after closure, the waste containers are expected to breach, exposing waste to any brine that may have accumulated in the interim. The amount of accumulated brine in the facility at the time when the salt has closed around the waste is being determined as part of the performance assessment conducted pursuant to 40 CFR Part 191 (EPA, 1985).[1] Expected total inflow estimates have been calculated to be between four and 40 cubic meters per typical waste storage room (a typical waste storage room will have an initial excavated volume of 3,600 cubic meters) (Nowak, 1988). The plugging and sealing of the facility in addition to the natural closure of the salt rooms, will minimize the amount of contaminated brine that can occur in the facility. These factors also assure that any such brine will be trapped in the facility formation with little likelihood of mobilization into ground water resources.

Additional engineered alternatives for mitigating the effects of brine inflow are being considered. One feasible alternative is to backfill rooms with mined salt or mixtures of mined salt and bentonite or other suitable materials. The backfill would limit the porosity of backfilled openings and increase the rate at which mined openings would be restored to nearly-undisturbed, low-permeability conditions due to creep closure. Water-absorbing tailored backfill materials, such as salt and bentonite, can be designed to absorb and immobilize the maximum expected 100-year brine accumulation in the WIPP disposal rooms.

The WIPP site is located in a very sparsely populated region in which major land uses are grazing, oil and gas production, and potash mining. The site is remote from significant surface water resources, and the quality of ground water in the area limits its possible uses. Water in the water-bearing strata overlying and underlying the facility horizon is high in dissolved solids and is not potable. The only potable ground water in the area is found in isolated and discontinuous perched or semiperched water tables. The nearest wells that produce potable water used for domestic and livestock purposes are located approximately three miles south of the WIPP site. There is no connection between ground water at WIPP and nearby surface water bodies. There is, therefore, little potential for waste placed in WIPP to affect water resources by entering water supply wells or surface water.

To summarize, for waste to migrate to ground water-bearing units there must first be a transport mechanism, in this case water or brine. There must be a pathway, such as a shaft or a drill hole that connects the contaminated brine with overlying water-bearing units, which are expected to be the most likely routes to the accessible environment. None of these factors is considered to be significant at the WIPP, either because of the condition of the site or because of facility design. There is no feasible transport medium during the operational phase of the WIPP. With the proper sealing of the facility, there will be no pathway available for the hazardous waste and hazardous waste constituents to migrate to the overlying or underlying water-bearing units. A ground water monitoring waiver for WIPP is justified because the potential for waste migration in ground water is very low.

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[1] Rule currently remanded back to EPA.

3.0 WIPP GEOGRAPHICAL SETTING AND LAND USE

The WIPP site is located in the Pecos River Valley section of the Great Plains physiographic province in the north-central part of the Delaware Basin. The land surface in the region surrounding the WIPP site slopes gently to the west and southwest at approximately 45 feet per mile. The surface elevations rangefrom 3,550 feet above mean sea level along the eastern border of the site to 3,300 feet in the west. Eolian sand, which occurs as partially stabilized or active sand dunes, covers much of the site. The sand, of Holocene age, is very erratic in distribution and thickness (DOE, 1988a).

The site is in Eddy County approximately 40 kilometers (25 miles) east-southeast of Carlsbad, New Mexico, in an area known as Los Medanos "The Dunes" (Figure 3.1). This area is relatively flat and sparsely inhabited with little water and limited land uses. Most of the land is federally or state owned and is used principally for grazing. Other uses of land in the area include potash mining and oil and gas exploration and development.

The WIPP site consists of 16 sections of federal land located in Township 22 South, Range 31 East (Figure 3.2). Fourteen sections of federal land were withdrawn from the application of public land laws by Public Land Order 6403, which authorized the land to be used for the construction of the WIPP facility. Two sections previously owned by the state were recently traded to the federal government. Surface land uses remain largely unchanged with the exception of the 2.75 square kilometer (1 square mile) area encompassing the facility. Mining and drilling are restricted in the 16 sections for purposes other than support of the WIPP project.

The WIPP site is divided into three zones (Figure 3.2). Zone I encompasses all major surface facilities and is surrounded by a chain-link fence. Zone II indicates the maximum extent of present and future underground development. The WIPP site boundary extends a minimum of 1.6 kilometers (one mile) beyond any underground development and provides a functional barrier between the underground region defined by Zone II and the accessible environment.

The major use of land within ten miles of the center of the site is cattle ranching. There are about 500 head of cattle within five miles of the site, and approximately 1,500 head between five and ten miles from the site. At present, none of the ranches within a ten-mile radius of WIPP use well water for livestock. The Smith Ranch used well water until 1978, but the quality was poor and they now use water supplied by pipeline. Drinking water is supplied by the International Mineral and Chemical Corporation (IMCC) which has a well system in the Capitan Aquifer. Stock water comes from IMCC and the New Mexico Potash Corporation, whose well system taps the Ogallala Formation (DOE, 1988a).

The WIPP site lies in a sparsely populated area with no nearby residences or industrial activities. About eight people reside at the Mill's Ranch, the nearest residence to the WIPP site, which is located 3.5 miles south-southwest of the site. The nearest town, Loving, New Mexico, has a population of about 1,700. Loving lies about 15 miles southwest of the site. There are several active potash mines within 15 miles of WIPP, the closest of which is the Western Ag-Mineral Company potash mine located approximately five miles west-southwest of the WIPP site.

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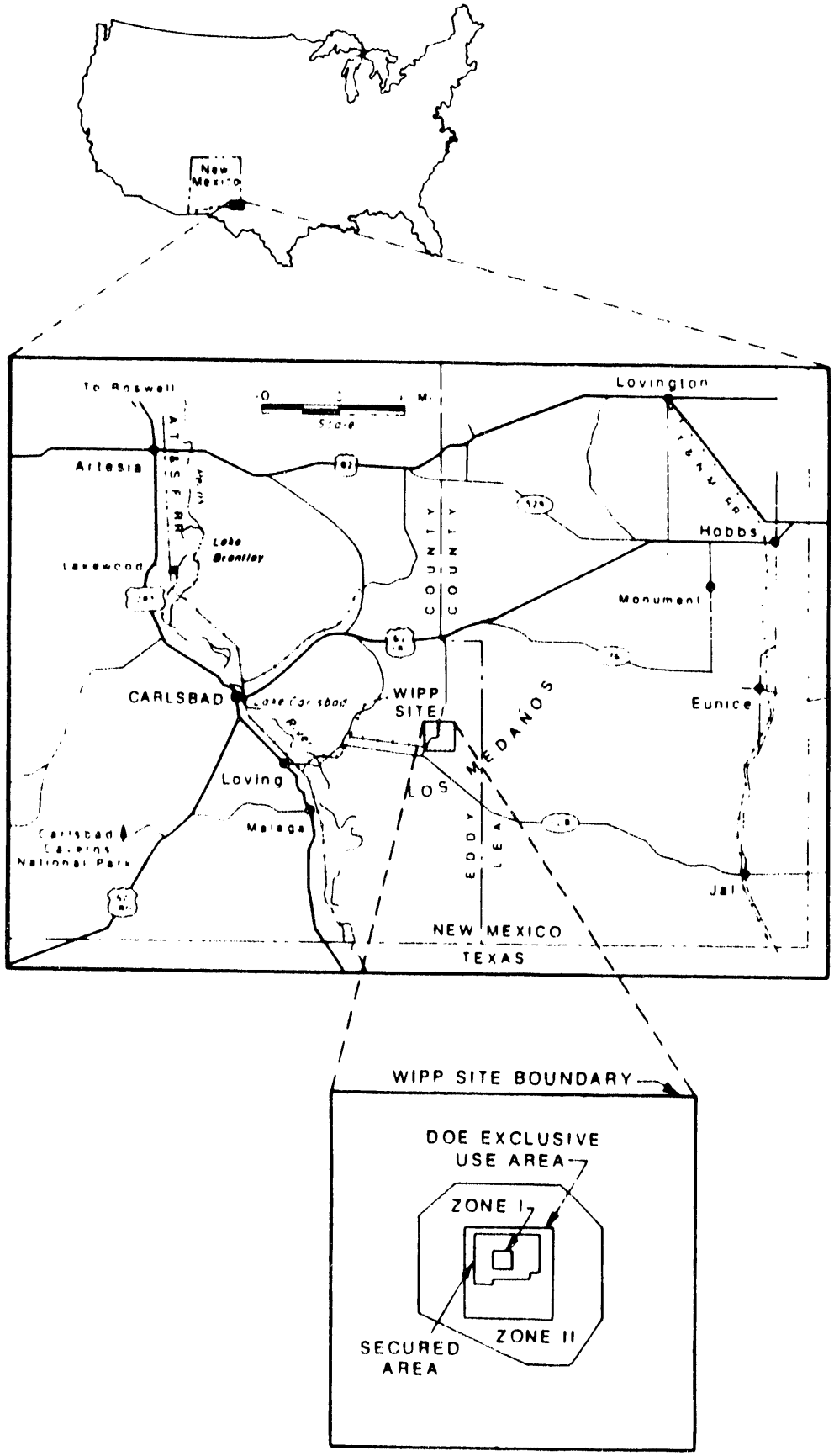

FIGURE 3.1 - LOCATION OF THE WIPP SITE

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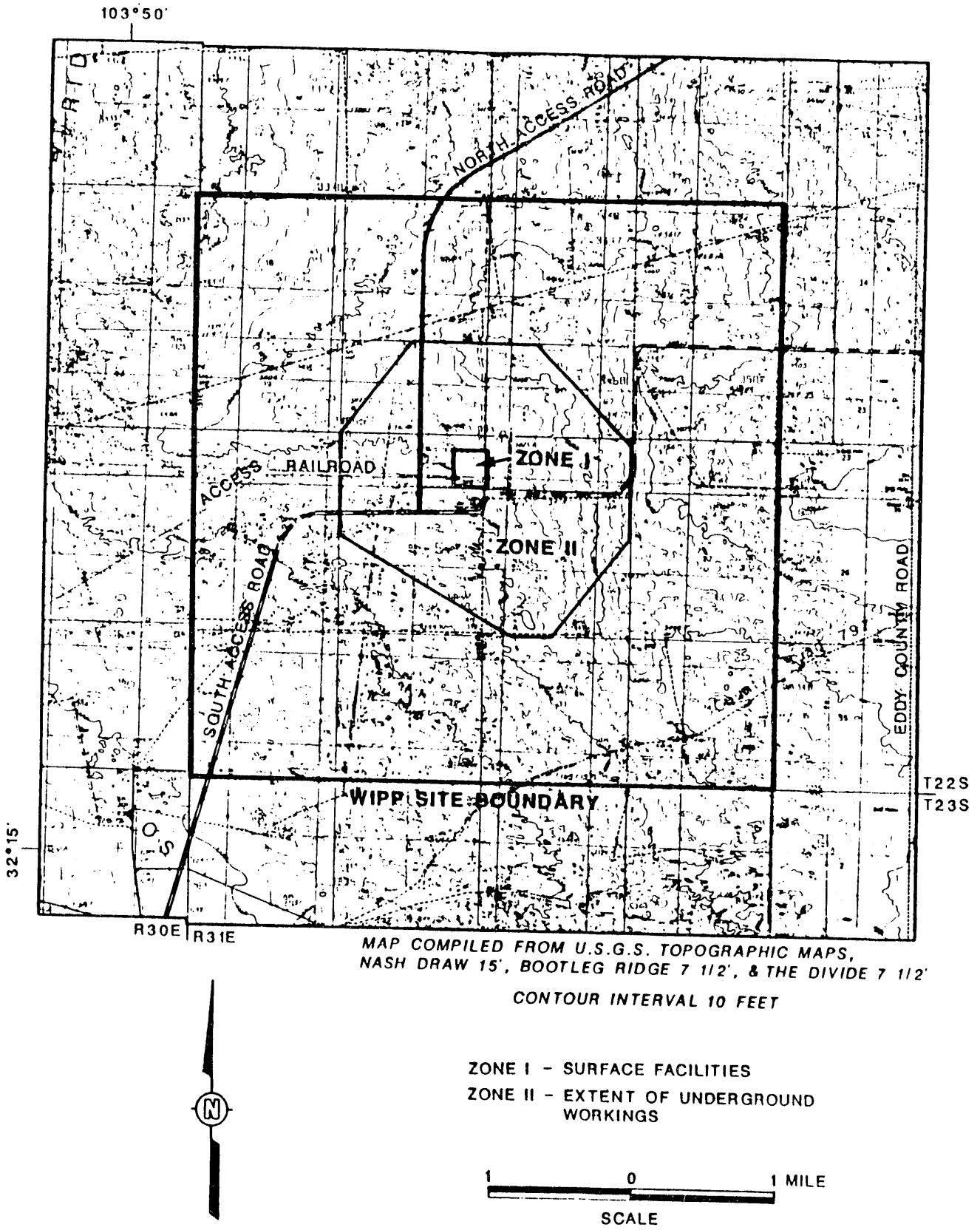

FIGURE 3.2 – WIPP LOCATION AND BOUNDARIES

4.0 SITE GEOLOGY

4.1 SITE-SPECIFIC EXPLORATION TECHNIQUES

Detailed site-specific exploration techniques have been and are being utilized at the WIPP site. Among these are seismic reflection; resistivity; gravity; electromagnetic and magnetic surveys; borehole exploration including coring, geophysical logging and hydrologic testing; and reconnaissance geologic mapping. Many publications describe the geology at the WIPP site, including the WIPP "Geologic Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico" (Powers et al., 1978) and the WIPP "Draft Final Safety Analysis Report" (FSAR) (DOE, 1988a).

4.2 SITE STRATIGRAPHY

The WIPP facility is being constructed near the middle of a sequence of evaporite beds about 3,600 feet thick that consist primarily of halite and anhydrite (Figures 4.1, 4.2). This chapter summarizes the stratigraphic units from the Castile Formation, underlying the Salado Formation, to the surface. Special emphasis is placed on the water-bearing units and the Salado Formation whose properties determine the low potential for waste migration from the WIPP site. Detailed descriptions of local stratigraphy are provided in the reports named above.

4.2.1 Permian System

The nearly 13,000 feet of Permian strata that were deposited within the Delaware Basin area constitute the most complete Permian sequence in North America (Brokaw et al., 1972). At the WIPP site, the Permian sequence averages about 12,800 feet thick. The upper part of the sequence, in which the facility is located, is composed of approximately 3,600 feet of thick evaporite beds (primarily halite and anhydrite) with only minor amounts of clastic material (DOE, 1988a). The Permian System is divided into four series which are, in ascending order, the Wolfcampian, Leonardian, Guadalupian, and Ochoan. The Permian age rocks of interest here are part of the Ochoan Series.

Ochoan Series

The Ochoan sediments are of marine origin and are separable into two distinct sections: a thick lower section of evaporites and a thinner upper layer of redbeds. The lower section includes, in ascending order, the Castile, Salado, and Rustler Formations. The upper section consists of the Dewey Lake Redbeds. A summary of the Ochoan evaporites in the northern Delaware Basin is provided in Bachman (1984).

Castile Formation

The Castile Formation underlies the Salado Formation. The thickness of the Castile at and near the WIPP site is approximately 1,250 feet. Lithologically, the Castile contains a sequence of three thick anhydrite beds, separated by two thick halites sequences. These low-permeability units lie between deeper ground water-saturated rocks of the Bell Canyon Formation and the overlying Salado Formation.

Salado Formation

The WIPP facility is being constructed in the Salado Formation. A core hole, ERDA-9, was drilled at the center of the WIPP site through the Salado and into the Castile Formation. At ERDA-9 the top of the Salado is 848 feet below ground surface (BGS) and the base is at 2,824 feet BGS for a total thickness of 1,976 feet. The waste storage horizon is located approximately 2,150 BGS. Schematic sections and detailed lithologic logs for ERDA-9 and additional core holes surrounding the site, as well as information obtained from shaft mapping may be found in the draft of the WIPP FSAR (DOE, 1988a).

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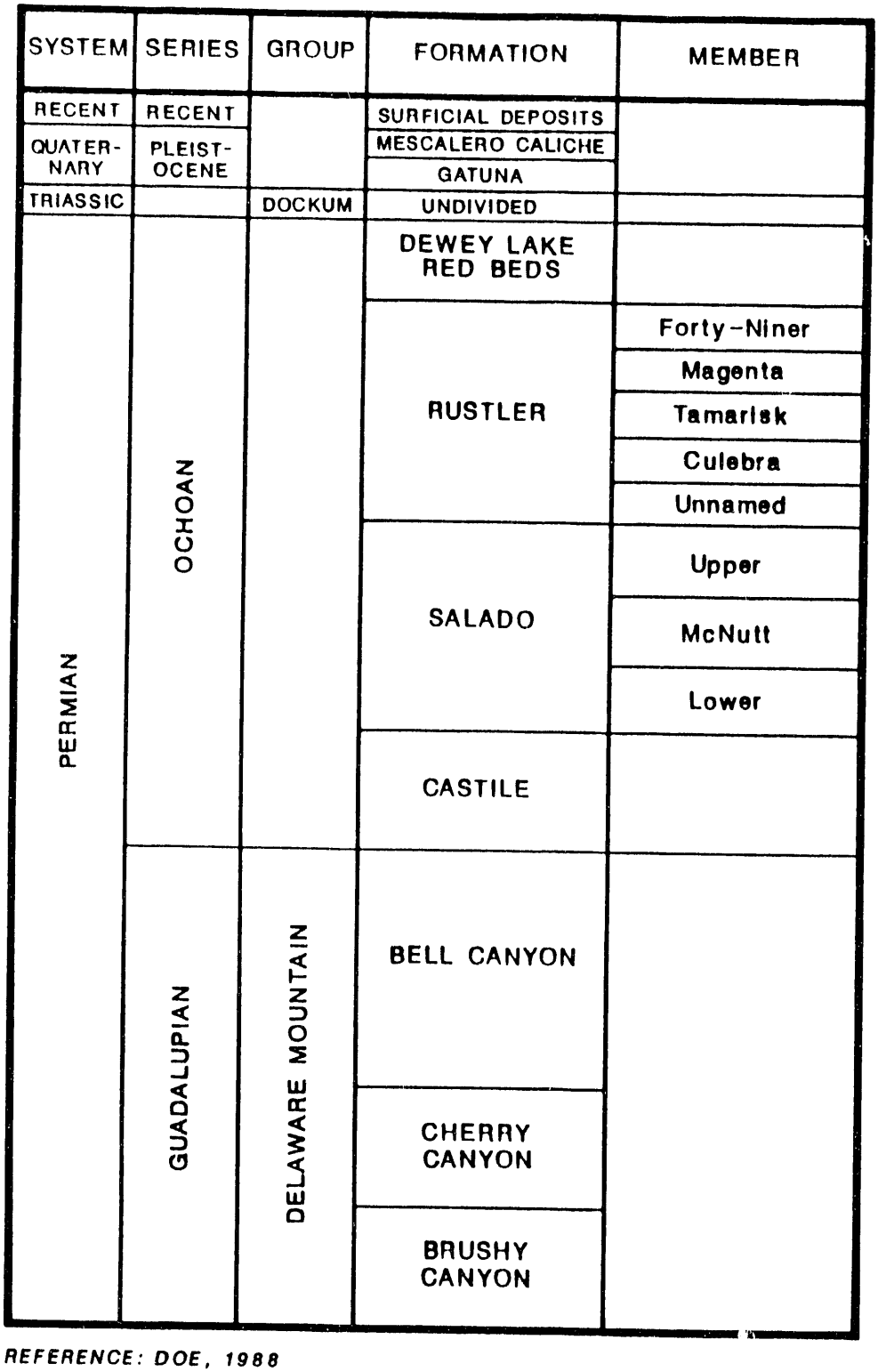

REFERENCE: DOE, 1988

FIGURE 4.1 - STRATIGRAPHIC COLUMN AT THE WIPP SITE

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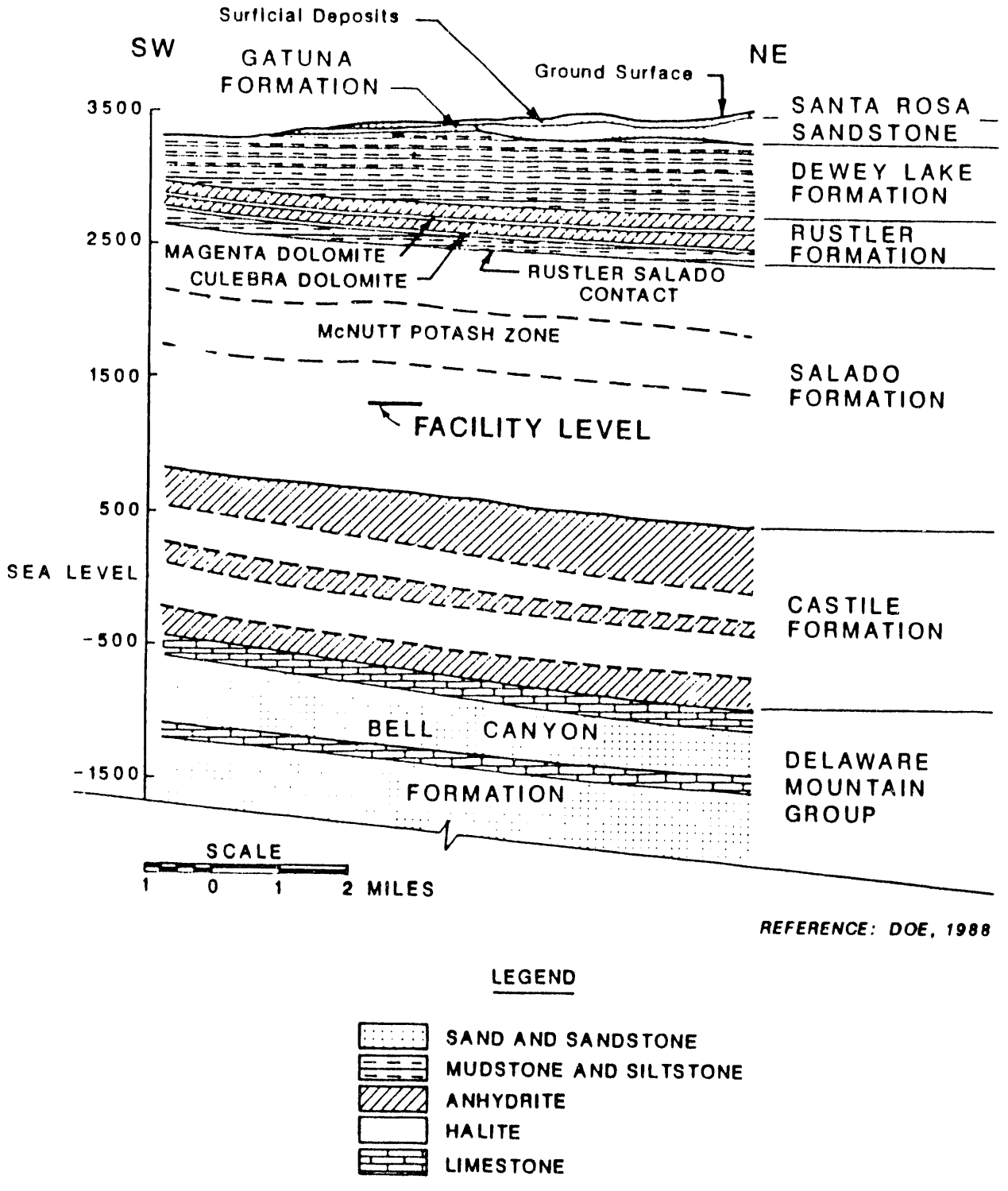

FIGURE 4.2 - GENERALIZED STRATIGRAPHIC CROSS SECTION

The Salado Formation is composed predominantly of halite, which constitutes about 85 to 90 percent of this formation at the WIPP facility. The next most abundant rock type in the formation is anhydrite. The remainder of the formation is polyhalite and other potassium-rich rocks with subordinate amounts of glauberite, magnesite, sandstone, siltstone, and claystone (DOE, 1988a).

The Salado Formation is divided informally into three members, an unnamed lower member, the McNutt potash zone, and an unnamed upper member. The WIPP underground facility is in the lower member, which is 1,094 feet thick and is composed of alternating thick layers of halite and thinner seams of anhydrite and polyhalite. Thin bands of magnesite form a carbonate-rich zone in the lower part of most of the polyhalite and anhydrite seams. Seams of claystone underlie the anhydrite and polyhalite seams. The clay seams in turn are underlain by dark to medium-gray argillaceous halite, which grades downwards into polyhalite or clear halite (DOE, 1988a).

The McNutt potash zone is 380 feet thick at the center of the WIPP site and differs from the other members of the Salado in that it is rich in potassium-bearing minerals. In addition to potassic rocks, the McNutt contains thin seams of anhydrite and polyhalite within the dominant halite (DOE, 1988a).

The upper, unnamed member is 502 feet thick at the center of the WIPP site and is composed of halite, minor amounts of anhydrite and polyhalite. It also contains two persistent beds of very fine-grained sandstone. These relatively thin sandstone beds occur, respectively, 30 to 40 feet and 112 to 120 feet below the top of the unit (DOE, 1988a).

Bedded salt formations such as the Salado Formation respond to mining activities in a predictable and measurable manner. Once a portion of the salt is removed, the opening created will begin to creep inwardly and eventually close the void space. This property increases the isolation capabilities at the WIPP facility because, with time, the host rock can be expected to return to a nearly undisturbed, low-permeability condition that encapsulates the waste.

Rustler Formation

In the WIPP site area, the Salado Formation is overlain conformably by the Rustler Formation. The Rustler Formation is approximately 310 feet thick at the center of the site. Overall, the lithology of the Rustler is quite variable, containing carbonates, sulfates (gypsum, anhydrite, polyhalite), clastic materials, and halite. The clastic-rich lower part is approximately 100 feet thick dominated by siltstone and claystone with lesser amounts of anhydrite and halite. The anhydritic upper part of the formation is approximately 210 feet thick and contains gray anhydrite with a few interbeds of reddish-brown clay and gray dolomite (Powers et al., 1978). The Culebra and Magenta Dolomite Members of the Rustler Formation are found within this section. These two dolomite members are water bearing in the vicinity of the WIPP site. Each unit is discussed below.

Culebra Dolomite Member

The Culebra Dolomite Member occurs in the Rustler Formation between 704 and 727 feet BGS near the center of the WIPP site (Winstanley and Carrasco, 1986). It is a thinly-bedded microcrystalline dolomite that contains many small spherical cavities ranging 2 to 20 millimeters in diameter. These cavities may be partially filled with secondary anhydrite, gypsum, or calcite. Although many cavities are open, they do not appear to be interconnected except along fractures (Mercer, 1983).

Magenta Dolomite Member

The Magenta Dolomite Member occurs in the Rustler Formation between 596 and 620 feet BGS near the center of the WIPP site (Winstanley and Carrasco, 1986). It is characterized by alternating wavy laminae

of silty dolomite and anhydrite altered locally to gypsum. The dolomite is bounded above and below by anhydrite (Mercer, 1983).

Dewey Lake Redbeds

The Dewey Lake Redbeds is the uppermost unit of the Late Permian Ochoan Series at the WIPP site and represents the top of the Paleozoic section in the Delaware Basin. At the center of the WIPP site the Dewey Lake is 474 feet thick. The Dewey Lake Redbeds consists of mudstone, siltstone, and interbedded thin lenticular beds of sandstone.

4.2.2 Triassic System

Late Triassic rocks in the northern part of the Delaware Basin belong to the Dockum Group which unconformably overlies the Dewey Lake Redbeds. The Santa Rosa Sandstone of the Dockum Group occurs in the vicinity of the WIPP site as an erosional wedge pinching out near the center of the site. It consists of fine to coarse-grained sandstone with interbeds of siltstone and mudstone. Throughout most of the area, the Santa Rosa Sandstone is covered by surficial Cenozoic deposits.

4.2.3 Quaternary System

Cenozoic rocks in the WIPP site area are the Pleistocene and Holocene age Gatuna Formation and the Mescalero Caliche. Twenty-seven feet of the Gatuna Formation were encountered at the center of the site. It is a reddish-brown, poorly consolidated sand, gravel, and silty clay. Beneath a cover of windblown sand, much of the site area is covered by a hard, resistant petrocalcic horizon informally known as the Mescalero Caliche. It is about 4.3 feet thick in the site area (DOE, 1988a).

The Ogallala Formation, of late Cenozoic age, is a major water-bearing unit supplying ground water for a large area of the Permian Basin east of the WIPP site. This unit does not occur at WIPP; therefore, WIPP will not impact the Ogallala aquifer.

Recent (Holocene age) deposits in the vicinity of the WIPP site include windblown sand, alluvium, and playa lake deposits (Powers et al., 1978). The most prevalent recent deposits consist of the windblown sand that covers most of the WIPP area (Figure 4.3). The sand occurs as either tracts of conspicuous dune fields or as sheet deposits. The dune deposits can be up to 100 feet, while the sheet deposits are typically no more than 10 to 15 feet thick.

Alluvial deposits occur in one-quarter to three-quarter mile wide belts along declivities into Nash Draw, for example, along the base of Livingston Ridge and locally in small depressions (Figure 4.3). These deposits are similar to small alluvial fans or sheet deposits.

Playa deposits consist of eolian sand and alluvium that occur in mudflats. The nearest playas are about five miles west of the WIPP site adjacent to Nash Draw (Figure 4.3).

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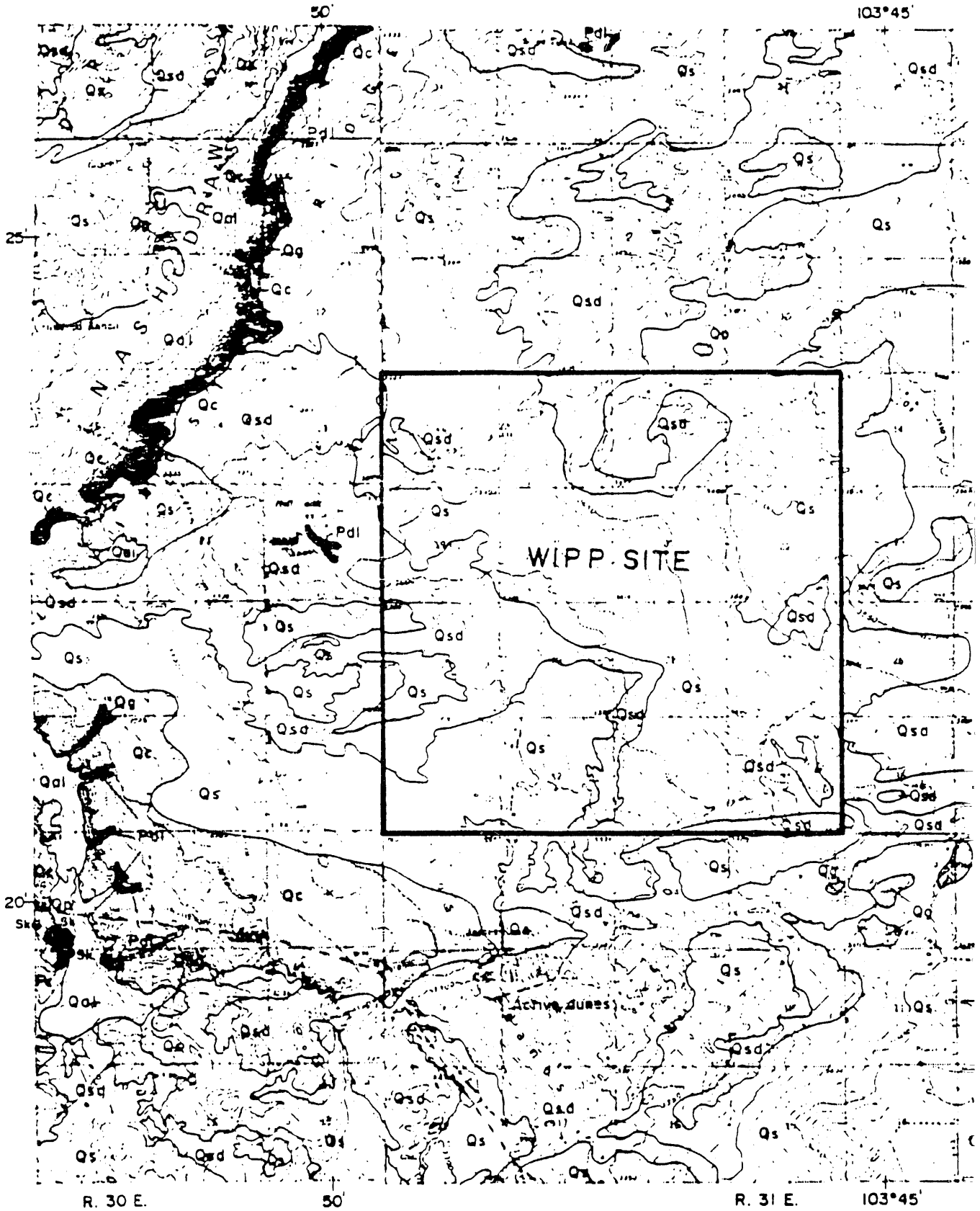
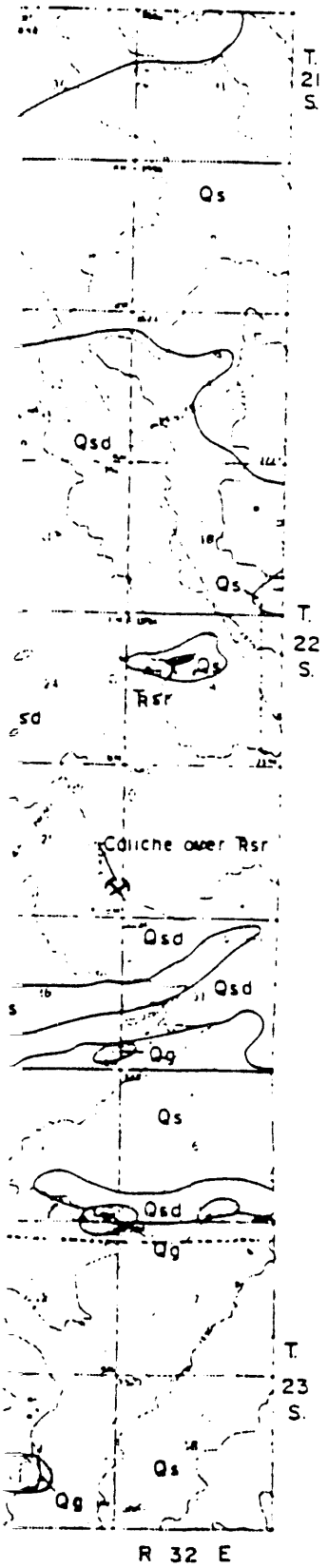


FIGURE 4.3 – MAP OF S





EXPLANATION

QUATERNARY

RECENT

Qs Qsd — SAND – Eolian sand plains (Mescalero sand). Qsd, conspicuous dunes, generally stabilized or partly stabilized

Qa Qp — ALLUVIUM – Sand and silt, locally conglomeratic, deposited on gentle slopes and depressions. Qp, playa deposits of sand and silt in shallow intermittent ponds or lakes

PLEISTOCENE

Qc — CALICHE – Limestone (Mescalero caliche), dense to travertine-like, with included sand grains and rock fragments. Has been assigned to Yarmouth interglacial stage

Qg — GATUNA FORMATION – Gravel, sand, silt and clay deposited as alluvium; dominantly reddish-orange, grading to pink, gray or yellow. Has been assigned to Kansan glacial stage

TRIASSIC

UPPER TRIASSIC

Rsr — SANTA ROSA SANDSTONE – Conglomeratic sandstone, moderate reddish-brown to light brown, poorly sorted, cross-bedded, interbedded locally with moderate reddish-brown claystone and siltstone

PERMIAN

OCHOAN

Pdl — DEWEY LAKE REDBEDS – Fine sandstone and siltstone, moderate reddish-orange to reddish-brown, conspicuous thin laminae generally less than 1/4 inch thick, locally clayey and with light greenish-gray partings

Pr — RUSTLER FORMATION – White, massive gypsum

SK — Sinkhole

Quarry

REFERENCE

DOE, 1988a

Contour interval = 10 feet

0 1 2 3 4 KM

0 1 2 3 MI

SCALE

RFICIAL GEOLOGY

5.0 CLIMATOLOGY AND WATER BALANCE

5.1 CLIMATOLOGY

The regional and local climate is semi-arid. The mean annual rainfall is approximately 12 inches, about half of which is received from thunderstorms during June through September. Daytime summer temperatures consistently exceed 32°C (90°F) and occasionally rise above 38°C (100°F). Winter afternoon temperatures often rise as high as 21°C (70°F). Night-time lows during the winter average near -5°C (23°F), occasionally dipping below -10°C (14°F). Prevailing winds are from the southeast; however, strong winds are frequent (especially in the spring) and can blow from any direction, creating potentially violent windstorms which can carry large volumes of dust and sand. Detailed compilations of climatic data for the WIPP site appear in the Ecological Monitoring Reports (Reith et al., 1985; Fischer, 1985 and Fischer, 1986). Climatic data are currently being collected near the northeast corner of the Zone I boundary of the WIPP site. Additional climatic information appears in the Final Environmental Impact Statement (FEIS) (DOE, 1980) and Draft WIPP FSAR (DOE, 1988a).

The infiltration and percolation rates of meteoric water into the sediments overlying the facility horizon have been investigated for the U.S. Bureau of Land Management (Geohydrology Associates, 1978). Evapotranspiration was measured to be at least 96 percent of precipitation. On the average, therefore, the annual amount of infiltration would be less than 0.5 inch per year.

The widespread presence of the Mescalero Caliche, several feet below the surface, does indicate that not enough infiltration on a regional scale has taken place since its formation (410,000 to 510,000 years ago) to result in its wholesale dissolution. It is difficult to arrive at a precise figure for the amount of water that infiltrates downward into the formations overlying the WIPP site. Infiltration is apparently negligible as evidenced by the absence of a near-surface ground water body or regional water table above the Rustler Formation at the WIPP site (DOE, 1988a).

5.2 WATER BALANCE

A regional water balance study has been conducted covering approximately 2,000 square miles in Eddy County, east of the Pecos River (Figures 5.1 and 5.2) (Hunter, 1985). The study encompassed stratigraphic units above the Salado Formation and below the Ogallala Formation. The only area in the study that is connected hydrologically to the Rustler Formation water-bearing units in the vicinity of the WIPP site is approximately 400 square miles south of Highway 180, west of "The Divide," and east of the Pecos River, including Nash Draw (Figure 5.2).

Elsewhere the study showed that recharge to the Rustler Formation probably occurs at a high spot (or "ridge") in the ground water table between Lakes McMillan and Avalon and the northern portion of Eddy County, as well as east of Clayton Basin. Clayton Basin appears to be a discharge point for local ground waters from the Rustler Formation, Triassic rocks, and surficial alluvium. The basin presently is hydraulically separate from Nash Draw and the WIPP site, but may discharge into Nash Draw in the future if the ground water ridge which lies between Nash Draw and Clayton Basin is altered by human activities. This ground water ridge may be an artifact of water discharge from mining activities in the area. It is possible that the mining activities taking place near the ground water ridge are unrelated to the ridge, and the ridge is of natural origin (Hunter, 1985).

At the San Simon Swale, ground water seems to percolate downward and leaves the area to the southeast. In the part of the study area hydraulically connected to the WIPP site, ground water recharge appears to take place at The Divide and Mimosa Ridge. The locations of discharge areas are still uncertain. The water-bearing unit of greatest concern in the WIPP area is the Culebra Dolomite Member

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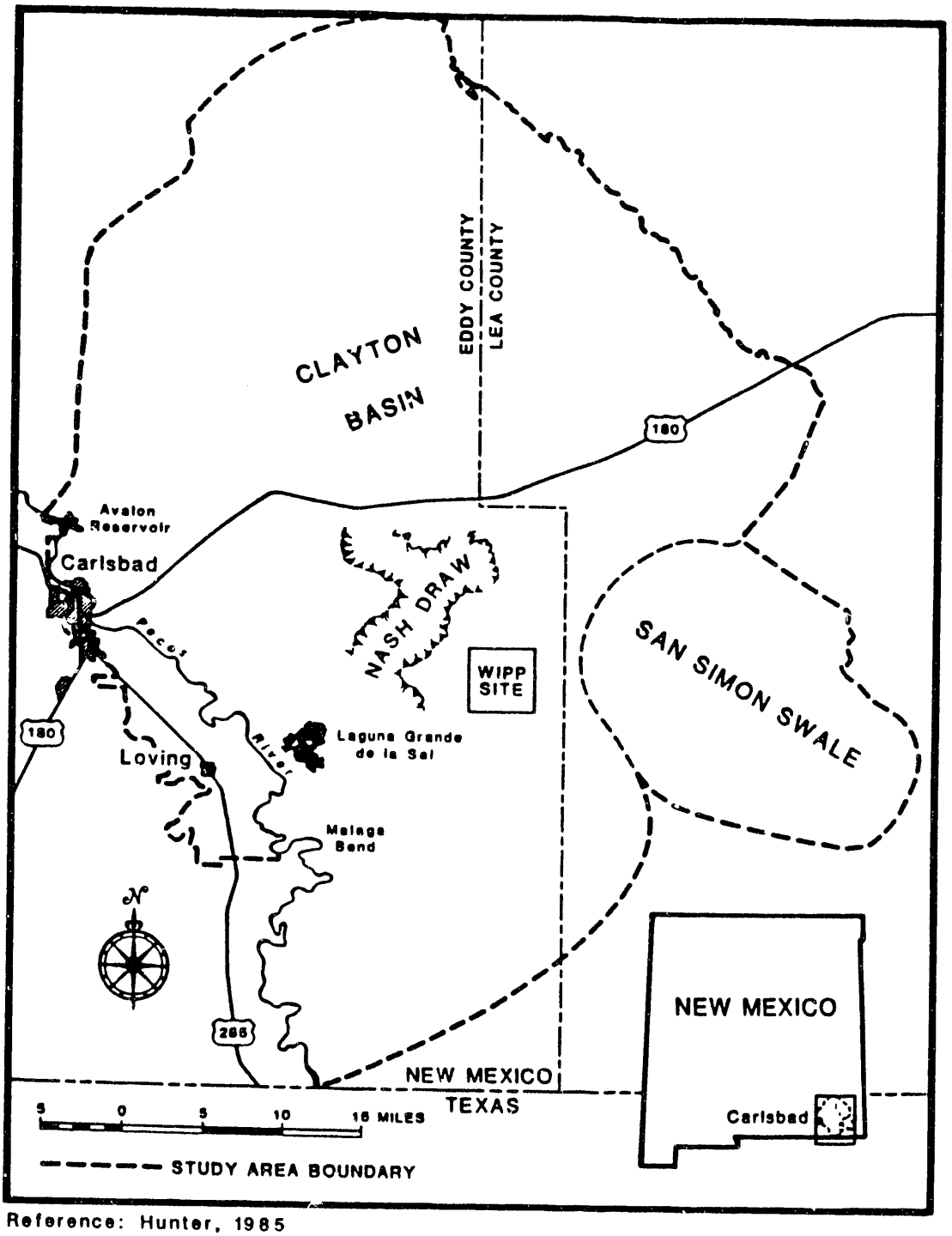

Reference: Hunter, 1985

FIGURE 5.1 - STUDY AREA FOR THE WIPP WATER BALANCE STUDY

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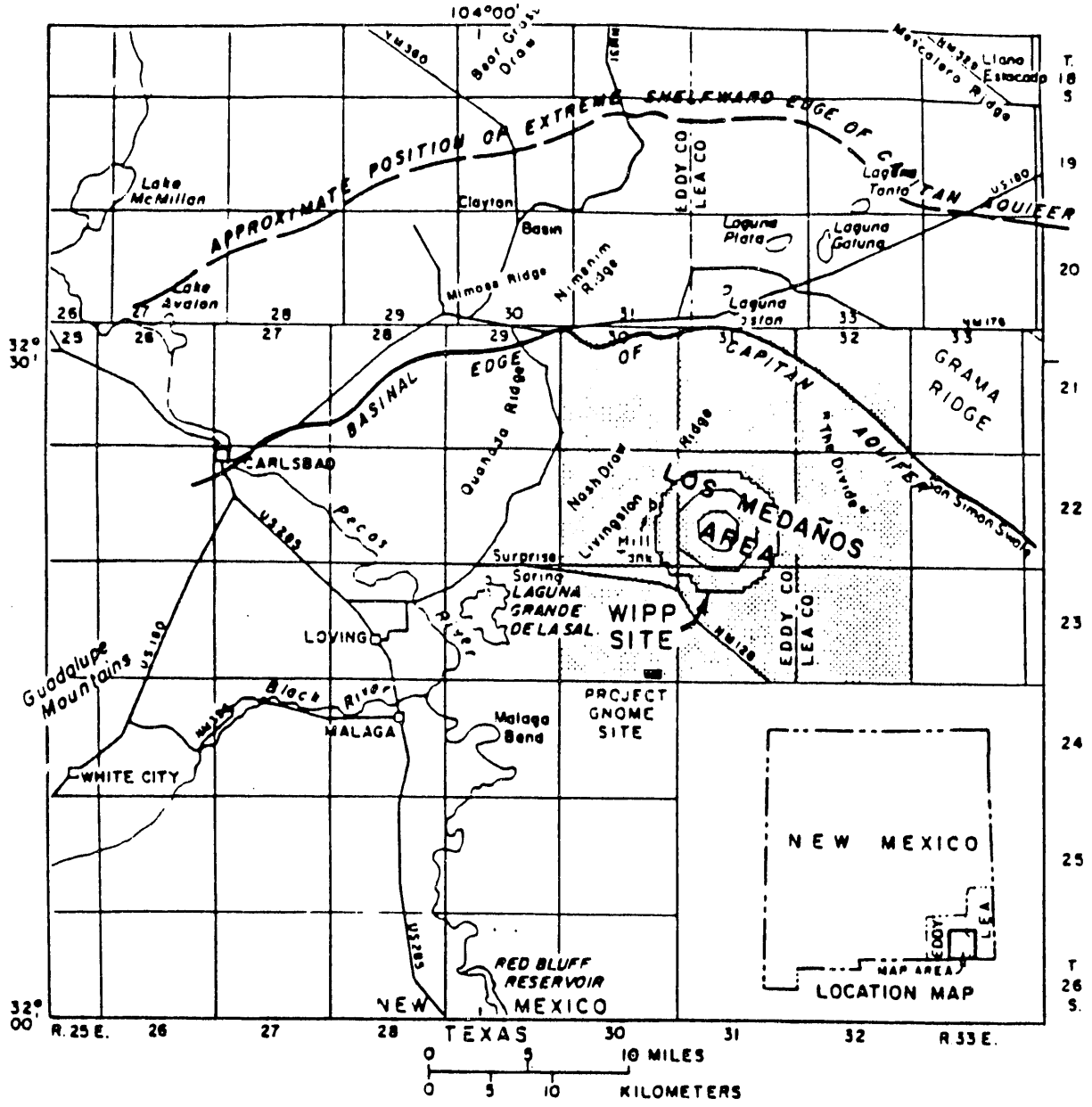

REFERENCE: DOE, 1988

FIGURE 5.2 – WIPP LOCATION AND SURROUNDING FEATURES CONTRIBUTING TO WIPP WATER BALANCE

of the Rustler Formation (Section 6.0). A diagram showing most likely flow directions in the Culebra Dolomite Member computed from potentiometric surfaces is shown in Figure 5.3 (LaVenue et al., 1988; Crawley, in preparation). This figure shows ground water flow in this aquifer is predominantly to the south in the area of the WIPP Site.

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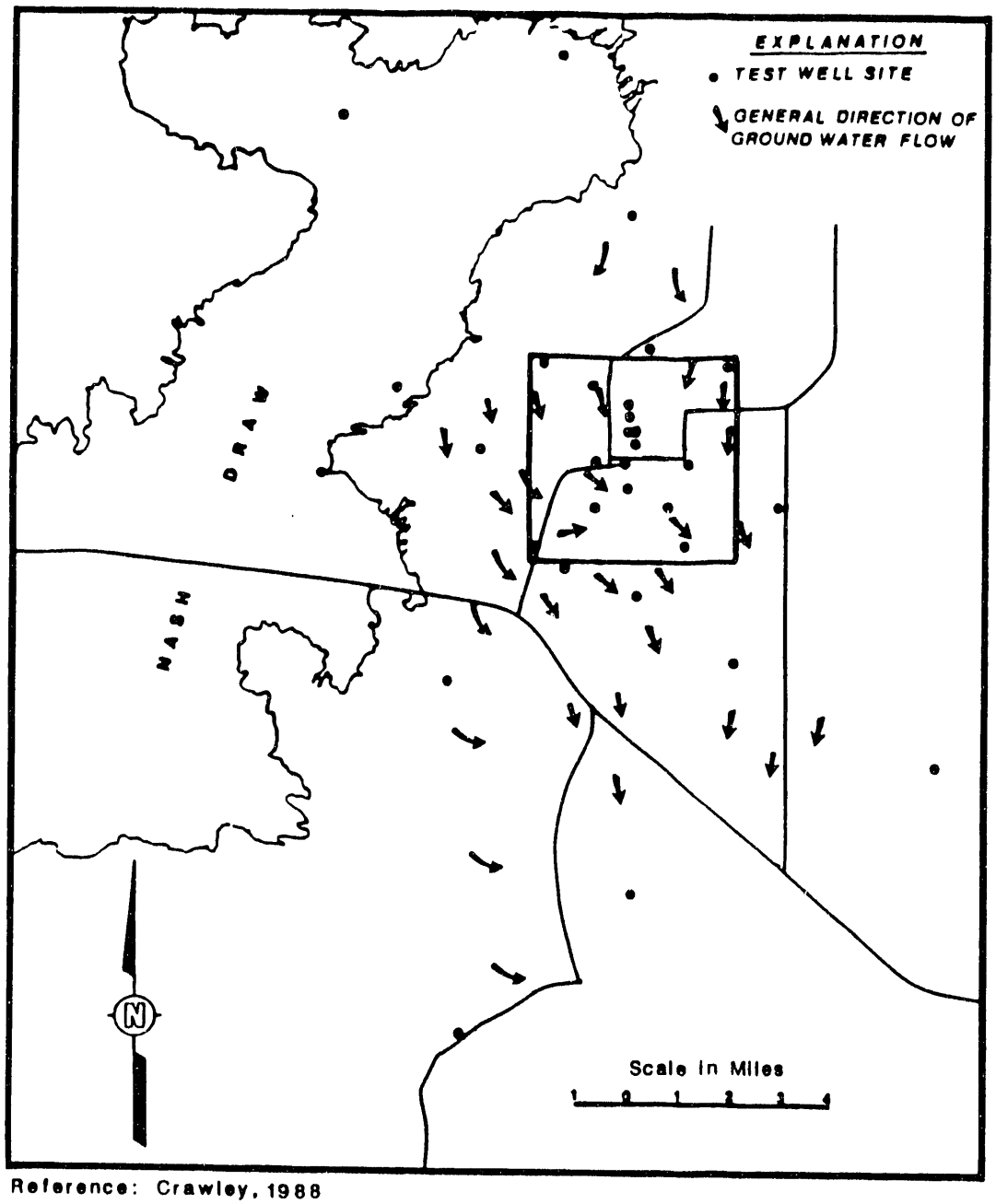

Reference: Crawley, 1988

FIGURE 5.3 - CALCULATED GROUND WATER FLOW DIRECTIONS
CULEBRA DOLOMITE MEMBER OF THE RUSTLER FORMATION

6.0 SITE HYDROLOGY AND WATER QUALITY

6.1 SURFACE HYDROLOGY

Surface water is absent at the WIPP site. The nearest large surface water body, Laguna Grande de la Sal, is about eight miles west-southwest of the WIPP site in Nash Draw where shallow brine ponds occur. The only other surface water is the Pecos River, which is about 13 miles southwest of the WIPP site at its closest point. Small livestock water holes ("tanks") occur several miles from the WIPP site, but are not hydrologically connected to the formations overlying WIPP. The source of water in these tanks is runoff from precipitation (Hunter, 1985).

6.2 SUBSURFACE HYDROLOGY

Several water-bearing zones have been identified and extensively studied near WIPP. Limited amounts of potable water are found in the Dewey Lake Redbeds and the overlying Triassic Dockum Group in the vicinity of WIPP. Two water-bearing units, the Culebra and Magenta dolomites, occur in the Rustler Formation and produce brackish to saline water in the vicinity of the site. Another saline water-bearing zone identified is the Rustler-Salado contact. These water-bearing horizons, which occur above the WIPP storage facility horizon, are described below. Brine and gas occurrences in the Salado and Castile Formations are also described.

6.2.1 Hydrology of the Castile Formation

The Castile Formation is composed of a sequence of three thick anhydrites separated by two thick halites. This formation acts as an aquitard, separating the Salado Formation from the underlying water-bearing sandstones of the Bell Canyon Formation (DOE, 1988a). Except for the isolated brine reservoirs locally found in the fractured anhydrites, very little hydrologic data are available from the Castile Formation (Mercer, 1987). In the halite zones, the occurrence of circulating ground water is restricted because halite at these depths does not readily maintain secondary porosity, open fractures, or solution channels. Drill stem tests conducted in the Castile Formation show the permeability of the anhydrite and salt beds underlying WIPP to be negligible, and in most tests, values for permeabilities were too low to be determined accurately with conventional methods. Based on the limitations of the instrumentation to measure these very low permeabilities, a conservative estimate for permeability would be less than 0.1 microdarcy (Mercer, 1987).

No regional ground water flow system is present in the Castile Formation. The only significant water present in the formation occurs in isolated brine reservoirs in fractured anhydrite. The brine occurrences are described in several reports (Popielak et al., 1983; Mercer, 1983; Griswold, 1980; DOE, 1988a). Geochemical data support the hypothesis that the brines represent trapped, Permian seawater that is now in equilibrium with the host rock. Therefore, these brine reservoirs are not increasing in volume or pressure, are unconnected with other aquifers or the surface, and have little potential to dissolve the host rocks or move through them.

6.2.2 Hydrology of the Salado Formation

The massive halite beds within the Salado Formation host the WIPP storage facility horizon. The Salado Formation represents a regional aquiclude due to the hydraulic properties of the bedded halite that forms most of the formation. In the halites, the presence of circulating ground water is restricted because halites does not readily maintain primary porosity, solution channels, or open fractures. During the mapping that was conducted as part of the construction of the waste-handling and exhaust shafts, the Salado Formation did not produce any observable fluid inflow (Holt and Powers, 1984; 1986). In addition, significant brine flows have not been encountered in hydraulic testing from the surface (Lappin, 1988).

Limited hydrologic testing has been conducted within the Salado Formation. The results of the permeability testing, both within the facility and from the surface, are generally consistent with a permeability of the undisturbed salt mass of approximately 0.001 to 0.01 micodarcy, with no distinguishable strata variability (Lappin, 1988). This indicates that any fluid flow within the competent salt is extremely slow and would result in an imperceptible rate of fluid movement in conventional hydrologic considerations. The only significant variation to these extremely low permeabilities stated occurs in the immediate vicinity of the underground workings. Gas-flow permeability tests indicate a marked increase in the permeabilities within approximately six to seven feet of the underground working (Stormont et al., 1987). This apparent increase in permeability is restricted to the disturbed zone immediately surrounding the excavation and is believed to be a result of near-field fracturing and possible matrix dilatancy due to stress relief.

Salado Formation Brine and Gas Inflow

Minor quantities of gas and brine have been encountered in the salt beds of the WIPP excavation, as described in Deal and Case (1987). The inflows of brine occur as "weeps" on the exposed surfaces of the underground workings and as accumulations in some of the boreholes drilled outward from the workings, most noticeably in the downholes. Gas is usually associated with the brine inflow and can be observed as gas bubbles in the brine occurrences. The amount of brine that occurs naturally in the rock is in order of 0.1 to 0.5 percent by weight of the surrounding rocks. Most of the measured brine inflows in boreholes have ranged between a few tenths to a few hundredths of a liter per day. The liquid and gas movement observed in the walls, floors, and roofs of the excavated surfaces are believed to be the result of the pressure gradient caused by the excavation. Geochemical studies on the origin of the brines indicate they originate as intergranular fluids which have residence times within the Salado Formation of at least several million years (Stein and Krumhansl, 1987). In addition, the variability of the fluid compositions near the WIPP workings by Stein and Krumhansl is consistent with there being little or no vertical fluid movement. During the operational phase, virtually all of the moisture entering the facility from the host rock will evaporate and be removed in the air circulated by the underground ventilation system (Deal and Case, 1987).

6.2.3 Hydrology of the Rustler-Salado Contact

The contact zone between the Rustler and Salado Formations at the WIPP site was tested in 20 cased and open drill holes (DOE, 1988a). In Nash Draw and areas immediately west of the site, the contact exists as a dissolution residue capable of transmitting water. As one moves eastward from Nash Draw toward the WIPP site, the amount of dissolution decreases and the transmissivity of this interval decreases. All tests within the boundary of the WIPP site showed very low transmissivities, ranging from $3x10^{-5}$ to $3x10^{-3}$ ft^2/day (Mercer, 1983).

6.2.4 Hydrology of the Culebra Dolomite

The Culebra Dolomite Member of the Rustler Formation has been studied extensively through the site characterization program. Because it is the most transmissive hydrologic unit in the WIPP site area, it is considered the most likely hydrologic pathway to the accessible environment for any potential contamination.

Mercer (1983) and Mercer and Orr (1977) provide detailed test results for a number of wells completed in the Culebra prior to 1983. Results for both single and multiwell hydrologic tests are presented by Beauheim (1986b, 1987) and Lambert and Robinson (1983). These tests show that the Culebra Dolomite is a fractured, heterogeneous system with varying local anisotropic characteristics. Calculated transmissivities for the Culebra Dolomite within the WIPP site boundary have a wide range with values between $9x10^{-2}$ to approximately 69 ft^2/day, with the majority of the value less than 1 ft^2/day (Beauheim, 1987). Transmissivities generally decrease from west to east across the site area.

Potentiometric surface maps have been constructed using water level data. The Culebra Member is heterogeneous and anisotropic, and the flow path of water moving through the Culebra Member is affected by fractures and variable water densities caused by compositional variability. Consequently, the regional direction of flow may have little or no relationship to local flow paths. An interpretation of flow direction in the Culebra Member is depicted in Figure 5.3 of the previous section. This map shows the regional flow direction of ground water in the Culebra Member to be to the south and southeast (Crawley, in preparation).

6.2.5 Hydrology of the Magenta Dolomite

The hydrology of the Magenta Dolomite Member was tested in 15 cased and open holes at the WIPP site. Transmissivities within the WIPP site boundary calculated from the results of these tests range from $1x10^{-2}$ to $3x10^{-1}$ ft^2/day (Mercer, 1983).

Water level data have been collected and potentiometric surface maps constructed. The direction of ground water flow at the WIPP site, as estimated from the potentiometric surface map, is west-southwest toward Nash Draw (Mercer, 1983).

6.2.6 Hydrology of the Dewey Lake Redbeds

Hydrologic investigations at and near the WIPP site have not identified a continuous zone of saturation within the Dewey Lake Redbeds. Where water is present in the formation, it is generally in small perched or semiperched water tables, and its occurrence is localized (Mercer, 1983). Several wells believed to be completed in the Dewey Lake Redbeds are located within several miles of WIPP. These wells include Ranch Well, Barn Well, Twin Wells, Fairview Well, and Unger Well. Of these wells, one supplies drinking water to a ranch house (Barn Well) and the remainder supply water for livestock (Figure 6.1).

Four intervals of the Dewey Lake Redbeds were tested in drill holes at the WIPP site. Although no saturation was encountered during drilling, ten wells were completed as observation wells (Ward and Walter, 1983). The data obtained showed that there was no development of a zone of saturation in any of these wells.

6.2.7 Hydrology of the Dockum Group

At the WIPP site, exploratory holes were drilled through the Gatuna Formation and the Dockum Group. The Gatuna Formation and Dockum Group occur within 50 feet of the surface and little or no water was encountered in these formations. Only one hole reported a small zone of moisture in the Dockum Group, but observation wells completed in the Dockum Group were dry. Private wells (Commanche and Clifton wells) do produce potable water from the Dockum Group approximately 10 miles east of the WIPP site, and they are used for livestock watering.

6.3 WATER QUALITY

In addition to the study of site hydrology, surface and ground water quality has been characterized for two major reasons: (1) to establish baseline levels of naturally occurring inorganic solutes and radionuclides and potential organic contaminants in water prior to waste emplacement, and (2) to define the existing use in the area for ground and surface-water as a supply for domestic, industrial and livestock consumption. Evaluation of WIPP site area hydrology and water quality indicates that existing and potential future use of ground and surface water is extremely limited due to non-saturated conditions and very poor water quality. Table 6-1 lists the wells currently sampled as part of the WIPP Water Quality Sampling Program (WQSP) and the formation sampled by each well. The wells are shown in Figure 6-1. The subsections below describe the quality of the ground water which occurs in the WIPP area.

TABLE 6-1

WELLS SAMPLED AS PART OF THE WATER QUALITY SAMPLING PROGRAM

WELL NAME	WATER BEARING UNIT	WELL NAME	WATER BEARING UNIT
DOE-1	Culebra	H-14	Culebra
DOE-2	Bell Canyon	H-15	Culebra
DOE-2	Culebra	H-17	Culebra
H-02a	Culebra	H-18	Culebra
H-03b1	Magenta	P-14	Culebra
H-03b3	Culebra	P-17	Culebra
H-04a	Magenta	Barn Well	Dewey Lake
H-04b	Culebra	Clifton Well	Santa Rosa
H-05a	Magenta	Comanche Wells	Santa Rosa
H-05b	Culebra	Engle Well	Culebra
H-06a	Magenta	Fairview Well	Dewey Lake
H-06b	Culebra	Mobley Ranch Well	Culebra
H-07b1	Culebra	Poker Trap	Culebra
H-08a	Magenta	Ranch Well	Dewey Lake
H-08b	Culebra	Twin Wells (Pasture)	Dewey Lake
H-09b	Culebra	Unger Well	Dewey Lake
H-11b3	Culebra	USGS-1	Culebra
H-12	Culebra		

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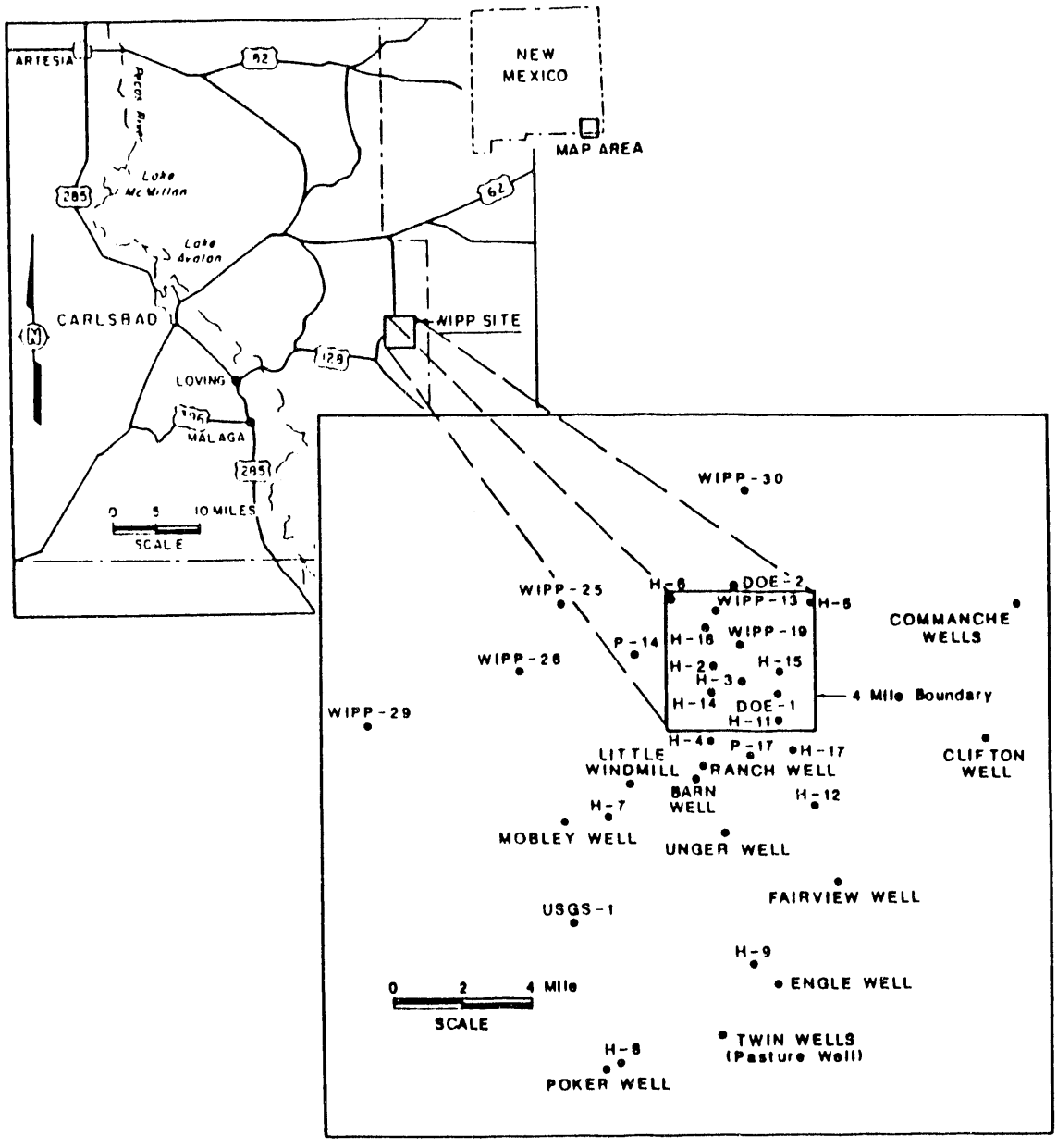

FIGURE 6.1 - GROUND WATER SAMPLING AND PRIVATE WELL LOCATIONS

Rustler-Salado Contact

Mercer provides data from 20 wells sampled in the WIPP vicinity from the Rustler-Salado contact. The largest concentrations of total dissolved solids (TDS) in the WIPP water-bearing formations are contained in the Rustler-Salado contact. TDS values range from 79,800 milligrams per liter (mg/l) in well H-07b1 to 480,000 mg/l in well H-01. Sulfates and chlorides of calcium, magnesium, sodium, and potassium make up the primary dissolved mineral constituents of this brine.

Culebra Dolomite

The water quality of the Culebra varies greatly. The TDS values range from 3,200 mg/l at well H-08b to about 291,000 at well WIPP-29. These two wells are fairly remote from the site, but even at closer proximity to the facility location, a marked variation in the water quality is observed. H-02a is located one-half mile west of the site and has a TDS of 13,500 mg/l while H-15 which lies two miles east of the site has a TDS of 231,000 mg/l. The chemical constituents consist predominantly of sulfates and chlorides of calcium, magnesium, potassium, and sodium.

Magenta Dolomite

The water-quality data for the Magenta Dolomite indicate the water is saline to briney, with TDS values ranging between 5,460 to 270,000 mg/l. The predominant dissolved species are sodium, calcium, magnesium, chloride, and sulfate.

Surface Water

No surface water occurs in the area of the WIPP site, but surface water bodies within an approximate 25-mile radius of the site, such as the Pecos River, the Laguna Grande de la Sal, and livestock tanks which are fed from surface runoff, are sampled and water quality is determined. Data are collected and reported as part of the WIPP Radiological Baseline Program, the Water Quality Sampling Program, and the Ecological Monitoring Program.

7.0 WIPP FACILITY DESIGN

The WIPP facility is a complex of surface and subsurface installations designed to receive, handle, and safely dispose of radioactive mixed waste underground. Several design features, particularly in the shafts connecting the surface and subsurface operations, are utilized to assure that ground water does not enter the facility or that any wastes enter the ground water system during the operational period. As the facility is filled and following decommissioning, seals will be emplaced in the facility and shafts to help assure long-term isolation of waste from the environment. This section summarizes these design features of WIPP.

7.1 SHAFT DESIGNS

The WIPP facility design includes four shafts. These are the Waste Shaft, the Construction and Salt Handling Shaft, and the Exhaust Shaft, which have been completed, and the Air Intake Shaft which is currently under construction. Each shaft includes a shaft collar, a shaft lining, and a shaft key section (DOE, 1988a).

The reinforced concrete shaft collars extend from the surface to the top of the underlying consolidated sediments. Each collar serves both to retain adjacent unconsolidated sands and soils and to prevent surface runoff from entering the shafts. The shaft linings extend from the base of the collar to the top of the salt beds approximately 850 feet below the surface. The shaft lining serves to prevent water from seeping into the shafts from water-bearing formations, such as the Magenta and Culebra Dolomite Members of the Rustler Formation overlying the facility host rock. The liners are also designed to retain loose rock. The shaft liners are concrete except in the Construction and Salt Handling Shaft in which a steel shaft liner has been grouted in place.

The shaft key is a circular reinforced concrete section emplaced in each shaft below the liner in the base of the Rustler Formation and extending about 100 feet into the Salado Formation. The key functions to resist lateral pressures and to support the shaft liner. The key assures the liner will not separate from the host rocks or fail under tension. This prevents the shaft from becoming a conduit for ground water flow into the facility.

Two water seal rings are incorporated in each key. The rings are separated by an 11-foot interval into which eight two-inch diameter pipes are inserted to monitor any water that may penetrate the upper ring. If ground water is detected flowing past the upper ring, this condition can be corrected by injecting chemical sealants or cement grouts to stop the leakage.

On the inside surface of each shaft, excluding the Construction and Salt Handling Shaft, there are three water collection rings. The first is located just below the Magenta Dolomite interval, the second just below the Culebra Dolomite interval, and the last at the lowermost part of the key section. These collection rings function to collect any ground water that may seep into the shaft through the liner. The ground water may then be piped to the storage horizon station area and into storage tanks near each shaft. The water can then be transported to the surface in portable tanks for disposal (DOE, 1988a).

7.2 REPOSITORY SEALS

Upon closure of WIPP, sections of the shaft liners may be removed and replaced by permanent shaft seals. Seals may also be placed in boreholes at the WIPP site, as well as in drifts and panels throughout the facility. These seals will function primarily to limit any seepage into the facility from overlying water-bearing units or from infiltration from the surface. In addition, seals will help prevent any contaminated water in the facility from being mobilized and reaching the accessible environment.

The approaches to preliminary seal design and performance goals for WIPP are described in detail by Stormont (1988). The general approach taken in the preliminary design concepts for shaft and borehole seals at WIPP is to limit the inflow of ground water from formations above the facility level until the host rock and the backfill encapsulate the waste because of salt consolidation. Water from other sources, such as saturated interbeds near the facility horizon or from the host salt itself, may also enter the repository following decommissioning. Although these water sources are volumetrically less significant, the seal system will be designed to limit inflows and limit expulsion of contaminated brines through shafts upon pressurization due to host formation consolidation. Seals will be emplaced throughout the facility to separate areas of the facility should human intrusion, such as drilling, occur at some time greater than 100 years following decommissioning. Boreholes will be sealed; however, no surface boreholes penetrate the facility itself and are unlikely to cause significant flow paths unless substantial dissolution of the host formation can occur between the facility and the nearest boreholes. Thus, borehole seals provide some additional assurance that dissolution will be minimized.

8.0 WASTE CONTAINMENT

The operational phase of the WIPP is scheduled to extend to about the year 2013. During the first five years of operation, the waste containers will be emplaced in the storage rooms without backfill to enable easy retrieval of the waste should DOE desire to remove or relocate the waste. Following this initial five year period, the waste will be emplaced with an engineered backfill and no consideration given to ease of retrieval. It is expected that with time, the closure of the storage rooms from the salt creep will gradually crush the waste containers. The preliminary conclusion thus far is that the room contents (waste and backfill) will be completely, or near completely, encapsulated in a solid mass within the first 100 years after emplacement (Tyler, 1988). This process of encapsulation due to the creep closure, together with the thick sequence of extremely low permeability salt surrounding the backfill and waste matrix, will enhance the ultimate isolation of the TRU waste in the WIPP.

The Waste Acceptance Criteria (WAC) for transuranic waste (DOE Rev. 2, 1985) specifically control inclusion of constituents that are chemically incompatible into the waste to be shipped to WIPP. Strict control of explosives, pyrophorics, combustibles, gas generators, heat generators, toxics, and corrosives is covered in the WAC and reduces the potential for waste releases due to accidents or container breaches in the facility subsequent to disposal. Importantly, no waste containing free liquids will be accepted at WIPP. Thus, the waste itself cannot provide a liquid medium that could potentially mobilize waste to the Culebra dolomite or other water-bearing units. Limits on respirable particulates in the waste (less than one percent by weight) help reduce the potential for waste releases due to accidents. All materials shipped and emplaced in the WIPP must meet these stringent requirements for stability, compatibility, and physical form to insure the safety of the repository even in the unlikely event that waste comes into contact with the formation.

9.0 SUMMARY AND CONCLUSION

The WIPP site has a very low potential for releasing waste to the accessible environment either in the interim status period, or subsequently under final status or post-closure. The principal means by which waste may reach the environment is through the Culebra Dolomite Member, a water-bearing stratum in the Rustler Formation overlying the facility. The Culebra dolomite is highly variable in its hydrologic characteristics but may, at least locally, possess relatively high transmissivities which could facilitate waste migration were any waste able to reach this aquifer.

Several characteristics of the site and the design of WIPP indicate there is little likelihood of waste reaching the Culebra dolomite and subsequently, affecting the accessible environment. These characteristics include site geology, site hydrology, climate, ground water utilization in the WIPP area, as well as WIPP shaft designs and facility sealing plans. The request to waive ground water monitoring requirements under interim status at WIPP is based on the information provided in the previous sections of this report. The major points justifying the waiver are:

- The facility horizon is located in the Salado Formation which is composed mainly of bedded salt. The salt acts as a very low-permeability barrier isolating the facility from water-bearing units above and below. The Castile Formation underlying the Salado Formation is also a very thick, low-permeability evaporite unit that further isolates the facility from underlying water-saturated units.

- There appears to be little infiltration of precipitation at WIPP, and no shallow, perched saturated zones have been detected at the site.

- There is very little likelihood of ground water reaching the facility in quantities capable of transporting waste to the Culebra dolomite.

  During operations, small brine seeps from the host Salado Formation will evaporate in circulating air in the facility. The shafts penetrate water-bearing units but incorporate features designed to minimize and control ground water inflow to the facility and to divert any inflow for collection and disposal. Furthermore, the waste form includes no free liquid.

- Following decommissioning and closure of WIPP, seals and backfills will be installed to minimize the amount and effects of any ground water that may reach the facility. Backfills will reduce the porosity of the openings available for brine inflow and will reduce the time required for the facility to return to a low permeability and approximately "undisturbed" state due to creep closure of the host salt. Permanent seals in and adjacent to water-bearing horizons penetrated by shafts and boreholes will reduce the flow of ground water through the shafts.

- Ground water quality in the vicinity of WIPP, particularly in the Rustler and Rustler-Salado Formations contact water-bearing zones, is generally poor. Thus, ground water from these water-bearing zones is not a resource for domestic, irrigation, or livestock use. Contamination of these units, if any, is unlikely to reach the food chain or affect the environment. The major ground water resources in the area, the Capitan and Ogallala aquifers and surface water, are hydrologically unconnected with the WIPP site or water-bearing units overlying WIPP.

This document serves as a ground water monitoring waiver under RCRA interim status requirements, as described in 40 CFR Part 265.90 (c). This waiver demonstrates that, to the best of DOE's knowledge, there is little potential for migration of waste emplaced in the WIPP facility to pose a threat to the environment. The facility provides effective isolation of waste from ground water sources that would be

expected to be the most likely pathway to the accessible environment. Because it has been demonstrated that there is very low potential for hazardous waste or hazardous waste constituents to enter any water-bearing formations at WIPP, there can be little potential for hazardous waste or hazardous waste constituents to move via these water-bearing formations to water supply wells (domestic, industrial, or agricultural) or to surface water. Ground water monitoring, as mandated by RCRA, does not appear to be required at this time. As certified by a qualified geologist, this document meets the requirements of 40 CFR Part 265.90 (c).

Certified by: (Geologist or Geotechnical Engineer)

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(Signature)

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APPENDIX E

WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL

The Quality Program Manual defines procedures and instructions which establish quality standards for specific tasks or activities at the WIPP facility. The Manual meets the requirements of ANSI/ASME NQA-1-1986 and 10 CFR Part 71.

INTRODUCTION AND LETTER OF PROMULGATION

The overall responsibility for Quality Assurance during the design, construction, transitional, and operational phases of the Waste Isolation Pilot Plant (WIPP) rests with the Owner, the U.S. Department of Energy (DOE). The DOE has delegated to the Westinghouse Electric Corporation, Waste Isolation Division (WID), serving in the capacity of the WIPP Management and Operating Contractor, prime execution responsibilities for selected quality-related functions, which include design, procurement, facility operation, geotechnical, waste handling operations, mining, and other operating responsibilities.

DOE has delegated the WID to manage the National Contact-Handled and Remote-Handled TRU Waste Program. The DOE has overall responsibility for this program and will be the licensee of the NRC certificate of compliance. In compliance with DOE Order 1540.2, the WID has structured the WID QA Program to comply with NQA-1 and 10 CFR 71, Subpart G (Operation) and Subpart H (QA), and augmenting regulatory guides for control of the procurement, use, maintenance, repair, and modification of the TRU waste transportation equipment.

Westinghouse, serving as the Management and Operating Contractor for the DOE WIPP Project Office (WPO), recognizes the responsibility to establish and implement an adequate and effective program for Quality Assurance, with due regard for the health and safety of the public and plant personnel, and the safe and reliable operation of the WIPP facility.

The WID Quality Assurance Program shall be implemented on a schedule to support the involved activities. All WID personnel involved in the performance of quality-related functions shall adhere to and comply with the policies and requirements of the WID Quality Program Manual. Deviations from this program shall not be permitted, except as specifically authorized by the WID Quality Assurance Manager. Each member of WID management shall assure that the policies and procedures set forth in this program are implemented in a timely and effective manner.

The WID Quality Assurance Manager shall coordinate and monitor the WID Quality Program to ensure compliance with the specified policies and requirements. He has the responsibility and authority to stop unsatisfactory work and control further processing, delivery, or installation of any nonconforming materials or equipment.

W. C. Moffitt
General Manager

Date: 04-29-88

MANAGEMENT & OPERATING CONTRACTOR
WIPP QUALITY PROGRAM MANUAL

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DEFINITIONS

Owner	The term "owner" when used in this manual refers to the U.S. Department of Energy.
Quality Assurance	Comprises all those planned or systematic actions necessary to provide adequate confidence that a component, system, structure, or facility will perform satisfactorily in service. Quality Assurance includes both "quality achievement" and "quality verifications."
Quality Achievement	The line function of obtaining required quality objectives. Quality Achievement is accomplished by those who are assigned the responsibility for performing work: (e.g., a welder, designer, a buyer, etc.). Interim examinations, checks, and inspections of the involved work may be made by the individual performing the work to assure that the applicable quality objectives are being attained.
Quality Verification	The independent act of verifying by examination, audits, reviews, surveys, and inspections that activities are performed in accordance with all applicable requirements and that all components, systems, structures conform to applicable requirements.
Quality Control	Comprises all those quality assurance actions related to the physical characteristics of components, systems, or structures which provide a means to control and measure the quality of a component, system, or structure to predetermined requirements.
Audit	An activity to determine, through investigation, the adequacy of, and adherence to, established procedures, instructions, manuals, specifications, codes, and standards or other applicable requirements, and the effectiveness of implementation.

DEFINITIONS
(continued)

Quality-Related Activities	Those activities and services which could affect the quality of WIPP components, systems, structures, and facilities including associated documentation.
Quality	All of the functional and physical characteristics, properties, or attributes of a part, component, system, or structure which are required to be achieved in a controlled manner to assure that the item can safely and satisfactorily perform its intended functions.
Nonconformance	Nonconformances are deviations from established requirements and can either be "hardware" or "procedural" in nature. Hardware nonconformances include items such as the failure of purchased equipment to meet specifications, and the failure of plant components or systems to function as designed. Procedure nonconformances include items such as the failure to comply with testing or inspection procedures.
Note:	Additional definitions are presented in Supplement S-1, "Terms and Definitions," of ANSI/ASME NQA-1.

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Subject: ORGANIZATION

1.0 SCOPE

This section defines the Westinghouse Waste Isolation Division (WID) organizational structure, quality-related functional responsibilities, and authority assignments for the design, procurement, geotechnical, construction, mining, and waste management phases of the Waste Isolation Pilot Plant, the certification of radioactive waste, and for the development and procurement of transportation packaging including its use for the transportation of radioactive material.

2.0 ORGANIZATIONAL STRUCTURE

The overall organizational structure for the WID is shown in Figure 1-1. The Quality Assurance Program interface relationships between the WID and other Major Project Participants are shown in Figure 1-2.

The WID Quality Assurance Manager reports directly to the WID General Manager. This organizational structure provides the Quality Assurance Manager with the necessary independence and authority to identify quality problems, initiate or recommend corrective action, and verify implementation of solutions. The Quality Assurance Manager is independent of cost or schedule responsibilities insofar as it applies to carrying out the responsibilities of the QA Department discussed in paragraph 3.0 below.

3.0 GENERAL RESPONSIBILITIES AND AUTHORITIES

The overall responsibility during site investigation, design, procurement, geotechnical, construction, mining, and waste management operation of the WIPP rests with the Department of Energy (DOE). The WID assists DOE in the overview, monitoring, and auditing of the development and implementation of the Quality Assurance Programs of the Major Project Participants. The WID has also been assigned the responsibility for the coordination and control of the National Contact-Handled and Remote-Handled Waste Program.

The WID General Manager has the overall responsibility for the WID Quality Assurance Program. The WID General Manager is also responsible for the establishment of appropriate organizational structures for the preparation, implementation, and monitoring of the WID Quality Assurance Program.

The WID General Manager reports to the Vice President and General Manager, Nuclear Fuel Business Unit.

The Quality Assurance Manager reports directly to the WID General Manager and is responsible for establishing, maintaining, and monitoring the overall WID Quality Assurance Program. Quality Assurance Department personnel receive technical direction and are under the administrative control of the Quality Assurance Manager. On work performed under the direct cognizance of the WID, Quality Assurance has the responsibility and authority to stop unsatisfactory work and control further processing, delivery, or installation of any nonconforming materials or equipment.

Each WID Staff Manager is responsible for ensuring that work is controlled in accordance with the Quality Assurance Program, including the following:

- o Establishing and implementing methods and procedures which control the quality of their work in accordance with the Quality Assurance Program.
- o Obtaining Quality Assurance Department participation and concurrence in all quality-related decisions or commitments, both internally and with DOE, subcontractors, or suppliers, waste generators, and waste carriers.
- o Ensuring that their personnel whose work may have an effect upon quality are adequately trained to perform their responsibilities. Instruction shall include training within their areas of responsibility and participation in training offered by the Quality Assurance Department.
- o Performing internal reviews and audits to assess compliance with the Quality Assurance Program.
- o Identifying causes of deficiencies found by inspection, audit, or other means; determining appropriate dispositions and corrective actions; and assigning responsibilities and schedules for such actions.
- o Notifying Quality Assurance promptly of any incident, failure, or deficiency which could adversely affect the quality of work.
- o Stopping or correcting work whenever continuation could result in a violation of approved work requirements, damage to essential items, or personnel injury. Prime responsibility for this action rests with the responsible performing organization.
- o Periodically performs a management assessment of their department's quality-related functions.

4.0 SPECIFIC RESPONSIBILITIES AND AUTHORITIES

4.1 The specific responsibilities and authorities of WID organizations involved in the establishment and implementation of the WID Quality Assurance Program are outlined below.

4.1.1 Quality Assurance

- Develops and maintains overall Quality Assurance policy for the WID.
- Prepares, maintains, and controls the WID Quality Assurance Program Manual and associated Quality Procedures/Instructions Manuals.
- Maintains a Quality Program index identifying those procedures and documents in effect which detail the activities necessary to fulfill the requirements of this Quality Assurance Manual.
- Assures that a management assessment of each WIPP program is performed on a periodic basis.
- Provides interface control between the WID Quality Assurance Program and the DOE Project Office Quality Assurance Program.
- Plans and participates in audits of quality-related activities.
- Plans and participates in quality-related audits of other Major Project Participants and Waste Generators.
- Maintains liaison on quality matters with WID management, the Department of Energy, subcontractors, suppliers, waste generators, and carriers.
- Verifies that necessary quality training, indoctrination, and qualification are provided for personnel whose work may have an effect upon quality or who are responsible for verifying quality.
- Reviews and concurs in other departments' policies, procedures, and sub-tier documents which control the quality of work.
- Reviews and approves all Quality Code 1, 2, and 3 purchase requisitions, and changes thereto, to ensure inclusion of appropriate quality requirements.
- Reviews WID supplier drawings, procedures and data submittals.
- Reviews Construction Contractor and suppliers drawings, procedures, and data submittals.
- Participates in supplier evaluations.
- Reviews and approves WID-prepared drawings, specifications and other WID-prepared design documents for appropriateness of the quality-related features.

- Reviews Quality Assurance Program documents prepared by other Major Project Participants, Waste Generators, and carriers.

- Performs overview inspections of Major Project Participants, waste generators, and carriers.

- Assures compliance with packaging Safety Analysis Reports and the reporting of noncompliance to the proper authorities.

- Performs source and/or receiving inspection for WID procurements and waste shipments.

- Participates as a member of the Engineering Review Board for the disposition of Variation Requests.

- Assists in maintaining Chapter 11 of the WIPP Safety Analysis Report.

- Identifies Quality Assurance records that must be maintained and submitted to the Master Records Center.

- Assists other departments, subcontractors, and suppliers with quality planning.

- Monitors work by WIPP suppliers and subcontractors to ensure that work is performed in accordance with approved work packages including construction contract packages (CCPs), traveler work packages, and test program packages.

- Identifies quality problems and recommend or assist in development of solutions through performing organizations.

- Ensures that disagreements regarding quality problems or proposed solutions are promptly referred to higher level management for resolution.

- Ensures that items or services which do not or may not conform to specified quality requirements are controlled to prevent use until disposition and corrective action, where applicable, are properly authorized and implemented.

4.1.2 Other WID Departments

The following list of quality-related functions is not intended to be an all-inclusive listing, but rather a general list.

4.1.2.1 Safety, Security and Environmental Protection

- Reviews engineering/design documentation to ensure that applicable environmental and

radiation protection requirements are satisfied and maintained throughout the design, construction, and operation.

- o Prepares environmental permitting documentation.
- o Prepares environmental analyses, assessments, and other documentation required to comply with the DOE Guidelines for compliance with the National Environmental Policy Act.
- o Prepares radiological effect documentation of operational accidents and/or breaches of the underground facility which could result in release of radioactive materials and radiological impacts of transportation.
- o Participates in change control activities on equipment or components to ensure that appropriate regulatory and institutional requirements are satisfied and maintained throughout the design, fabrication, and installation process.
- o Reviews in an advisory capacity to DOE, the radiation and safety requirements of design documents, design documentation, and construction contract packages.
- o Conducts technical evaluation of bid proposals, supplier technical submittals, etc., involving radiation and safety requirements.
- o Prepares and/or reviews all regulatory and institutional documentation.
- o Coordinates the preparation and issue of the Safety Analysis Report and subsequent amendments.

4.1.2.2 Engineering and Repository Technology

NOTE: The following responsibilities and authorities for Engineering and Repository Technology are for functions performed with regard to the WIPP facility, receipt of waste and waste management. For the responsibilities and authorities for waste certification and transportation, see paragraph 4.1.2.7.

- o Performs work in support of experimental programs to determine the safe handling, emplacement, and retrieval of radioactive waste.

- Manages and directs the site geotechnical and geoscience team whose functions include:
  - mapping of shafts and excavations;
  - technical inspection of geomechanical instrumentation and verifying field calibration, drilling and installation, and operational checkout;
  - instrumentation data collection and maintenance, and distribution of records;
  - periodic inspection of underground excavations for stability;
  - core drilling in facility excavation.
- Performs detailed component design.
- Reviews construction contract packages.
- Prepares purchase requisitions and change notices thereto.
- Provides technical evaluation of suppliers' facilities and capabilities.
- Controls and distributes all drawings and specifications utilized to implement the WID Quality Assurance Program.
- Provides technical evaluation of bid proposals for WID procurements and other assigned procurements.
- Reviews and approves supplier technical submittals for WID procurements and other assigned procurements.
- Reviews and settles supplier nonconformances for WID procurements and other assigned procurements.
- Provides engineering support for the maintenance, operation, or modification of the facility.
- Provides engineering support for facility turnover, start-up and testing operations.
- Provides support for construction inspection for underground construction contracts.

4.1.2.3 Administrative Services

- o Ensures that all applicable ordering requirements are completely and accurately incorporated into purchase orders.
- o Ensures that only qualified suppliers are used.
- o Arranges for and participates in the selection, evaluation, and qualification of new suppliers when required.
- o Ensures that all technical and quality changes are promptly transmitted to affected suppliers.
- o Ensures that all required supplier submittals are made in a timely manner.
- o Coordinates action, as appropriate, with suppliers to resolve any nonconforming conditions associated with purchased materials.
- o Coordinates corrective actions, as required, with suppliers who exhibit a poor quality performance record.
- o Makes appropriate arrangements for source inspections, audits, and final inspections at supplier's plant.
- o Develops and maintains a Records Management System including required facilities and equipment.
- o Controls and distributes all manuals, procedures, and instructions utilized to implement the WID Quality Assurance Program.
- o Develops and maintains a Form Control System.
- o Develops and maintains Correspondence Control System.

4.1.2.4 Operations

- o Performs, or provides for, in-service inspection and maintenance and repairs of packaging in accordance with Operation and Maintenance Manuals.
- o Conducts mining activities in accordance with engineering specifications and procedures.

- Operates surface facilities in accordance with applicable procedures and performance requirements.

- Performs all waste handling and emplacement activities in accordance with applicable procedures.

- Conducts and coordinates training activities to ensure a quality training program.

4.1.2.5 Construction

- Coordinates and provides administrative and technical support for work involving construction contracts and Engineering Work Packages.

- Performs necessary startup tests to verify equipment operability and readies the equipment for normal operation in accordance with contract and design criteria.

- Coordinates WID participation in prefinal and final inspections of facilities prior to turnover to verify the facility is in compliance with contractual requirements and that the operability meets the requirements necessary to achieve the successful emplacement of waste.

- Coordinates facility inspections and tests. Based on vendor, contract, or specified engineering program requirements, preoperational tests are scheduled for performance following turnover, and upon successful verification of operability, the facility is released for normal operation.

- Provides preventive maintenance services, repairs, and service contracts on buildings and equipment.

- Conducts corrective maintenance and modifications in accordance with the applicable quality requirements.

4.1.2.6 Public Affairs

- Supports all WPO offsite activities related to the Stipulated, Supplemental Stipulated, and Consultation and Cooperation Agreements, and any revisions between DOE and the state of New Mexico.

- o Coordinates arrangements for speaker's bureau, visitor program, community outreach, public and media information, and exhibits.

- o Coordinates external State/tribal emergency response programs.

- o Interfaces with states and Indian tribes on transportation issues.

- o Interface with National Academy of Sciences and New Mexico Government Committees.

4.1.2.7 TRU Waste and Integration

- o Coordinate and control the National Contact-Handled and Remote-Handled Waste Program.

- o Operate the WIPP waste management data base and other waste data bases, as required.

- o Maintain and control the WIPP waste acceptance and transportation waste acceptance documents and support certification audits at generator sites.

- o Perform special studies of waste to support licensing of packaging and support the project with other special waste studies, as identified.

- o Prepare and submit program plans to DOE.

- o Recommend solutions for the disposition of special case wastes and hazardous and toxic wastes.

- o Maintain a liaison with generator sites to support the shipment of radioactive wastes.

- o Procure the services for the design and fabrication of a fleet of Type B packages licensed by the Nuclear Regulatory Commission (NRC), assuring that the license(s) are maintained as specified by the NRC certificate of compliance, the Safety Analysis Reports, and Code of Federal Regulations, Title 10, Part 71.

- o Procure the design, certification, and fabrication of Type A standard waste boxes for use in Type B packaging.

- o Schedule and track all waste shipments to WIPP.

- Provide technical evaluation of suppliers, carriers, and generator sites facilities and capabilities.

- Provide technical evaluation of bid proposals for WID packaging, transportation, and certification procurements and other procurements.

- Provide engineering support for the safe and efficient movement of waste to WIPP through the implementation of DOE shipping policies applicable to WIPP.

- Provide engineering support in the development of waste acceptance criteria and waste certification documents.

4.2 Major WID Subcontractors

Major subcontracts by the WID for operations such as mining and geotechnical will be in compliance with the same requirements as the WID program, i.e., ANSI/ASME NQA-1 and applicable supplements. Quality Assurance Programs for the design and fabrication of Type B packaging shall be in compliance with 10 CFR 71, the WID program, and shall have been approved by the NRC. When WID subcontractors employ their own Quality Assurance Programs, in lieu of the specific requirements contained herein, including those approved by the NRC, such programs will be approved by the WID.

5.0 QUALITY ASSURANCE INTERFACES

The WID Quality Assurance Department will interface at several different levels throughout the WIPP Program. These interfaces include the following:

- Quality Assurance Branch of the DOE Project Office
- Participating WID departments and sections
- Architect-Engineer
- Scientific Advisor
- WID suppliers
- The Nuclear Regulatory Commission
- Waste generators
- Waste carriers

5.1 WID Interface with DOE Project Office

The WID Quality Assurance Manager will work closely with Quality Assurance personnel from the DOE Project Office. This will include

development and maintenance of Quality Assurance Plans and procedures for the WIPP Project Office. It will also include discussing quality program requirements and interpretations, reviewing plans and status of Quality Assurance activities, performing overview inspections of the Construction Manager, providing timely and responsive replies to requests for information on DOE Quality Assurance audit reports, participating in meetings to support the overall project Quality Assurance Program, resolution of quality problems and implementation of appropriate corrective actions, and reviewing all WID Quality Assurance plans, manuals, and programs subject to the approval of the DOE Project Office.

5.2 Interface within WID Organization

Activities performed by the WID Quality Assurance Department will be under the direction of the Quality Assurance Manager. In addition to directing internal WID Quality Assurance activities, Quality Assurance will interface with the other WID departments in the performance of their quality-related functions. Quality Assurance will review quality-related documents for adequacy of Quality Assurance requirements and audit the implementation and effectiveness of the Quality Assurance Program as it is applied by the various WID departments.

5.3 Interface with Architect-Engineer

The WID Quality Assurance Department will work closely with the Architect-Engineer during the design and construction phases. The WID Quality Assurance Department may participate in audits of the Architect-Engineer's Quality Assurance Program.

5.4 Interface with Scientific Advisor

The WID Quality Assurance Department will work closely with the Scientific Advisor during the construction and operation of WIPP. The WID Quality Assurance Department may participate in audits of the Scientific Advisor's Quality Assurance Program.

5.5 Interface with WID Suppliers

The WID Quality Assurance Department interface with their suppliers will include participation in supplier evaluations, as required, and the performance of surveillance and/or inspection at the supplier's facility to verify that items and services are in compliance with the WID procurement document requirements.

5.6 Interface with the Nuclear Regulatory Commission

The WID Quality Assurance Department interface with the NRC shall be as directed by Code of Federal Regulations, associated regulatory guides, and the Safety Analysis Report(s) for packaging.

5.7 Interface with Waste Generators

The WID Quality Assurance Department interface with the waste generators will be by participation in DOE audits and the verification of compliance with Safety Analysis Report(s) for packaging.

5.8 Interface with Waste Carriers

The WID Quality Assurance Department interface with the waste carriers shall be by receipt inspection of waste shipments and the verification of compliance with Department of Transportation requirements and trailer Operation and Maintenance Manuals.

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Figure 1-1: **WESTINGHOUSE WASTE ISOLATION DIVISION**

NOTE: This chart reflects the WID Organizational Structure in effect at time of issuance. The chart will be reviewed and updated periodically, as required.

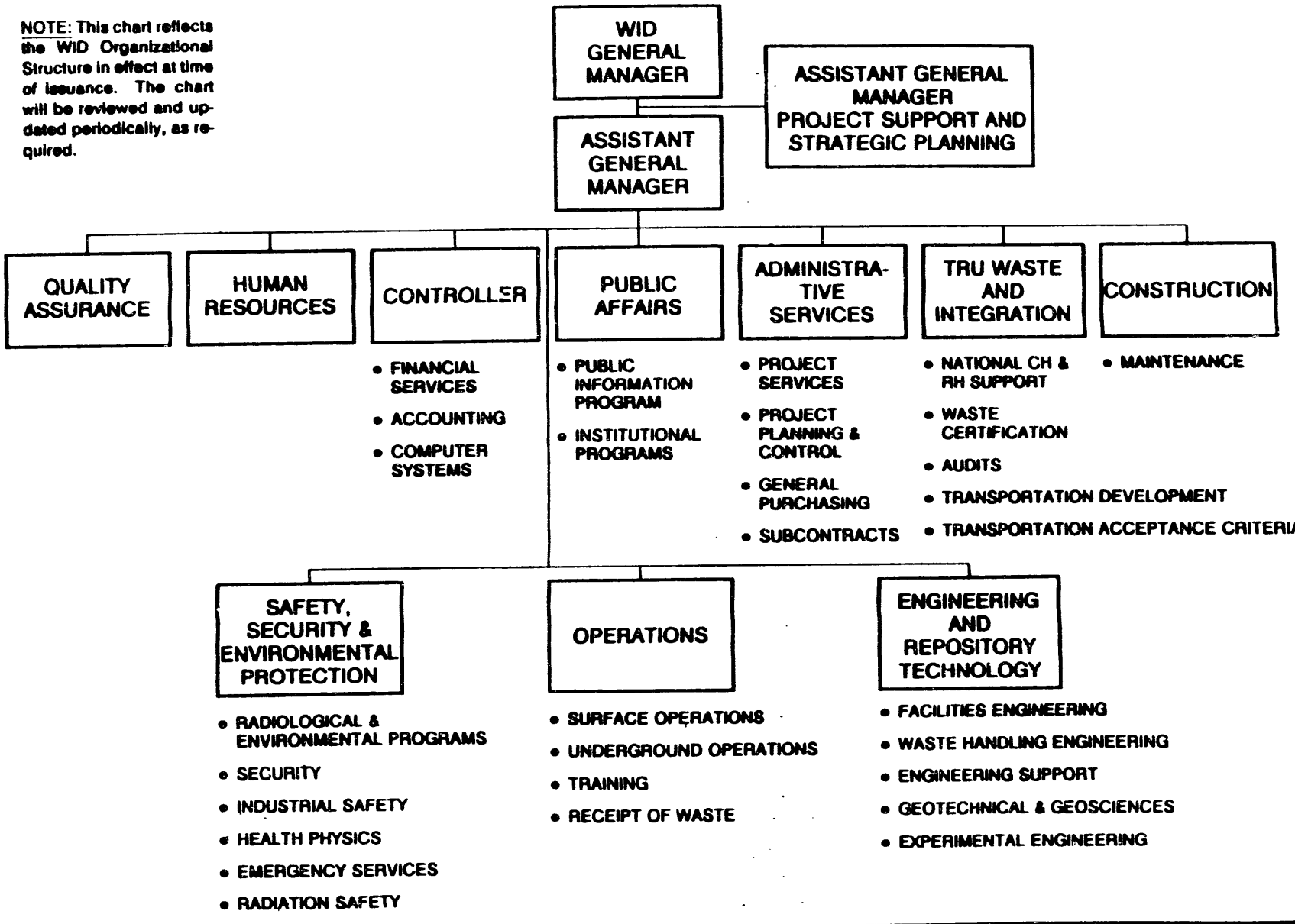
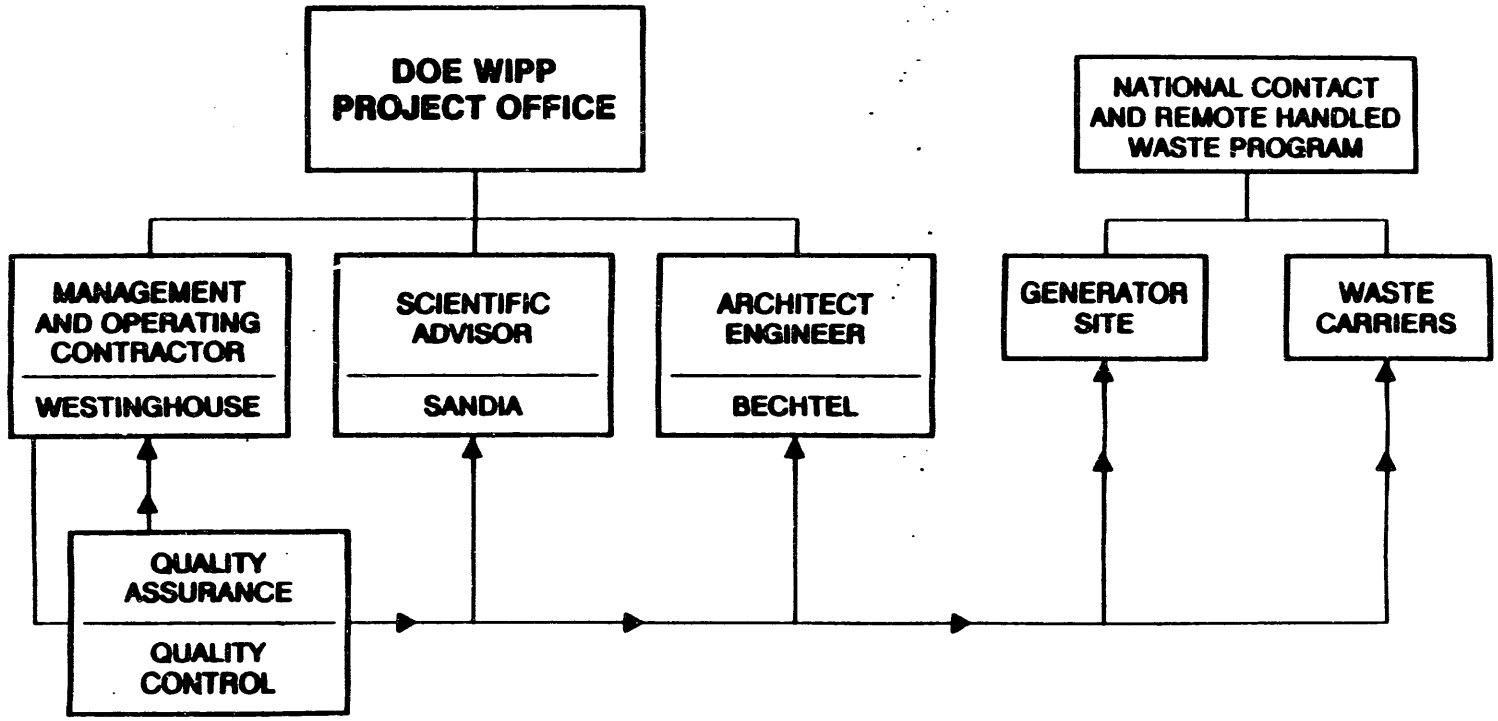


Figure 1-2:

QUALITY ASSURANCE PROGRAM INTERFACES

MANAGEMENT AND OPERATING CONTRACTOR AND OTHER CONTRACTORS



NOTE: This chart indicates the WID interface with other Project contractors in effect at time of issuance. The chart will be reviewed and updated periodically, as required.

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Subject: QUALITY ASSURANCE PROGRAM

1.0 SCOPE

This section describes the overall Quality Assurance Program to be implemented by the Waste Isolation Division (WID) departments involved in the performance of activities that could affect the quality of components, systems, structures, waste transportation, waste certification, and operations.

2.0 QUALITY ASSURANCE PROGRAM

2.1 Program Applicability

2.1.1 The WID Quality Assurance Program is applicable to all activities performed within the WID organization that could affect the quality of WIPP components, systems, facilities and operations, waste transportation, waste certification, and waste management, including associated services and documentation. The activities are referred to as "quality-related" activities throughout this manual and in the detailed procedures that are prepared and used to implement the requirements contained in this manual.

2.1.2 The requirements of the WID Quality Assurance Program will also be applied to contractors and/or suppliers and waste carriers who perform work under the prime cognizance of the WID or work which affects the responsibilities of the WID. The requisitioner, working in conjunction with Quality Assurance, is responsible for ensuring that all applicable technical and quality requirements are specified in purchasing and/or subcontracting documents and for the control of waste transportation and waste certification.

2.1.3 WID Quality Assurance has responsibility for the preparation, maintenance, and control of the Quality Program Manual and the supporting Quality Procedures/ Instructions including ensuring that the WID Quality Assurance Program is modified and updated as codes, regulations, standards, and experience dictate. The WID Quality Assurance Program is approved by

the WID General Manager for applicability to all quality-related activities performed within the WID organization.

The WID Quality Assurance Program shall be reviewed and approved by DOE.

2.2 Program Description

2.2.1 The WID Quality Program Manual is based upon the requirements of the WIPP Safety Analysis Report, and the various packaging of Safety Analysis Reports for Packaging, and is structured to invoke ANSI/ ASME NQA-1 and all supplementary requirements and 10 CFR 71, as applicable thereto. Those requirements of 10 CFR 71 that are not included in NQA-1 have been incorporated into this manual. This manual is structured to permit selective application of quality requirements, dependent upon design classification and complexity and consequence of failure of items or operations. Quality program plans developed in accordance with the quality procedures manual reflect a standard and graded approach for application of inspection and/or verification of attributes/characteristics with the assigned quality code. Assignment of a specific quality level (Quality Code) to an item or operation is based upon the guidelines presented in Attachment A and are commensurate with the component's or system's design classification or packaging as defined in Safety Analysis Report(s). These levels of control provide an effective program of quality assurance which reflects due regard for the health and safety of the public and plant personnel and the safe and reliable operation of the WIPP facility and the Waste Certification and Transportation Program. The Quality Program Manual, in turn, is supported by the Quality Procedures/Instructions Manual and by implementing procedures prepared by other departments engaged in quality-related activities.

2.2.2 Revisions, amendments, and addenda to Safety Analysis Reports, DOE Order 5700.6, NQA-1, and 10 CFR 71 are reviewed by Quality Assurance as they are issued for any impact to WID responsibilities and the WID Quality Assurance Program. Results of these evaluations are incorporated into revisions to this manual and supporting procedures.

2.2.3 All departments are responsible for the effective implementation of their respective quality-related activities. The WID Quality Assurance Department additionally is assigned the prime responsibility for ensuring that the program is being implemented as described. The responsibilities and authorities of Quality Assurance and other WID departments are provided in Section I, Organization.

2.3 Documentation of Program

2.3.1 This Quality Program Manual defines the overall policies, requirements, and assignment of responsibilities which govern the WID Quality Assurance Program.

2.3.2 A series of procedures and instructions contain the details for implementing the WID Quality Assurance Program. The content of these documents is compatible with the overall policy and requirements contained in the WID Quality Program Manual.

2.4 Control of Quality Program Manual

Controlled copies of the WID Quality Program Manual will be distributed to those having a need for the manual by Administrative Services, who will maintain a listing of all holders of controlled copies. Revisions to the manual shall be distributed and controlled in the same manner as the original issue.

2.5 Indoctrination and Training

Indoctrination and training programs are established and conducted for those WID personnel assigned to perform or verify quality-related activities to ensure that:

- Personnel are instructed as to the purpose, scope, and implementation of the quality-related manuals, instructions, and procedures.
- Personnel verifying activities that affect quality are trained in the principles, techniques, and requirements of the activity being performed.
- Proficiency of personnel performing and verifying activities affecting quality is maintained by retraining, re-examining, and/or recertifying as determined by management or program commitment.

3.0 RESPONSIBILITIES

3.1 WID General Manager

The WID General Manager is responsible for approval of the WID Quality Assurance Program and for endorsement of the program for applicability to quality-related activities performed within the WID organization.

3.2 WID Quality Assurance Manager

The WID Quality Assurance Manager has the primary responsibility for the effectiveness of the overall WID Quality Assurance Program. The WID Quality Assurance Manager will also periodically report on the

effectiveness of the program. Additionally, the WID Quality Assurance Manager shall assure that a management assessment of the Quality Program is performed on a periodic basis. He shall also maintain a Quality Program index listing those procedures and documents in effect which detail the activities necessary to fulfill the requirements of the WID Quality Assurance Manual.

3.3 WID Department Managers

Each WID department manager is responsible for the performance of quality-relating activities performed by their respective organizations and establishing written controls for the preparation, review, approval, and revision of such documents.

3.4 Each WID department manager is also responsible for ensuring that quality-related activities performed by their respective organizations are performed in accordance with written documents that are procedurally controlled and in conformance with the policies and requirements contained in this manual.

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QUALITY CODE/DESIGN CLASSIFICATION CORRELATION

QUALITY CODE	COLUMN "A" APPLICABILITY	COLUMN "B" IMPLEMENTATION
1	o Design Class I, II, or IIIA facility systems, structures, components, and spare parts, including: - Equipment/components used for containment and handling of radioactive waste during shipping and storage activities. - Analytical or laboratory services required for acquisition of data necessary to support or substantiate design assumptions, site validation, or radiological and environmental monitoring program activities. - Design or design development services (Procured or Delegated) required for support of WID design activities for Design Class I, II, or IIIA facility systems, structures, components, or spare parts. - Services associated with maintenance, repair, modification, testing, or nondestructive examination of items in Design Class I, II, or IIIA facility systems, structures, components,	Drawings, specifications, work packages, instructions, procedures, test plans, and purchase requisitions associated with the activities identified in Column "A" shall be submitted to Quality Assurance. Quality Assurance will develop inspection and/or verification plans commensurate with the requirements established by applicable documents, specifications, and procedures. These plans will be based upon the criticality, uniqueness, and complexity of the component, or the operation being performed and will reflect inspection and/or verification attributes or characteristics as necessary to assure compliance with specified requirements. Quality Assurance review and/or approval of requirement documents will be conducted in accordance with the established document review and approval program.

QUALITY CODE/DESIGN CLASSIFICATION CORRELATION

QUALITY CODE	COLUMN "A" APPLICABILITY	COLUMN "B" IMPLEMENTATION
	and spare parts. Note: If a spare part purchased to support a critical system or equipment is a standard commercial, off-the-shelf item and is not unique to that system or equipment, it may be ordered to a lesser design class and quality code. Example: oil, filters, etc. - Operations associated with receipt, installation, modification, testing, repair, maintenance, handling, or storage of Design Class I, II, or IIIA facility system, structures, components, and spare parts. - Activities associated with radioactive waste transportation, receipt, waste certification, storage, handling, emplacement, and retrieval operations. - Experimental Programs conducted by the NID obtain data for support of radioactive waste disposal technology. - Operations associated with the acquisition of environmental samples where such samples are used for Design Validation or Radiological Monitoring.	

QUALITY CODE/DESIGN CLASSIFICATION CORRELATION

QUALITY CODE	COLUMN "A" APPLICABILITY	COLUMN "B" IMPLEMENTATION
	- Geological programs related to assessment and confirmation of the underground geological conditions and programs to collect data relative to long term performance assessments, hydrology programs, etc.	
2	o Design Class IIIB systems, structures, and components where specifications, drawing, or procurement documents specify witness and/or hold points for inspection/verification of the identified operation, including: - Operations/Activities associated with receipt, installation, testing, repair, maintenance, handling, or storage of the Design Class IIIB items identified above. - Mining Operations that require adherence to specified dimensions, configurations, or orientations that are critical to operational or experimental activities.	Drawings, specifications, work packages, instructions, procedures, test plans, and purchase requisitions associated with the activities identified in Column "A" shall be submitted to Quality Assurance. Quality Assurance verification actions shall be consistent with the inspection points established by the applicable document.

QUALITY CODE/DESIGN CLASSIFICATION CORRELATION

QUALITY CODE	COLUMN "A" APPLICABILITY	COLUMN "B" IMPLEMENTATION
3	o Design Class IIIB commercial products where standard design, fabrication, and construction practices are employed to produce a quality product in accordance with recognized codes and standards. - Temporary facility equipment and buildings. - Mining Operations not included in Code 1 above. - Operations/activities associated with receipt, installation, testing, repair, maintenance, handling, or storage of the Design Class IIIB items specified in this section. - Services not included in Code 1 above.	Quality Assurance inspection/verification is required for the activities identified in Column "A" unless identified otherwise by Quality Assurance during the procurement review cycle. Quality Assurance will periodically monitor these activities as necessary to assure compliance with specified requirements.
4	- Non-facility items, office equipment/ furniture, janitorial supplies, stationery, etc.	No Quality Assurance required.

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Subject: DESIGN CONTROL

1.0 SCOPE

This section of the Quality Assurance Program establishes the requirements and responsibilities of the Waste Isolation Division (WID) for the Technical Review and Design activities, which have been delegated to the WID by the Department of Energy (DOE). These activities encompass the following:

- o The technical review of design documents and supporting documentation prepared by other Project Participants for compatibility with environmental and safety assurance, operational requirements, and design acceptability, maintainability, and constructability.
- o The performance of detailed design work, including the establishment and implementation of associated design control measures.
- o The control of design activities performed on behalf of the WID.

2.0 GENERAL REQUIREMENTS

2.1 Technical Reviews

The WID acts in an advisory role to the DOE Project Office for technical review activities, in which the WID does not perform any direct design of the WIPP components, equipment, or structures. In this advisory role, the WID performs the types of technical reviews outlined in 2.1.1 through 2.1.3. The WID also performs a technical overview of the packaging designs prepared by design contractors.

2.1.1 The WID will review Title I design documentation for operability, maintainability, and constructability. The WID will provide the necessary input data to the Architect-Engineer to ensure that the resultant constructed facility can be operated efficiently and in accordance with the designated mission of WIPP. In addition, the WID will perform complete design reviews of selected items designed by other Project Participants.

2.1.2 The WID will review construction contract packages, technical specifications, and standard drawings submitted by the Architect-Engineer for progress review and construction. Review will concentrate on a practical, complete, and integrated design with emphasis on operability, maintainability, and safety.

The WID will perform a design overview that will concentrate on top-level documents such as general arrangements, processing and instrument diagrams, flow diagrams, electrical one-line diagrams, and heating, ventilation, and air conditioning (HVAC) diagrams. Detailed drawings will only be reviewed if the drawings contain designs, details, and interfaces that are relevant to operability, maintainability, and safety, or if relative to items where the WID has specific design responsibility. The review will concentrate on facilities and equipment that are significant to the mining and waste storage activities with respect to operations, maintenance and safety.

2.1.3 The WID will review design and construction documentation (e.g., design change requests, vendor drawings, as-built drawings, etc.) developed as part of Title III activities.

In addition, the WID may take part in design reviews conducted by or for the DOE Project Office.

2.1.4 Documents for technical review by the WID are submitted to DOE by the other Project Participants. The DOE transmits these documents to the WID for review and comment. After receipt, the documents are logged in and distributed in accordance with written procedures.

2.1.5 The WID will review/comment/approve those design drawings, specifications, and procedures prepared by packaging design contractors to assure compliances with regulations, national codes, contract requirements, and the requirements of paragraph 2.2 (below) as applicable. This is performed through the WID procurement process.

2.1.6 All WID technical review activities shall be performed in accordance with written procedures.

2.2 Design Activities

The actual design activities performed by the WID shall be accomplished in accordance with written procedures that describe the controls necessary to ensure that these activities are performed in a planned and systematic manner. Procedures for the control of design activities shall be in accordance with the requirements of ANSI/ASME NQA-1 and Supplement 3S-1 thereto and shall include the following as a minimum:

- Measures to ensure the correct translation of DOE requirements and design basis into drawings, specifications, procedures, instructions, and that design documents are prepared in a controlled manner.

- Definition of organizational responsibilities for the preparation, review, approval, and the verification of design documents such as design input and criteria, design process, design drawings, specifications, design analyses, and computer programs.

- Controls to ensure that quality standards are specified in design documents and that deviations from such standards are controlled.

- Methods to ensure that adequate reviews for application suitability are conducted for materials, parts, equipment, and processes.

- Provisions for ensuring that standard commercial (off-the-shelf) items receive adequate reviews for suitability of use.

- Measures for applying design control practices to various analyses such as stress material behavior, and accident analysis; design control provisions shall also apply to material compatibility studies, and accessibility studies for in-service inspection, maintenance, and repair.

- Management review of the status and adequacy of the design control program.

- Provisions for the necessary training of personnel performing the activities covered by the design control program.

- Provisions for design documents to be reviewed and approved by Quality Assurance, Engineering, and other technical WID personnel, prior to issue, as appropriate.

- Controls for internal and external design interfaces which shall include the review, approval, release distribution, and revisions of documents involving design interfaces among participating design organizations, suppliers, and contractors.

- Methods for the verification or checking of design adequacy by independent design review, a multi-organization review, or single person review, by alternate calculations, or by a qualification test program.

- Provisions to ensure that design changes, including field or supplier changes, are subject to the same review and requirements as the original design; where a significant design change is necessary because of an incorrect design, the design process and verification procedure shall be reviewed and modified as necessary.

- Controls to ensure that design verification actions are accomplished by groups or individuals other than the original designer or immediate supervisor.

- Provisions to ensure that design verification, if other than by qualification testing of a prototype or lead production unit, is completed prior to release for procurement or other uses.

- Provisions for the appropriate review, approvals, and maintenance of design documents and design records.

- Methods for documenting and correcting errors and deficiencies in the design activities, including design methods, and for ensuring that corrective action has been taken to preclude recurrence.

- Control of documents to prevent the inadvertent use of superseded design information.

- Measures to ensure that design documentation and records provide evidence that the design development and review process was performed in accordance with applicable procedural requirements.

- Measures to ensure that design activities and site geotechnical and experimental activities are carried out in a planned, controlled, and orderly manner.

- Measures to ensure that design activities performed on behalf of the WID are adequately described and controlled.

- Measures for describing the design classification system; establishing the basis for classifying structures, systems, and components; and defining the corresponding Quality Assurance requirements.

3.0 RESPONSIBILITIES

3.1 Engineering and Repository Technology

Engineering and Repository Technology is responsible for the performance of technical reviews of design documents and supporting documentation prepared by other Project Participants, and the preparation and implementation of written procedures that describe and control the design activities delegated to the WID by DOE. The WID written procedures shall be in compliance with the requirements contained in Paragraph 2.0 of this section.

3.2 TRU Waste and Integration

The Transportation Development Section of TRU Waste and Integration shall identify design requirements in procurement specifications.

Certain milestones in the design process shall be identified for WID overchecks or verifications and approvals with a minimum of final design approval.

3.3 Quality Assurance

Quality Assurance is responsible for reviewing all design control and technical procedures generated by the various WID organizations and design contractors to ensure compliance with the Quality Program Manual. Quality Assurance shall review WID and design contractor prepared design documents, prior to issue, to ensure that:

- o Design characteristics are controlled, and can be inspected or tested.
- o Appropriate quality levels, acceptance standards, inspection and testing criteria and records requirements are identified.
- o Design documents have been prepared, checked, reviewed, and approved by the responsible WID groups.

In addition, Quality Assurance will be responsible for monitoring and/or auditing of design activities performed on behalf of WID, auditing of the WID and Design Contractor Design Control program, and for participation in selected design reviews.

3.3 Other WID Departments

To the extent that other WID Departments are involved in technical review and design activities, they shall be governed by the applicable detailed procedure.

4.0 ATTACHMENT A

Design Classification System

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DESIGN CLASSIFICATION SYSTEM

Design Classes

DESIGN CLASS I — Items essential to the prevention or mitigation of the consequences of accident or severe natural phenomena that could result in a 50 year dose commitment beyond the Zone 1 boundary in excess of 25 Rem to the whole body or 75 Rem to specific organs.

DESIGN CLASS II — Items not included in Class I that are relied upon to:

- Provide permanent confinement, monitoring and control of radioactive effluents.
- Provide permanent shielding.
- Monitor variables to:
  - Verify that selected WIPP operational limits are not exceeded.
  - Indicate the status of safety system bypasses that are not automatically removed as a part of safety system operation.
  - Indicate status of Class I items during all plant conditions.
  - Verify that off-site radiological dose limits are not exceeded following accidental releases of radioactive material.

DESIGN CLASS IIIA — Items not included in Design Class I or Class II for which a higher level of quality is desired beyond that expected in commercial-industrial practice. Functional considerations pertinent to assigning items to Class IIIA include the following:

- Monitoring variables to determine onsite radiological dose rates including airborne radioactivities following accidental releases of radioactive materials.
- Where failure could cause a major sustained stoppage of waste handling and storage operations.
- Design and fabrication complexity or uniqueness.
- Potential for contamination if component fails.
- Where special considerations beyond those contained in nationally recognized codes and standards are required to insure the health and safety of operating personnel.
- Where failure could be of special significance to health and safety of operations personnel.

DESIGN CLASS IIIB — Items not included in previous classes. Conventional design, fabrication and construction practices as employed in commercial-industrial facilities where high standards of quality control and adherence to recognized codes and standards are enforced, are utilized to these items.

Subject: PROCUREMENT DOCUMENT CONTROL

1.0 SCOPE

This section establishes policy requirements and associated responsibilities of the Waste Isolation Division (WID) for the preparation, review, and control of procurement documents.

2.0 GENERAL REQUIREMENTS

All WID procurement actions shall be performed in accordance with written procedures that describe the actions involved in the preparation, review, approval, and control of procurement documents and changes thereto. Procurement actions performed by other Westinghouse Divisions, on behalf of the WID, shall be described in Project Control Releases (PCRs) prepared and issued in accordance with the established WID procedures for controlling this effort.

2.1 Purchase Requisitions and Purchase Requisition Change Notices

Purchase Requisitions (PRs) and Purchase Requisition Change Notices (PRCNs) shall be prepared, reviewed, approved, and controlled in accordance with the established Waste Isolation Division Procedures. Requisitioners shall utilize the guidelines provided therein to designate the applicable Quality Code on all PRs and PRCNs for items and services for waste transportation and waste certification and those designated as design class I, II, III A, or III B items or services. The applicable design class shall be indicated on PRs and PRCNs (for internal use only). The Quality Codes indicate a level of control commensurate with the items' design classification, uniqueness, complexity, and importance to public and operational safety. Quality Code 1, 2, and 3 designated requisitions, or documents attached or referenced therein, shall contain information outlined in subsections 2.1.1 through 2.1.5, as applicable.

2.1.1 Scope of Work

A statement of the scope of work to be performed by the supplier shall be specified.

2.1.2 Technical Requirements

Technical requirements shall be specified. These requirements shall include a reference to specific drawings, specifications, codes, standards, regulations and procedures, or instructions, as appropriate. The applicable revision levels and dates of the referenced documents shall be provided. The PRs and PRCNs, or referenced documents, shall identify appropriate testing, inspection, and acceptance requirements as necessary to facilitate WID monitoring and evaluation of the suppliers performance.

2.1.3 Quality Assurance Requirements

PRs, PRCNs, or referenced documents shall identify when a documented Quality Assurance Program is required and/or shall invoke portions or all of the requirements specified in the WID Quality Assurance Program. The content of any required program shall depend upon the type and use of the item, or the service being procured. The procurement documents shall require suppliers to incorporate appropriate Quality Assurance Program requirements in sub-tier procurement documents.

2.1.4 Documentation Requirements

PRs, PRCNs, or referenced documents, shall identify the documentation required to be submitted by the supplier for information, review, or approval, and shall establish the required submittal schedule. When the supplier is required to maintain specific quality assurance records, the retention times and disposition requirements shall be specified.

2.1.5 Administrative Requirements

Requisitioners shall specify on the PRs, PRCNs, or referenced documents, the appropriate administrative requirements. This shall include appropriate administrative instructions, such as Westinghouse form 7180, or portions thereof, as applicable to the procurement.

2.1.6 Reviews

PRs and PRCNs, and referenced documents, for Quality Code 1, 2, and 3 requisitions, shall be reviewed and approved by Quality Assurance and other WID departments as defined in the established WID procedure. Quality Assurance shall monitor requisitions as necessary to ensure compliance to waste transportation, waste certification, and design classification requirements. PRCNs involving changes to technical or quality requirements shall be subject to the same degree of control as provided in the preparation of the original PR.

2.2 Purchase Orders and Purchase Order Change Notices

2.2.1 Purchase Orders (PO) and Purchase Order Change Notices (POCNs) shall be processed in accordance with the WID Purchasing Policy and Procedure Manual, which describes the actions required to accomplish the preparation, review/approval, administration and control associated with the documents. POCNs shall be subject to the same degree of controls as provided in the preparation of the original PO.

2.2.2 Administrative requirements shall be specified in POs and POCNs, as appropriate. Right of access for WID or other parties designated by the WID, control of lower-tier procurements, requirements for records retention, and requirements for handling nonconformances are examples of administrative provisions that are to be considered for inclusion in POs and POCNs.

2.2.3 POs and POCNs resulting from Quality Code 1, 2, and 3 PRs and PRCNs shall be monitored by the WID Quality Assurance Department to ensure there are no transcription errors from the PRs, PRCNs, or referenced documents, and that the supplier was evaluated and approved when required by the PR.

3.0 RESPONSIBILITIES

3.1 Requisitioners

Requisitioners are responsible for:

- Preparation of requisitioning documents.
- Identification of applicable technical records, administrative, and quality requirements, including identification to Engineering Work Package or Work Order, as applicable.
- Obtaining the required technical review and approvals.
- Identifying the need for supplier surveys or evaluations, as required.
- Provide for the maintenance of drawings and specifications used for procurement and the supplier's data package.

3.2 Engineering and Repository Technology

Engineering and Repository Technology is responsible for review of Quality Code 1, 2, and 3 PRs and PRCNs initiated by other WID departments to ensure that technical considerations are adequate, and that quality considerations have been included as requested by the requisitioning department.

3.3 TRU Waste and Integration

TRU Waste Integration is responsible for requisitioning items and services involving waste transportation and waste certification.

3.4 Safety, Security and Environmental Protection

Safety, Security and Environmental Protection shall review PRs and PRCNs initiated by other WID departments to ensure that criteria relevant to safety and control of radioactive materials is properly defined and expressed.

3.5 Purchasing

The Purchasing Department is responsible for:

- Ensuring that all technical, quality, and administrative requirements specified in the PRs or PRCNs are incorporated in the Request For Proposal (RFP), the purchase order, or purchase order change notice.
- Maintaining the record copies of PRs/PRCNs, POs/POCNs, bid review packages, supplier correspondence, and records of approvals of supplier documents.
- Arranging for pre-award supplier evaluations mutually determined by Purchasing, requisitioners, and Quality Assurance.
- Maintaining a qualified supplier's list (QSL) and supporting documentation.
- Obtaining the consent of the DOE Contracting Officer, as applicable.
- Coordinating internal review and approval of required supplier submittals.

3.5 Quality Assurance

The Quality Assurance Department is responsible for:

- Reviewing Quality Code 1, 2, and 3 designated PRs and PRCNs for completeness and adequacy of quality requirements.
- Monitoring Quality Code 1, 2, and 3 POs and POCNs following issuance to ensure conformance with requirements specified in PRs, and PRCNs, or referenced documents.
- Performing a technical review and evaluation of supplier's proposals when requested by the requisitioner or the Purchasing Department.
- Participation in supplier surveys, as required.

3.6 Other WID Departments

Other WID Departments are responsible for:

- o Providing review and input to procurement documents as requested by the requisitioner or Purchasing.
- o Performing Technical reviews and evaluation of suppliers' proposals as requested by the requisitioner or Purchasing.
- o Performing review/comment to suppliers' technical submittals.

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WESTINGHOUSE WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL	WP-QPM Section No. V Rev. 5 Effective Date 04/29/88 Superesedes: QPM V No. Rev. 4 Date 12/01/86

Subject: INSTRUCTIONS, PROCEDURES, AND DRAWINGS

1.0 SCOPE

This section establishes provisions and responsibilities for the preparation and use of instructions, procedures, and drawings by the Waste Isolation Division (WID) when performing quality-related activities.

2.0 GENERAL REQUIREMENTS

2.1 Each WID Department shall:

- Establish and implement a program that provides for the preparation and use of written documents for the performance of quality-related activities.
- Ensure that all quality-related activities are performed under suitably controlled conditions, including use of appropriate equipment; suitable environmental conditions; and the use of appropriately trained personnel.

2.2 Where appropriate, instructions, procedures, and drawings shall contain quantitative and qualitative acceptance criteria to verify that the involved quality-related activities have been satisfactorily accomplished.

2.3 Documents are to be issued in formats appropriate to their application and will include, but not be limited to:

- WID Procedures
- WID Quality Program Manual
- WID Quality Procedures/Quality Assurance Instructions
- WID Technical Activity Procedures
- WID Purchasing Policy and Procedures Manual
- Drawings
- Specifications

2.4 Each written document shall be reviewed and approved prior to being issued in accordance with the WID Documentation Plan.

Approved: WID Quality Assurance Manager	Prepared By:

WP Form 1004E

3.0 RESPONSIBILITIES

3.1 WID Department Managers are responsible for the preparation and use of instructions, procedures, and drawings on quality-related tasks performed by their respective organizations.

3.2 WID Quality Assurance shall verify by periodic audits that instructions, procedures, and drawings are prepared and implemented, as appropriate. In addition, WID Quality Assurance shall selectively review and concur with prepared documents.

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WESTINGHOUSE WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL	WP-QPM Section No. VI Rev. 6 Effective Date 04/29/88 Superesedes: QPM VI No. Rev. 5 Date 12/01/86

Subject: DOCUMENT CONTROL

1.0 SCOPE

This section establishes the requirements for the preparation, review, approval, issuance, and control of documents that are prepared and issued by the Waste Isolation Division (WID). It specifies the requirements that are considered necessary to ensure that documents such as procedures, specifications, instructions, and drawings (including changes thereto) are properly controlled when used for the performance of quality-related activities. It also requires that a system be established and maintained for controlling documents which are prepared by other Major Project Participants and used by the WID, or their suppliers, for the performance of quality-related activities.

2.0 GENERAL REQUIREMENTS

2.1 Document Preparation, Review, Approval, and Issue

Documented procedures shall be established that define the preparation, approval, and issue requirements for documents which are being used for the performance of quality-related activities for the Waste Isolation Division. As a minimum, the procedures shall include:

- Identification of the required document format.
- Identification of the individuals or organizations responsible for the preparation, review, approval, and distribution of documents.
- Provisions for documents to be reviewed by appropriate WID technical support departments.
- Provisions for Quality Assurance review and approval of all quality-related documents.
- Provisions for document changes other than obvious typographical errors to be controlled in the same manner as the original document.

Approved: WID Quality Assurance Manager	Prepared By:

- Provisions for the reviewing organization or individuals to have access to all pertinent background information required to perform their review.

- Requirements that all quality-related documents be consistent with the provisions of the WID Quality Program Manual.

2.2 Document Control

WID procedures shall be developed and implemented by the assigned organizations identified therein to ensure that quality-related documents are controlled in accordance with the requirements of ANSI/ASME NQA-1 and Supplement 6S-1. As a minimum the procedure shall include provisions for:

- Ensuring that documents are reviewed for adequacy and approved for use by authorized personnel.

- Ensuring that documents are distributed and used at locations where the prescribed activity is performed.

- Preventing the inadvertent use of obsolete or superseded documents in the performance of quality-related activities.

2.3 Types of Documents to be Controlled

- WID Procedures
- WID Quality Program Manuals
- WID Quality Procedures/Quality Assurance Instructions
- WID Department Manuals
- WID Department Procedures
- Drawings
- Specifications

3.0 RESPONSIBILITIES

3.1 Administrative Services/Engineering and Repository Technology/TRU Waste and Integration

The Administrative Services, Engineering and Repository Technology, and TRU Waste and Integration Departments are responsible for the establishment and implementation of a system for the controlled distribution of assigned quality-related documents issued by the WID, and a system for the control of required quality-related documents submitted by other Major Project Participants to the WID for use in the performance of quality-related work.

3.2 WID Department Managers

Each WID department manager is responsible for ensuring that quality-related documents prepared by their activity are in accordance with this section of the Quality Program Manual and established WID Procedures.

3.3 WID Quality Assurance

The WID Quality Assurance Department shall review all quality-related documents to ensure consistency with the quality policy requirements contained in the WID Quality Program Manual.

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Subject: CONTROL OF PURCHASED MATERIALS, EQUIPMENT, AND SERVICES

1.0 SCOPE

This section establishes the policy requirements and associated responsibilities of the Waste Isolation Division (WID) for the control of purchased material, equipment, and services including waste certification and of users of waste transportation packaging, and associated equipment.

2.0 GENERAL REQUIREMENTS

The extent and nature of the controls applied to procurement of waste transportation, packaging, waste certification, facility systems, structures, components, and services shall be commensurate with the item's design classification, uniqueness, complexity, and importance to public and operational safety. Controls applied to the users of waste transportation packaging and associated equipment shall be in accordance with the requirements of Safety Analysis Reports for packaging and 10 CFR 71.

2.1 Procurement

2.1.1 Procurement Planning

Procurement activities shall be planned and accomplished in accordance with applicable Waste Isolation Division (WID) Procedures which have been developed in accordance with the requirements of ANSI/ASME NQA-1 and Supplement 7S-1 thereto and the WID Purchasing Manual to ensure a systematic approach to the procurement process. Planning shall provide for the integration of the following, as appropriate:

- Procurement document preparation, review and change control, and identification to Engineering Work Package or Work Order, as applicable.
- Selection of procurement sources.
- Bid evaluation supplier qualification and award.
- Control of supplier performance.

- o Verification (surveillance, inspection or audit) activities by the WID, including notification for hold and witness points.
- o Control of nonconformances, including segregation and control of involved items.
- o QA requirements.
- o Corrective action.
- o Acceptance of item or service.
- o Quality Assurance records.

2.1.2 Selection of Procurement Sources

The extent of procurement source evaluation techniques to be utilized by the WID shall be primarily dependent upon the design classification, complexity, uniqueness and importance of the material, equipment, or service to public or operational safety.

When deemed appropriate by established written Purchasing or QA procedures, or requisitioner, prospective suppliers shall be evaluated prior to the award of purchase orders, to assess their capability to provide items or services in accordance with the requirements of the procurement documents. These evaluations shall be a joint effort by Engineering, Purchasing, and Quality Assurance. Favorable evaluations shall result in the supplier being placed on the Qualified Suppliers List (QSL). The following shall be considered when performing such evaluations:

- o Provisions for the use of qualified personnel to evaluate the supplier's technical and financial capabilities.
- o Provisions for the participation of technical personnel in the evaluation of those suppliers selected to provide critical components or services.
- o Provisions for the results of all supplier evaluations to be documented and filed.
- o Delineation and documentation of the methods to be used to evaluate a supplier's capability, including the use of past performance history on identical and similar products and surveys of the supplier's facility.
- o A decision to evaluate the supplier by one or all of the following methods: (1) supplier survey; (2) review of the supplier's QA manual or procedures; (3) supplier's past performance history on similar products; and (4) results of surveys by other

Westinghouse divisions, where that supplier is currently qualified by that Westinghouse division for supplying similar items or services.

- The results or methods of all supplier evaluations shall be documented and filed with the surveyed suppliers list.

2.1.3 Bid Evaluation

The technical evaluation of supplier bids to ensure conformance to the procurement document requirements shall be performed by personnel or organizations designated to evaluate the following subjects as applicable:

- Compliance with technical considerations
- Quality Assurance Program
- Supplier's personnel capabilities and qualifications
- Supplier's production capability
- Supplier's past performance
- Supplier's financial capabilities

Prior to award of the purchase order, the Purchasing Department shall resolve, or obtain commitments to resolve, unacceptable quality conditions resulting from the bid evaluation. The results of all bid evaluations shall be documented and filed.

2.1.4 Evaluation of Supplier's Performance

2.1.4.1 Interface with Supplier

The Purchasing Department shall establish measures as necessary to verify supplier's performance. These measures shall be conducted in a timely manner in accordance with written detailed procedures and shall include, as appropriate:

- Establishing an understanding between the WID and the supplier of the provisions and specifications of the procurement documents.
- Requiring the supplier to identify planning techniques and processes to be utilized in fulfilling procurement document requirements.
- Reviewing supplier documents that are generated or processed during activities fulfilling procurement requirements.
- Identifying, negotiating, and processing necessary change information.
- Establishing method of document information exchange between the WID and the supplier.

- o Establishing the extent of source surveillance and inspection activities.

2.1.4.2 Verification of Supplier Activities

Verification of a supplier's quality performance shall be accomplished by the WID using qualified personnel. The verification methods will include source inspection, receipt inspection, record review, audits, surveillance or witness of specific inspections or tests.

Activities performed to verify conformance to requirements of procurement documents shall be recorded. Documentation resulting from source surveillance, inspections (source/receipt), audits, nonconformances, waivers, and corrective actions shall be evaluated by the WID to determine the performance rating and effectiveness of the supplier's Quality Assurance Program. Actions, as necessary, shall be taken to correct any conditions of noncompliance. The results of these evaluations shall be recorded by Purchasing with the Qualified Suppliers List that will be available for use on future procurements, as appropriate.

2.1.5 Review and Approval of Supplier Submittals

Supplier submittals shall be reviewed and approved by assigned organizations in accordance with written procedures. The procedures shall identify the organization responsible for ensuring that all submittals required by the procurement documents, and the ensuing WID reviews and approvals, are made in a timely manner. The procedures shall provide for the acquisition and processing of documents and the recorded evaluation of technical, inspection and test data versus acceptance criteria.

2.1.6 Control of Changes in Items or Services

The WID shall be responsible to ensure that provisions for controlling changes in procurement documents are established, implemented and documented.

2.1.7 Acceptance of Item or Service

2.1.7.1 General

The Quality Assurance Department, in conjunction with other WID departments, shall establish methods for the acceptance of material, equipment, or services in accordance with written detailed procedures.

2.1.7.2 Methods of Acceptance

The WID methods to accept material, equipment or services from a supplier shall be source verification, receiving inspection, supplier certificate of conformance, post-installation test, or a combination thereof. Acceptance of design services shall be by design review, test results, and/or technical document review.

2.1.8 Control of Supplier Nonconformances

The WID shall establish and document methods for disposition of items that do not meet purchase order requirements. The details of controlling nonconforming items shall be in accordance with written procedures. Additionally, the Supplier QA Program shall establish a nonconformance control system as required by the purchase order.

2.2 Waste Certification

Each facility that plans to ship waste to WIPP is required to develop a waste certification program and to submit that plan and their Quality Assurance (QA) Plan to the WIPP Waste Acceptance Criteria Certification Committee (WACCC) for necessary review and recommended approval actions, as defined and controlled by the WIPP Project Office.

2.3 Use of Waste Transportation Packaging and Associated Equipment

Source surveillances and audits of records involving transportation packaging and associated equipment will be accomplished on a regular basis to ensure that:

- The design and fabrication of packaging were performed under the control of an approved Quality Assurance Program.
- Packaging, when received by the user, is accompanied by appropriate documentation as identified in the purchase order and that such documentation is referenced in the certificate of compliance, as well as identifying necessary actions to be taken prior to delivery of the material to a carrier for transport.

3.0 RESPONSIBILITIES

3.1 All WID Requisitioning Departments are responsible for:

- Identifying the need for surveys or qualification of potential suppliers of items that the WID department has procurement responsibility for, as required.
- Performing technical evaluation of supplier bids when requested by Purchasing.

- o Review and approval of supplier submittals, as required.
- o Participating in the evaluation of potential suppliers as requested by Purchasing or the requisitioner.
- o Establishing technical requirements.
- o In conjunction with Quality Assurance, defining quality requirement for procurements.
- o Participating in supplier surveys and audits, as requested.
- o Defining quality requirements for procurements.
- o Review and disposition of nonconformances reported by the supplier or by the WID during receipt inspection.

3.2 Safety, Security and Environmental Protection is responsible for review and approval of safety-related nonconformance dispositions reported by the supplier or by the WID during receipt inspection.

3.3 Purchasing is responsible for:

- o Arranging for pre-award supplier evaluations as mutually determined by purchasing, requisitioners, and Quality Assurance evaluation of supplier bids, including documentation of the results.
- o Placement of purchase orders with only properly evaluated and qualified suppliers.
- o Evaluation of suppliers' proposals, negotiating required purchase order pricing information documenting results.
- o Obtaining proper review and approval of supplier submittals required by the purchase order.
- o Arranging for source inspections to be performed by Quality Assurance prior to shipment.
- o Authorizing modification to terms of orders and shipments from the supplier's facility.
- o Placement of purchase orders with only properly evaluated and qualified suppliers.

3.4 Quality Assurance is responsible for:

- o Establishing QA requirements and approving PRs/PRCNs.
- o Conducting pre-award supplier evaluations.
- o Evaluation and grading of suppliers' quality performance.

- o Performing source inspections or surveillance for WID procurements, as required, on construction contractors' procurements.
- o Receipt inspection of WID-procured items.
- o Conducting supplier audits, as required.
- o Review and approval of nonconformance dispositions reported by the supplier or by the WID during receipt inspection.
- o Maintain records of QA activities.
- o Obtaining and monitoring the effectiveness of supplier corrective action.

3.5 Construction (Maintenance) is responsible for:

- o Receipt, notifications, storage, maintenance, and release of WID-procured items.

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WESTINGHOUSE WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL	WP-QPM Section No. VIII Rev. 7 Effective Date 04/29/88 Supersedes: QPM VIII No. Rev. 6 Date 12/01/86

Subject: IDENTIFICATION AND CONTROL OF ITEMS

1.0 SCOPE

This section describes the measures to ensure that only correct and accepted items are used or installed by the Waste Isolation Division (WID) during manufacturing, modification, installation, maintenance, repair, preoperational activities, waste management operations, and waste transportation activities.

2.0 GENERAL REQUIREMENTS

2.1 Identification and Control of Item Requirements

2.1.1 The identification and control of items shall include the following:

- o Physical identification, to the maximum extent possible.
- o Physical separation and procedural control, (if physical identification is either impractical or insufficient some other appropriate means shall be employed).
- o Identification on the item or on records traceable to the item.
- o Markings, when used, to be clear, unambiguous, and indelible and applied in such a manner as to not affect the function of the item.
- o Markings to be transferred to each part of an item prior to being subdivided, and not to be obliterated or hidden by surface treatment or coatings unless other means of identification are substituted.

2.1.2 Procurement documents shall specify identification and control of item requirements, as required.

Approved: WID Quality Assurance Manager	Prepared By

3.0 RESPONSIBILITIES

3.1 Operations is responsible for incorporating into operating procedures applicable requirements for the identification and control of items and the implementation of these requirements.

3.2 Engineering and Repository Technology and TRU Waste and Integration, as applicable have design responsibility, and as such, is responsible for incorporating into Purchase Requisitions, other applicable design documents and subsequent change notices thereto, requirements for the identification and control of items, which they have design responsibility. They are also responsible for reviewing Architect-Engineer specifications and ensuring that procurement packages contain the appropriate requirements for identification and control of items.

3.3 Purchasing is responsible for ensuring that any requirement in a Purchase Requisition or Purchase Requisition Change Notice related to the identification and control of items is included in the Purchase Order.

3.4 Quality Assurance is responsible to verify by periodic audits and inspections that involved WID departments are complying with requirements of established identification and marking procedures. In addition, WID Quality Assurance is responsible for reviewing and approving all Quality Code 1, 2, and 3 Purchase Requisitions and Purchase Requisition Change Notices to ensure that requirements for identification and control of items are adequately specified.

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Subject: CONTROL OF PROCESSES

1.0 SCOPE

This section describes the measures employed to ensure that processes performed by the Waste Isolation Division (WID) or their suppliers are accomplished under controlled conditions and in accordance with applicable Safety Analysis Reports for packaging, regulations, codes, standards, and specifications. These processes include waste transportation, waste certification of WIPP site-generated waste, waste handling and storage activities, welding, heat treating, cleaning, nondestructive examinations, and other processes performed by qualified personnel using approved procedures, as required.

2.0 GENERAL REQUIREMENTS

2.1 Material, Parts and Equipment Procurement

Procurement documents shall specify appropriate process control requirements to be used by the supplier in the manufacture of material, parts, and equipment.

2.2 Process Control Requirements

Process control requirements shall be identified in facility operating, design, repair, maintenance, and/or procurement documents and shall include the following, as appropriate:

- Qualification of personnel, procedures, and equipment shall comply with the requirements of all applicable codes and standards.
- Documentation shall be maintained for currently qualified personnel, processes, and equipment in accordance with the requirements of pertinent codes and standards.
- The necessary qualifications of personnel, procedures, and equipment shall be defined for processes not covered by existing codes or standards, or where item quality requirements exceed the requirements of established codes or standards.

3.0 RESPONSIBILITIES

3.1 Quality Assurance responsibilities include the following:

- Establish and maintain special QA process procedures and records and qualify QA personnel for those special processes performed by QA.
- Review of WID purchase requisitions, specifications, Engineering Work Packages (EWPs), Preventive Maintenance procedures, repair and modification instructions, and associated documents to ensure inclusion of appropriate process control requirements.
- Review and concurrence in waste generators, suppliers, and WIPP facility process procedures associated with radioactive waste transportation, certification, receipt, storage, monitoring, retrieval. Audit of the maintenance of qualification records for personnel, processes, and equipment.
- Perform inspection of operations to ensure compliance with acceptance criteria.

3.2 Engineering and Repository Technology and TRU Waste and Integration responsibilities include the following:

- Identification of appropriate process control requirements in design, waste certification, waste transportation, modification, repair, and/or procurement documents as required by applicable codes, standards, or regulations, and Safety Analysis Reports for packaging.
- Review of selected design specifications generated by designers to ensure that appropriate process control requirements are included in procurement packages.

3.3 Purchasing responsibilities include the following:

- Ensuring that the process control requirements included in the Purchase Requisition or the Purchase Requisition Change Notice are also included in the Purchase Order, or Purchase Order Change Notices.

3.4 Operations responsibilities include the following:

- Identification of appropriate process control requirements in operating procedures and instructions as required by applicable codes and standards, and Safety Analysis Reports for packaging, including those procedures associated with radioactive waste transportation, receipt, storage, monitoring, and retrieval.
- Maintenance of personnel, procedures, and equipment qualification documentation as required by applicable codes and standards.

- o Ensuring that processes are performed by qualified personnel in accordance with approved procedures, as required.

- o Maintain operating and inspection status documentation for radioactive waste receipt and processing, and the maintenance, testing, and repair of packaging.

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WESTINGHOUSE WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL	WP-QPM Section No. X Rev. 5 Effective Date 04/29/88 Superesedes: QPM X No. Rev. 4 Date 12/01/86

Subject: INSPECTION

1.0 SCOPE

This section describes the inspection program applied to waste transportation, waste certification, and facility operations and items for which the Waste Isolation Division (WID) has the responsibility for management, procurement, and/or construction responsibilities and for conducting inspection overview activities.

2.0 GENERAL REQUIREMENTS

All inspection activities shall be conducted in accordance with written procedures or instructions which describe the inspection requirements. Procedures for the control of inspection activities shall be in accordance with the requirements of ANSI/ASME NQA-1 and Supplement 10S-1 thereto and 10 CFR 71, Subparts G and H, as applicable to waste certification and transportation. The level of inspection shall be commensurate with the item's design classification, uniqueness, complexity, and importance to public and operational safety and the Safety Analysis Reports for packaging. Inspection activities shall be performed by persons independent of the work being inspected and the inspection personnel shall not report directly to the immediate supervisor responsible for the work being performed.

2.1 Source Inspections

Procurement documents shall include provisions for the WID's representatives to conduct required inspections and surveillances at the supplier's facility. Source inspection and/or surveillance activities are conducted to verify compliance with procurement requirements, and are performed when specified as witness or hold points in procurement documents, or when receiving inspections would be too late or impossible because of assembly configuration.

The WID source inspection of DOE Construction Contractors procurements, and waste generators and waste carriers will be conducted in accordance with the applicable WPO-DOE Standard Operating Procedures (SOP).

Approved: WID Quality Assurance Manager	Prepared By:

Source inspection of radioactive waste and waste shipping activities will be conducted in accordance with applicable procedures and DOE agreements with the waste generators and waste carriers.

2.2 Receipt Inspections

Inspections are planned and performed to verify conformance with specified requirements for radioactive waste shipments and facility materials and equipment. Verification is performed by direct measurement, examination, and/or tests when possible. Monitoring of processing methods, equipment, and personnel is utilized when direct verification methods are impossible or impractical.

Receipt of waste shipments and packaging are performed in accordance with procedures which establish acceptance criteria and records requirements.

Procured materials shall be inspected upon receipt at the plant site for damage, identification, and conformance to procurement requirements. Inspections are performed in accordance with established procedures or instructions that clearly identify the characteristics to be verified. The inspections are also performed in accordance with established acceptance criteria, including verification of receipt and review of required supplier documentation. Nonconforming or rejected materials, parts, or components are identified, marked, and segregated to preclude inadvertent use while the nonconformance is being evaluated.

2.3 Inspection and Overviews During Construction and Operation and Waste Certification and Waste Transportation

The WID will plan and conduct overviews of inspection activities to ensure that adequate and appropriate inspections are being performed by the responsible organizations.

Inspections of packaging design and fabrication activities, waste certification, and transportation activities and of WID or WID-subcontracted construction or operation activities will be conducted in accordance with procedures, instructions, or checklists to verify compliance with specified requirements outlined in contract documents, drawings or specifications. Modifications, repairs, or replacement of items subsequent to final inspection shall require re-inspections, as appropriate to verify acceptability.

These inspections include, but are not limited to, the following:

- o In-process inspection and monitoring
- o Maintenance and storage inspection
- o Nondestructive examination
- o Calibration control surveillance
- o Acceptance test inspection

- o Functional retesting
- o Facility inspections preparatory to turnover
- o Assembly prior to shipment
- o Properly completed shipping papers
- o Marking per DOT requirements
- o Tamper-proof seals intact
- o Emplacement inspections
- o Retrieval operations inspections

2.4 Inspection Documentation

Inspection results shall always be recorded on forms as required by the applicable procedure, specification, or instruction. The inspection documentation (inspection instructions, reports, checklists, work packages, travelers, etc.) shall, as a minimum, include:

- o Item/attribute inspected
- o Date of inspection
- o Inspector
- o Type of observation
- o Results of inspection
- o Reference to information on action taken in connection with nonconformances, if applicable

3.0 RESPONSIBILITIES

3.1 Quality Assurance responsibilities include the following:

- o Review of design, procurement, installation, and testing documents included in WID procurements to ensure that the quality requirements are correctly stated, inspectable, and controllable and that adequate acceptance and rejection criteria are specified.
- o Planning for source surveillance and receipt inspection of WID-procured equipment and radioactive waste, certification and packaging preparation for shipment, and shipping activities.
- o Source inspection at the WID supplier's facility and waste generator facility.

- o Inspection planning and inspection of WID-conducted or subcontracted site construction or operational activities.
- o Receipt inspection of WID-procured Quality Codes 1, 2, and 3 items when specified.
- o Monitoring of receiving activities for Code 3 facility items.

3.2 Construction (Maintenance) responsibilities include the following:

- o Conducting preliminary arrival inspection of all incoming WID-procured items for identification, accountability of items and documentation, and evidence of damage.
- o Receipt and documentation of items, other than those requiring Quality Assurance inspection.
- o Notification to Quality Assurance upon receipt of all Quality Code 1, Code 2, or Code 3 items requiring Quality Assurance inspection.
- o Identification and segregation of nonconforming items.
- o Storage, maintenance, maintaining traceability, and issuance of items subsequent to final acceptance.

3.3 Operations, in conjunction with Quality Assurance, are responsible for ensuring that activities involving receipt and maintenance of waste package shipments include, as a minimum, inspection of surface conditions, weld and structural integrity, condition of flange faces or sealing areas and related components, as well as labeling, marking, and other documented packaging requirements prior to being returned to the transport carrier.

3.4 Other WID Departments

All WID project personnel involved in the preparation or review of design, procurement, installation, operation, and testing documents are responsible for ensuring that appropriate inspection requirements have been specified in these documents.

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Subject: TEST CONTROL

1.0 SCOPE

This section describes the measures to be taken to ensure that the test activities performed by or for the Waste Isolation Division (WID) and waste generators are accomplished in accordance with appropriate written procedures or checklists, and under suitably controlled conditions.

2.0 GENERAL REQUIREMENTS

For tests performed by the WID, their suppliers, or waste generators, measures shall be established and implemented for documenting testing requirements in technical or test specifications and for verifying conformance to specified requirements by surveillance, monitoring, and auditing, as appropriate.

2.1 WID Testing Activities

2.1.1 Testing activities performed by the WID or their suppliers shall be accomplished in accordance with written test plans and procedures that shall be in accordance with the requirements of ANSI/ASME NQA-1 and Supplement 11S-1 thereto, and Safety Analysis Reports for Packaging. They shall contain the following provisions as applicable:

- Test Scope and/or definition or purpose
- Test prerequisites such as calibrated instrumentation and supporting data; adequate test equipment and instrumentation including accuracy requirements, completeness of item to be tested, suitable and controlled environmental conditions, and provisions for data collection and storage
- Instructions for performing the test
- Mandatory inspection hold points to be witnessed by the WID or other designated representatives
- Acceptance and rejection criteria

- Methods of documenting or recording test data
- Trained and qualified personnel
- Certification of testing activities by authorized personnel

2.1.2 Surveillance, monitoring, and auditing of test activities shall be accomplished by qualified WID personnel.

2.1.3 Test procedures prepared by other Project Participants and used as WID procurement documents will be reviewed by the WID to ensure that the documents are complete and the tests described by the documents are adequate to determine that the involved equipment, systems, or structures are operationally acceptable.

2.2 WID Supplier/Subcontractor/Waste Generator Test Activities

2.2.1 Procurement documents shall specify appropriate test requirements for WID suppliers and subcontractors. When specified in the procurement document, suppliers or subcontractors shall be required to submit test plans to the WID for review and approval.

2.2.2 When appropriate, WID representatives shall, when specified in the procurement document, witness supplier/subcontractor test activities.

2.2.3 WID representatives may be assigned to witness acceptance testing activities being conducted at waste generator/waste transporter facilities prior to delivering packages for transport to a carrier.

3.0 RESPONSIBILITIES

3.1 Responsible Technical Departments will prepare test documentation that is their responsibility, and ensure that appropriate test requirements are specified in system and component design specifications and drawings for WID procurements.

3.2 Engineering & Repository Technology has the responsibility to review test documentation prepared by other WID departments or WID suppliers for compliance with Paragraph 2.1.1 and to review the design, procurement and testing documents to ensure that the tests specified are adequate and appropriate, and ensure that the components or systems meet the established requirements.

3.3 TRU Waste and Integration is responsible to ensure that acceptance tests are conducted prior to delivering packages for transport to a carrier and that such testing includes provisions for: 1) structural, thermal, and shielding integrity; 2) leak-tightness; and 3) component performance for valves, gaskets, and transport devices. They are also responsible for implementing a program for ensuring

that test results are documented, evaluated, and determined by qualified personnel to be acceptable in order to assure that packages remain usable and free of excessive radiation and contamination.

3.4 Purchasing has the responsibility to ensure that testing requirements specified by a Purchase Requisition or by Purchase Requisition Change Notices are included in the request for quote and in the Purchase Order.

3.5 Quality Assurance has the responsibility to review and approve test procedures and instructions prepared by the WID or their suppliers for adequacy and appropriateness of the quality requirements contained in these documents.

3.6 Quality Assurance has the responsibility to verify by surveillance, monitoring and auditing, as appropriate, that testing activities performed by the WID or their suppliers are performed in accordance with applicable requirements and that deficiencies are documented and dispositioned.

3.7 Quality Assurance has the responsibility to review and approve all Quality Code 1, 2, and 3 Purchase Requisitions and Purchase Requisition Change Notices to ensure that requirements for Test Control are adequately specified.

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Subject: CONTROL OF MEASURING AND TEST EQUIPMENT

1.0 SCOPE

This section establishes the requirements and responsibilities of the Waste Isolation Division (WID) for the control of measuring and test devices used in activities affecting and/or determining quality characteristics, critical facility operations, radioactive waste storage, safety and health, and environmental monitoring. This section establishes the requirements and responsibilities for ensuring that measuring and test devices are properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within specified limits.

2.0 GENERAL REQUIREMENTS

The selection, use, and control of measuring and test equipment used by the WID for determining acceptability of quality characteristics, or used in activities associated with critical facility operations, radioactive waste storage, safety and health, or environmental monitoring shall be described in written procedures. These control measures are not applicable to rulers, tape measures, levels, and other such devices, if normal commercial equipment provides adequate accuracy. Procedures shall include the following:

- Provisions to ensure that tools, gages, electrical, and radiation instruments, and other inspection, measuring and test equipment and devices used are of proper range, type, and accuracy to adequately verify conformance to established requirements.

- Requirements for inspection, measuring, and test equipment to be controlled, calibrated, adjusted, and maintained at prescribed intervals with initial calibration prior to use, against certified equipment having known valid relationship traceable to nationally recognized standards. If no standard exists, the basis for calibration shall be documented. The calibration standards shall have an accuracy of at least the accuracy (calibration tolerance) of the item being calibrated. The use of a standard with lesser accuracy may be acceptable when limited by the "state-of-the-art."

- Defining calibration method and frequency of calibration for each device and shall be based on the type of equipment, stability characteristics, required accuracy, intended use and other conditions affecting measurement control.

- Provisions for out-of-calibration devices to be tagged or segregated to preclude use until they have been recalibrated.

- Provisions for special calibration to be performed when accuracy of the equipment is suspect.

- Provisions for an evaluation to be made when inspection, measuring and test equipment are found to be out of calibration to determine the validity of previous inspection or test results; and provisions for an evaluation of the acceptability of items previously inspected or tested. The results of the evaluation shall be documented.

- Provisions for inspection, measuring, or test equipment found to be consistently out of calibration, to be repaired or replaced.

- Provisions for records to be maintained and equipment suitably marked to indicate calibration status, date of next calibration, that the equipment is identified and traceable to the calibration test data, the identity of the individual who performed the calibration, and the procedure used.

- Provisions for calibration procedures to be approved by cognizant management personnel.

3.0 RESPONSIBILITIES

3.1 Construction (Maintenance) is responsible for:

- Establishment, coordination, and administration of the program for control of WID measuring and test equipment.

- Preparation and implementation of written procedures that describe the control measures specified herein.

- Performance or procurement of services for calibration activities.

- Maintains documentation of all calibration.

3.2 Other WID Departments are responsible for:

- Inclusion of provisions in technical work documents or procurement documents to ensure that measurement and test equipment used in the shops, field, and/or laboratory to determine compliance with specified requirements or for

obtaining test data are identified, checked, and calibrated at prescribed intervals and/or prior to use in accordance with methods specified by the manufacturer or otherwise established and documented.

- o Providing technical direction to the organization responsible for the preparation of calibration instructions.

3.3 Quality Assurance is responsible for:

- o Monitoring and/or auditing the calibration program to verify compliance to established procedures.
- o Reviewing of procedures for "control of measuring and test equipment" for compliance to Quality Assurance Program requirements.

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Subject: HANDLING, STORAGE, AND SHIPPING

1.0 SCOPE

This section describes the requirements necessary to ensure that the handling, storage and shipping of facility waste material, equipment and components, including spare parts, are controlled and performed in accordance with established instructions, specifications, procedures or drawings by the Waste Isolation Division (WID) or their supplier's throughout manufacture, receipt, installation and operation.

2.0 GENERAL REQUIREMENTS

Handling, shipping, storage, packaging and preservation requirements for critical, sensitive, perishable or high-value items shall be prescribed in written procedures or instructions as specified by applicable government and industrial codes, regulations, and standards, or when defined or identified in facility design or operations documents and packaging SARPs. These procedures or instructions shall include the information detailed in Sections 2.1 and 2.2, as appropriate.

2.1 Lifting and Handling

Lifting and handling procedures or instructions shall include the following information:

- Identification of special handling tools and equipment necessary to ensure safe and adequate handling
- Inspection and test requirements for special handling tools or equipment, including frequency of required inspections and tests
- Inspection and test acceptance criteria
- Requirements for operator training in the use of special lifting and handling equipment
- Requirements for periodic inspection and functional testing of equipment

- Test and inspection reporting requirements

2.2 Packaging, Shipping, Storage and Preservation

Marking and labeling instructions for packaging, shipment, storage and preservation of items shall adequately describe:

- Special storage requirements, if required
- Environmental requirements (inert gas atmosphere, moisture content levels, temperature levels, etc.)
- Special shipping equipment (containers, accelerometers, shock absorbers, etc.)
- Item identification requirements
- Requirements for special controls

3.0 RESPONSIBILITIES

3.1 Quality Assurance shall be responsible for:

- Participation in required inspections as identified in approved procedures or instructions
- Review and concurrence with facility design and operations documents that define or identify the need for detailed procedures for the control of handling, shipping, storage, cleaning and preservation of facility waste material, equipment and spare parts
- Monitoring or auditing of the overall program as necessary to ensure compliance with specified requirements
- Verification (through procedure review and source surveillance) that specified handling and storage procedures and practices utilized by suppliers are adequate and effectively implemented

3.2 Engineering and Repository Technology shall be responsible for:

- Identification of critical, sensitive, perishable, or high-value items requiring the preparation of detailed procedures to control handling, cleaning, storage, preservation, and shipping of facility materials, equipment or spare parts
- Inclusion of specific handling, storage, packaging, preservation and shipping requirements into technical documents/specifications prepared by the WID when required by applicable government and/or industrial safety codes and standards or when deemed appropriate

3.3 Operations shall be responsible for:

- Including appropriate handling, storage and shipping requirements in Operations Department documents
- Periodic inspection and functional testing of all lifting and handling equipment
- Preparation of detailed procedures or instructions for radioactive waste handling and storage to ensure proper quality and accountability control

3.4 Construction (Maintenance) shall be responsible for:

- Storage, preservation, packaging and shipping of facility items in accordance with approved procedures or instructions
- Preparation of written procedures for inspection, maintenance and functional testing of lifting and handling equipment

3.5 Requisitioners

Requisitioners from all WID departments are responsible for including appropriate requirements for handling, storage and shipping in purchase requisitions.

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Subject: INSPECTION, TEST, AND OPERATING STATUS

1.0 SCOPE

This section describes the measures to be used by the Waste Isolation Division (WID) to ensure that required inspections and tests are performed, and that acceptability of items with regard to inspections and tests performed is known throughout manufacturing, installation, facility maintenance, preoperational activities, operations, waste receipt, packaging maintenance, repair, modification, and waste certification, and those tests performed on waste transportation packaging prior to shipment.

2.0 GENERAL REQUIREMENTS

2.1 Inspection, Test and Operating Status Requirements

2.1.1 The status of inspection and test activities shall be identified either on the items or in documents traceable to the items to:

- o Ensure that required inspections and tests are performed.
- o Ensure that items that have not passed the required inspections and tests are not installed, used, or operated.

2.1.2 Status shall be maintained through indicators such as physical location and tags, markings, process travelers, stamps, or inspection records.

2.1.3 Procurement documents shall specify inspection, test, and operating status requirements, as required.

3.0 RESPONSIBILITIES

3.1 Requisitioners are responsible for including in Purchase Requisitions, and subsequent changes thereto, appropriate requirements for the identification of inspection, test, and operating status, as required.

3.2 TRU Waste and Integration is responsible to identify the requirements of Safety Analysis Reports for packaging to waste generators and waste carriers and assure those requirements are detailed in waste generator procedures for compliance. They also identify trailer maintenance requirements to waste carriers and assure procedures are in place for compliance.

3.3 Quality Assurance is responsible for ensuring that inspection, test and status requirements are specified, as required, during the review of Purchase Requisition and Purchase Requisition Change Notices. Quality Assurance is also responsible for the application and removal of tags, markings, labels, stamps or other status indicators on WID items at the WIPP site and for performing inspections during modifications, repairs, testing, and preparation for shipments to verify and validate through documented inspection reports that actual field conditions agree with drawings and procedures.

3.4 Purchasing is responsible for ensuring that the inspection, test, and operating status requirements specified by Purchase Requisitions and Purchase Requisition Change Notices are included in the Request For Quote and Purchase Order documents.

3.5 Construction (Maintenance) is responsible for notifying Quality Assurance when a shipment is received that requires inspection by Quality Assurance. Maintenance is also responsible for having a system which implements the inspection, test, and operating status specified by the responsible requisitioner.

3.6 Operations is responsible for facility maintenance activities, as well as activities involving the maintenance and repair of waste transportation packaging equipment.

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Subject: CONTROL OF NONCONFORMING ITEMS

1.0 SCOPE

This section describes the system for ensuring that appropriate measures are established to control nonconforming conditions that are detected during the procurement, installation, testing or operation of facility equipment, components, systems or structures, including radioactive waste shipments, for which the Waste Isolation Division (WID) has been assigned prime responsibility.

2.0 GENERAL REQUIREMENTS

A system shall be established for ensuring that adequate controls are maintained throughout procurement, installation, testing and operations conducted by the WID and by generator sites and carriers involved in the certification of waste and transportation of waste to prevent the inadvertent use of nonconforming items. Nonconformance Reports may be initiated by WID personnel and coordinated with Quality Assurance for review and issuance. This system shall include, but not be limited to, the following:

- o Control of nonconformances
- o Identification, documentation and segregation of nonconforming items
- o Disposition of nonconforming items
- o Reinspection of nonconformances
- o Reporting and maintenance of data

2.1 Control of Nonconforming Items

The nonconformance control system shall be described in written procedures that define measures necessary to ensure proper identification, control and disposition of nonconforming conditions detected at WID suppliers, WIPP facilities, and waste carriers. These procedures shall be in accordance with the requirements of ANSI/ASME NQA-1

and Supplement 15S-1 and 10 CFR 71, Subparts G and H, as applicable, and include, but are not limited to, provisions identified in 2.2 through 2.5.

Nonconformance as used in this procedure is defined as a deficiency in characteristic, documentation or procedure which renders the quality of an item unacceptable or indeterminate. Examples include:

- o Physical defects
- o Test failures
- o Incorrect or inadequate documentation
- o Deviation from prescribed processing, inspection, acceptance, or test procedures

2.2 Identification, Documentation and Segregation of Nonconforming Items

2.2.1 Identification

Nonconforming items shall be identified by legible and easily recognizable marking, tagging or other methods which do not adversely affect the end use of the item. Nonconforming items may be placed in identified containers, packages or segregated storage areas when identification of individual nonconforming items is impractical.

2.2.2 Documentation

Nonconformances identified during receipt, installation, testing, or operations at the WID shall be documented on the Nonconformance Report (Form WP 1035).

Nonconformances reported by WID suppliers, when required by procurement documents, shall be reported on the Approval/ Variation Request (Form WP 1477).

Nonconformances identified and reported by waste generators/ waste carriers shall be documented on appropriate nonconformance forms in use at a waste generator's facility or invoked as part of a contract with a waste carrier and will be submitted to WIPP in accordance with WAC requirements or in the case of a waste carrier, established contract requirements.

2.2.3 Segregation

Nonconforming items shall be segregated, when practical, by placing them in a clearly identified and designated hold area until properly dispositioned. When placement of the nonconforming item into a designated hold area is impossible or impractical due to size, weight or access limitations, the item must be clearly identified by tagging or other methods to preclude its inadvertent use.

2.3 Disposition of Nonconforming Items

Review and approval of nonconforming items shall be commensurate with the disposition actions proposed by the responsible WID representatives. Dispositions of rework, reject, scrap, or hold for disposition shall, as a minimum, be reviewed and approved either by the Engineering and Repository Technology or TRU Waste and Integration, and Quality Assurance Departments. Technical justification must be provided for nonconformances designated accept-as-is, repair, accept-for-limited use, or conditional approval and shall, as a minimum, require review and approval of the Engineering and Repository Technology, TRU Waste and Integration, Environmental Safety & Health, Operations, and Quality Assurance Departments.

Drawings shall reflect the as-built condition for accepted deviations. Nonconformances shall be evaluated to determine reportability as a significant condition adverse to quality, and if so determined, shall be processed/reported in accordance with the corrective action procedure (WP-QPM, Section XVI).

2.4 Reinspection of Nonconforming Items

Reworked or repaired items shall be reinspected for compliance to the approved disposition requirements, and to ensure that specified actions are accomplished in accordance with approved procedures, instructions or drawing requirements.

2.5 Reporting and Maintenance of Data

Nonconformance documents generated by WID personnel, their suppliers, or waste carriers shall be evaluated to determine if the reported deviation is a significant condition adverse to quality as defined WP-QPM, Section XVI. DOE and responsible WID management shall be notified of these conditions. A copy shall be maintained by Quality Assurance of all nonconformance reports generated by the WID, their suppliers, and carriers.

3.0 RESPONSIBILITIES

3.1 Requisitioners

Requisitioners are responsible for:

- Inclusion of requirements relative to supplier control of nonconformances in procurement documents, as appropriate
- Processing supplier nonconformance reports in accordance with established procedures

3.2 TRU Waste and Integration

TRU Waste and Integration is responsible for identifying Safety Analysis Report(s) for packaging requirements to waste generators

and waste carriers and the requirements of waste acceptance criteria for waste certification.

- Assuring procedures are in place to detect and report nonconformances
- Review and approval of proposed disposition of nonconformances

3.3 Quality Assurance

Quality Assurance is responsible for:

- Preparation of Quality Assurance procedures for nonconformance control
- Review and approval of proposed dispositions for nonconformances
- Verification and approval of inspection/close actions
- Evaluation of nonconformance reports to determine reportability as a significant condition adverse to quality and notifying WPO/QA regarding the nonconformance.
- Surveillance/auditing of nonconformance control systems, as necessary, to verify effective implementation of procedure requirements
- Reviewing and monitoring nonconformances for trend analysis

3.4 Department Managers

Department Managers are responsible for:

- Ensuring that nonconformances detected for items within their area of responsibility are identified, tagged, segregated, reported and processed in accordance with established procedures
- Providing disposition for nonconforming conditions identified within their area of responsibility
- Review and approval of proposed disposition of nonconformances, as required

3.5 Purchasing

Purchasing is responsible for forwarding supplier nonconformance reports to the cognizant requisitioner and Quality Assurance for proper processing and dispositioning, and subsequent transmittal to the supplier when WID disposition actions have been completed.

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WESTINGHOUSE WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL	WP-QPM Section No. XVI Rev. 7 Effective Date 04/29/88 Superesedes: QPM XVI No. Rev. 6 Date 12/01/86

Subject: CORRECTIVE ACTION

1.0 SCOPE

This section establishes the Waste Isolation Division (WID) requirements for the development and implementation of a system to determine, document, and initiate appropriate corrective actions after encountering conditions adverse to quality. Deviations detected and reported by the Internal/ External Audit System and/or the Unusual Occurrence Reporting System are specifically excluded from the requirements of this section.

2.0 GENERAL REQUIREMENTS

2.1 Documentation of Conditions Requiring Corrective Action

Conditions adverse to quality of a significant nature that are detected by WID personnel during the performance of their assigned duties shall be documented in accordance with the provisions of applicable project procedures or Quality Assurance procedures. Corrective action reporting is applicable, but not limited, to conditions adverse to quality of a significant nature that are defined as follows:

- Any violation of the requirements of Safety Analysis Report for packaging.
- Nonconformances found in hardware, design, construction, tests, or operations that would affect, if uncorrected, the safety-related function of permanent confinement, confinement during shipping, monitoring and control of radioactive effluents, or reduce the integrity of packaging, such that the health and safety of the public and operating personnel could not be ensured.
- Procedures inadequate to fulfill the intent of programmatic, specifications, or contractual requirements.
- Unsatisfactory conditions found to exist on a repetitive basis.

Approved: WID Quality Assurance Manager	Prepared By:

- o Noncompliance with administrative or procedural requirements.
- o Breakdown of any phase of the Quality Assurance system.

2.2 Preparation of Corrective Action Statement

Appropriate corrective action shall be identified, documented, and completed for each reported condition adverse to quality. The term "corrective action" (as used in this section) refers to a documented commitment to accomplish a specific action plan to resolve an identified condition adverse to quality. Corrective actions shall address the following points, as appropriate:

- o Action to resolve the initial problem
- o Determination of the cause of the problem
- o Action to preclude recurrence of the problem
- o Forecast completion dates for the required actions

2.3 Resolution of Significant Conditions Adverse to Quality

Conditions adverse to quality that are significant in nature (such as a breakdown of any phase of the Quality Assurance system or conditions that could have a major impact on the quality of WIPP packaging, components, systems, or structures), shall require "cause" and "corrective action to prevent recurrence" statements as part of resolution. Conditions of this nature shall be reported to senior WID management and to the DOE WIPP Project Office for their review and concurrence.

2.4 Corrective Action Follow-up System

A follow-up system shall be established to verify proper implementation of scheduled corrective actions and to complete the corrective action in a timely manner.

3.0 RESPONSIBILITIES

3.1 WID Employes are responsible for ensuring that any conditions adverse to quality encountered during the performance of their assigned duties are reported to Quality Assurance for appropriate action.

3.2 Department Managers are responsible for establishing and implementing appropriate and effective corrective action for reported conditions that are adverse to quality and pertinent to work areas/activities under their cognizance.

These responsibilities include the following:

- o Determination of the cause
- o Correction or resolution of reported conditions

o Implementation of corrective measures to preclude recurrence

3.3 Quality Assurance

3.3.1 Quality Assurance will issue the RCA when required, assign a number, and maintain a log of assigned RCA numbers that includes appropriate tracking and close-out information.

3.3.2 Quality Assurance is responsible for monitoring the WID Corrective Action System through audits, documentation reviews, follow-up reviews, and other appropriate methods, to verify that significant conditions adverse to quality are being documented, evaluated, and dispositioned, and that appropriate and effective corrective actions are being established and implemented.

3.3.3 Quality Assurance shall evaluate nonconformances and determine if the reported condition requires processing as a significant condition adverse to quality as defined in paragraph 2.1 of this procedure. Upon completion of the evaluation, Quality Assurance shall notify WPO/QA of the significant nonconformances.

3.4 Purchasing is responsible for obtaining subcontractor or supplier corrective action when required.

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Subject: QUALITY ASSURANCE RECORDS

1.0 SCOPE

This section and the attachment provides the Waste Isolation Division (WID) policy regarding identification, preparation, collection, storage, maintenance, disposition and permanent storage of Quality Assurance records associated with the site verification, design, procurement, construction, checkout, turnover, preoperational, and operational activities of the WIPP, and activities associated with waste certification and waste transportation.

2.0 GENERAL REQUIREMENTS

Quality Assurance records are those completed documents that furnish evidence of the quality of items and/or activities affecting quality. Records shall be generated and maintained by WID organizations involved in the performance and/or control of quality-related activities to provide documentary evidence that such activities are adequately controlled; and that associated parts, components, systems, facilities, and services comply with applicable requirements. The Quality Assurance records shall be consistent with the requirements of applicable technical and quality specifications, standards, drawings, codes, regulations, Safety Analysis Reports for packaging, and corporate requirements.

The specific requirements for the identification, preparation, and collection of Quality Assurance records are the responsibility of the Quality Assurance Department as included in the Records and Inventory Disposition Schedules (RIDS). The WID Records Management Program shall be consistent with the requirements of this section and other applicable requirements.

Quality Assurance records shall be classified as either Permanent or Non-Permanent in accordance with the following definitions. The classification of each Quality Assurance record entered into the Master Records Center (MRC) shall be indicated on the records listing maintained by the MRC.

Approved: WID Quality Assurance Manager	Prepared By:

2.1 Permanent Records

Permanent records are those required to be transferred to National Archives and Records Services and which may be retained for a long period of time. Permanent records are those which pertain to:

- Packaging design, fabrication, and certification
- Site underground facility characteristics
- Environmental characteristics
- Reports of a research/development nature having scientific, archival or historical interest
- Documents identifying the location of permanent site boundaries
- Site validation documentation
- Other records or data designated by the owner (DOE) or WID as requiring long-time retention such as those which meet one or more of the following criteria and are required to be maintained for the life of the particular item while it is installed in the plant or stored for future use.
    - Records which would be of significant value in demonstrating capability for safe operation including inspection, audit, and other Quality Assurance records
    - Records which would be of significant value in maintaining, reworking, repairing, replacing, or modifying an item
    - Records that provide traceability and process history for waste
    - Records which would be of significant value in determining the cause of an accident or malfunction of an item
    - Records which provide required baseline data for in-service inspection
    - Records which establish significant technical or administrative decisions

2.2 Nonpermanent Records

Nonpermanent records are those required to show evidence that an activity was performed but need not be retained for the life of the item because they do not meet the criteria for Permanent records Such records are to be submitted to the MRC in accordance with established RIDS Schedules.

3.0 SPECIFIC REQUIREMENTS

3.1 Preparation

The WID department managers shall take action or assure action is taken to generate and maintain Quality Assurance records for the quality-related activities performed under their cognizance. As a part of this action, they shall ensure that records which are prepared to provide objective evidence that activities have been performed in compliance with specified requirements satisfy the following particulars:

- Inspection and test reports shall, as a minimum, identify the inspector, the type of observation, the results, the acceptability, and action taken with respect to any non-conformance. Records concerning packaging shall be approved by the inspection supervisor.

- All Quality Assurance records shall be legible, complete per applicable instructions, and identifiable to the document number, title, revision number, and date.

- The requirements for WID supplier Quality Assurance records will be incorporated in the procurement documents. The Quality Assurance records to be generated, supplied, or retained shall be specified in applicable design specifications, procurement documents, test procedures, operational procedures or other similar documents.

- The requirements for records for waste certification and transportation shall be identified by specification's Safety Analysis Reports for packaging and procedures.

3.2 Identification and Filing

The types of documents required to be generated and preserved as Quality Assurance records shall be identified and listed in Records and Inventory Disposition Schedules (RIDS). The development of the listing should involve input from all cognizant WID managers and forms the basis for the development of requirements for the preparation of specific types of Quality Assurance records and for the Quality Assurance development and maintenance of their filing system for Quality Assurance records.

3.3 Storage Controls During the Period of Record Generation

Stored records, until released to the MRC, shall be adequately filed and protected to preclude deterioration. As a minimum, the below listed requirements apply:

- Records shall be stored to prevent damage from moisture, temperature, and pressure.

- Records shall be firmly attached in binders or placed in folders or envelopes for storage in steel file cabinets or on shelving in containers.

- Special processed records (such as radiographs, photographs, negatives, and microfilm) shall be stored to prevent damage from excessive light, stacking, electromagnetic fields, and temperature.

3.4 Collection and Receipt Control

Provisions for the timely collection and controlled receipt of all Quality Assurance records shall be established and implemented as part of the WID Records Management Program. The collection and receipt control system shall include the following:

- The use of a record transmittal form which identifies the records being transmitted per RIDS, the retention classification of the documents (i.e., permanent), retrievability coding, and the signature of the person who has reviewed the records for legibility and accuracy authorizing the transmittal of the records to the MRC.

- A check by the MRC of the records received to confirm agreement with those listed on the transmittal form. The transmittal form shall also be checked for completeness by MRC personnel.

- Provisions for Records Operations to monitor the submittal of those Quality Assurance records being generated and retained by cognizant departments or sections to ensure that such records are being submitted upon completion to the MRC as identified in RIDS.

3.5 Storage, Preservation, and Safekeeping of Records in the MRC

Prior to the storage of records, the MRC shall prepare written storage instructions that include the assignment of responsible persons for enforcing the requirements of the instructions. In addition to those requirements outlined in 3.3, the procedure shall include, as a minimum, the following:

- A description of the storage facility

- The filing system to be used

- A method for verifying that the records received are in agreement with the transmittal document and that the records are legible

- A method for verifying that records are those designated

- The rules governing access to and control of the files

- A method for maintaining control of and accountability for records removed from the storage facility

- A method for filing supplemental information and disposing of superseded records

3.6 Retrieval of Records

The WID Records Management System shall provide for the timely retrieval of records. Records maintained by a manufacturer shall be accessible to the buyer for the designated retention period for the specific records involved. The specific methods used by the MRC to accomplish the accurate and timely retrieval of Quality Assurance records shall be included in the WID records management procedure.

3.7 Disposition of Quality Assurance Records

Provisions for the disposition of records by the MRC shall include, as a minimum, the following:

- o The disposition of the actual hard-copy records received by the MRC from the various organizations after such records have been officially processed (e.g., microfilmed, etc.) into the MRC.
- o Records in the MRC after they have been retained for their specified retention period.

4.0 RESPONSIBILITIES

4.1 Department Managers

4.1.1 WID Department Managers are responsible for taking action to generate and maintain Quality Assurance records for the quality-related activities performed under their cognizance.

4.1.2 WID Department Managers are responsible for assigning a Records Coordinator to establish and implement the actions necessary, within their respective organization, to achieve compliance with the requirements of this section. The actions required will include, as a minimum:

- o Identifying all Quality Assurance records in their possession
- o Performing periodic reviews of their Quality Assurance records to identify those Permanent records which have been completed and submitting these completed records to the MRC for microfilming and disposition. The review should include provisions for making necessary amendments to existing records
- o Providing for protection of records while in storage

4.2 Project Services/Records Operations

4.2.1 Project Services is responsible for administering the requirements of this section as a part of the overall records program.

4.2.2 Records Operations has the responsibility for the preparation and issuance of an implementing WID procedure for the overall control of all WID records. The procedure must be adequate to ensure full compliance with the requirements of this section in order to be in accordance with the requirements of ANSI/ASME NQA-1 and Supplement 17S-1.

4.2.3 Records Operations has the responsibility for the establishment and continued operation of an MRC for the collection and controlled storage of all Quality Assurance records generated by the WID, or by their suppliers and subcontractors, as identified on RIDS.

4.2.4 Records Operations will establish a scheduled reminder system to alert involved managers for the need to submit records to the MRC, based on RIDS implementation.

4.3 Purchasing

Procurement documents issued by Purchasing shall contain appropriate requirements for Quality Assurance records. The specific requirements will be determined during the review/approval process for each procurement action. In addition, Purchasing is responsible for obtaining records from suppliers, as required.

4.4 Quality Assurance

4.4.1 Quality Assurance has the responsibility to review procedures generated within the WID to ensure compliance with the record requirements, including records to be generated, retention times, storage methods, and identification.

4.4.2 Internal audits shall be performed by Quality Assurance to assess that the various organizations within the WID are operating in compliance with applicable requirements related to control of Quality Assurance records.

5.0 ATTACHMENT A - Quality Records System

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QUALITY RECORDS SYSTEM

WID RECORDS PROGRAM	BASIC ADMINISTRATIVE FUNCTIONS	RESPONSIBILITY
Preparation	o Take action to generate and maintain quality records	Cognizant Organization
	o Prepare/update RIDS	Cognizant Organization
Identification	Appointment of Department Records Coordinators	Cognizant Organization
	o Identify by appropriate methods (e.g., notation on file index or file folder) documents that are quality records	Cognizant Organization
Filing and Protection	o Develop file system	Cognizant Organization
	o Maintain files and provide necessary protection	Cognizant Organization
Processing	o Periodically review files and determine if completed record has been submitted via other systems and if so, determine need for additional processing	Cognizant Organization
	o Prepare record transmittal document and submit records to Records Operations	Cognizant Organization
	o Receive and verify records	Records Operations
	o Provide interim storage	Records Operations
	o Microfilm record	Records Operations
	o Amend records as required	Cognizant Organization
Transfer and Disposition	o Send duplicate of record to offsite Federal records location and dispose of original document(s) in accordance with the established project procedure for records management	Records Operations
Retrieval	o Provide required retrieval upon request	Records Operations
Control	o Conduct follow-up with WID organization to ensure submittal of completed records as identified in RIDS	Records Operations
	o Conduct periodic audits to assess the overall Quality Records System	Quality Assurance

WESTINGHOUSE WASTE ISOLATION DIVISION QUALITY PROGRAM MANUAL	WP-QPM Section No. XVIII Rev. 8 Effective Date 04/29/88 Superesedes: QPM XVIII No. Rev. 7 Date 12/01/86

Subject: AUDITS

1.0 SCOPE

This section establishes provisions and responsibilities for quality assurance-type audits performed by the Waste Isolation Division (WID). The audits are conducted to evaluate the effectiveness of the implementation of procedures and practices in areas including design, procurement, construction, installation, turnover inspection, acceptance testing phases, operations and waste certification.

2.0 GENERAL REQUIREMENTS

Quality Assurance shall establish and implement a program to conduct internal audits and external audits of the Waste Isolation Division, as required. In addition, Quality Assurance participates in audits of other Major Project Participants, Waste Generators/Shippers, and waste carriers. The purpose of the audits are to verify compliance with important aspects of the Quality Assurance Program and determine the effectiveness of implementation of the program in order to be in accordance with the requirements of ANSI/ASME NQA-1, Supplement 18S-1, and 10 CFR 71, Subparts G and H, as applicable.

2.1 The major characteristics of the WID internal audit program are outlined below.

2.1.1 Audits are scheduled on a regular basis. The schedule is designed to be flexible to provide for audits of quality-sensitive and suspected problem areas.

2.1.2 Audits will cover WIPP activities and will be based upon a documented audit plan that identifies the specific activities to be audited, the requirements upon which the audit is based, the team members, and the lead auditor.

2.1.3 Notification is given to the responsible management of the work activity to be audited. Responsible management will be advised of the audit, the audit team members, and the audit date.

Approved: WID Quality Assurance Manager	Prepared By:

2.1.4 Audit checklists are used for itemizing areas to be audited and resulting observations.

2.1.5 Preparation of audit checklists and the orientation of team members is the responsibility of the lead auditor.

2.1.6 A pre-audit meeting is held with the management personnel responsible for the audited activities.

2.1.7 A post-audit discussion of audit findings is held with the management personnel responsible for the audited activities.

2.1.8 Audit findings are documented in an audit report which is distributed to responsible management.

2.1.9 A response is required from the management responsible for the activity audited indicating the corrective action taken, or to be taken (including schedules), to preclude recurrence of audit findings.

2.1.10 An evaluation of the adequacy of the responses and follow-up is made by Quality Assurance to ensure implementation of corrective action.

2.1.11 A follow-up review of implementation of corrective actions on previous audit findings is made.

2.1.12 Audits are closed out when all findings are resolved and follow-up actions are completed.

2.2 External audits shall, in general, include the same characteristics as indicated above.

2.3 The lead auditor shall be a trained and qualified auditor. Specific requirements and procedures for auditor training and qualification, as well as the various types of audits conducted by the WID, are detailed in WID procedures. Qualification requirements for WID lead auditors are specified in applicable WID procedures.

2.4 The effectiveness of the overall Quality Program is measured, in part, by the internal audit program. Therefore, an assessment of the internal audit program is conducted periodically and, if adjudged inadequate, adjusted to increase the effectiveness thereof. The assessment may be performed by WID Quality Assurance or by Westinghouse external organizations, as optioned by the Manager, WID Quality Assurance. Internal audit reports are distributed to the WID General Manager providing an assessment of the quality related subjects and areas audited.

2.5 Any significant (see WP-QPM XVI) findings detected during an internal audit shall be reported to the DOE WIPP Project Office.

3.0 RESPONSIBILITIES

3.1 WID Quality Assurance

3.1.1 Quality Assurance is responsible for audit scheduling, notification, audit team selection, conduct of the audit, reporting, follow-up of audit responses and closeout of audit findings.

3.2 WID Departments

3.2.1 Other WID departments are responsible for providing technical personnel to serve as auditors on an as-needed basis.

3.2.2 Cognizant management is required to formulate a written response to audit findings indicating corrective action taken, or to be taken, to preclude recurrence of deficiencies. This response shall also indicate a proposed date of completion for corrective action.

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APPENDIX F

WATER QUALITY SAMPLING PLAN

The Water Quality Sampling Manual (WP 7-2, Rev. 1) supports the hydrologic site characterization program at the WIPP facility. Site characterization activities are conducted in accordance with program plans and task-specific procedures which specify the scope, quality objectives, quality requirements, and methods to be used to perform water sampling tasks and to ensure that quality objectives are met.

OCTOBER 1987

WASTE ISOLATION PILOT PLANT
WATER QUALITY SAMPLING MANUAL
WP 7-2
REVISION 1

Cognizant Section: Geotechnical and Geosciences

Approved by:



LIST OF REVIEWERS

Procedure Number: WP 7-2

Revision Number: 1

Procedure Title: Water Quality Sampling Manual

Reviewer's Name	Department
R. Kehrman	W - Env.
R. Youngman	W - QA
K. Robinson	S.N.L.
M. Schulz	I.T. - QA
M. Crawley	I.T. - GGS
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WATER QUALITY SAMPLING PLAN

WP 7-2

Revision 1

1.0 INTRODUCTION

This document presents the plan for the collection of water quality samples from wells in the vicinity of the Waste Isolation Pilot Plant (WIPP) site (Figure 1-1), under the Water Quality Sampling Program (WQSP). The objective of the sampling program is to obtain representative and repeatable groundwater quality data from selected wells under rigorous field and laboratory procedures and protocols. At each site, a well is pumped and the groundwater serially analyzed for particular field parameters. Once the field parameters have stabilized--denoting a chemical steady-state with respect to those parameters analyzed--a final groundwater sample is collected.

Approximately 24 wells are to be sampled during the baseline study years by the Management and Operating Contractor (MOC) of the WIPP Project. These wells are listed in Table 1-1. The generalized stratigraphy of the WIPP site is shown in Figure 1-2. Of the 24 wells expected to be pumped and sampled, 20 of these wells will produce water from the Culebra Dolomite; four of the wells will produce water from the Magenta Dolomite. These 24 wells have been selected because of their areal coverage of the WIPP site, type of well completion, and flow rate--these factors increase the likelihood of obtaining representative water samples.

The WQSP is being conducted by the DOE-WIPP MOC. Groundwater samples collected as part of the WQSP will be used in several different WIPP-related studies. These studies include the DOE's environmental, radiological, and performance assessment programs. The field and laboratory procedures developed for this program draw on a variety of past experiences in sampling wells near the WIPP site. In addition, the resources and scientific expertise of the MOC and Sandia National Laboratories (SNL) are being combined to assure an effective and technically sound program.

The WQSP is designed to coordinate the activities of the MOC in an efficient manner, and to assure that samples are collected in a consistent and repeatable fashion throughout the duration of the sampling and analyses program. The WQSP Plan is divided into four sections. Section 1.0 provides an overall introduction to the WQSP. Section 2.0 details the groundwater pumping and sampling systems performed in the field, and explains the concepts on which these procedures and techniques are founded. Section 3.0 presents an overview of the sample collection procedures and techniques. Section 4.0 outlines the Quality Assurance and Quality Control (QA/QC) procedures which will be adhered to in strict accord by all participants of the WQSP. Attachment A presents a general overview of the subprogram for collection of samples from private wells.

All DOE sites are required, by DOE Order 5480.2, to monitor groundwater in accordance with the requirements of either 40 CFR 264 or 265. Groundwater

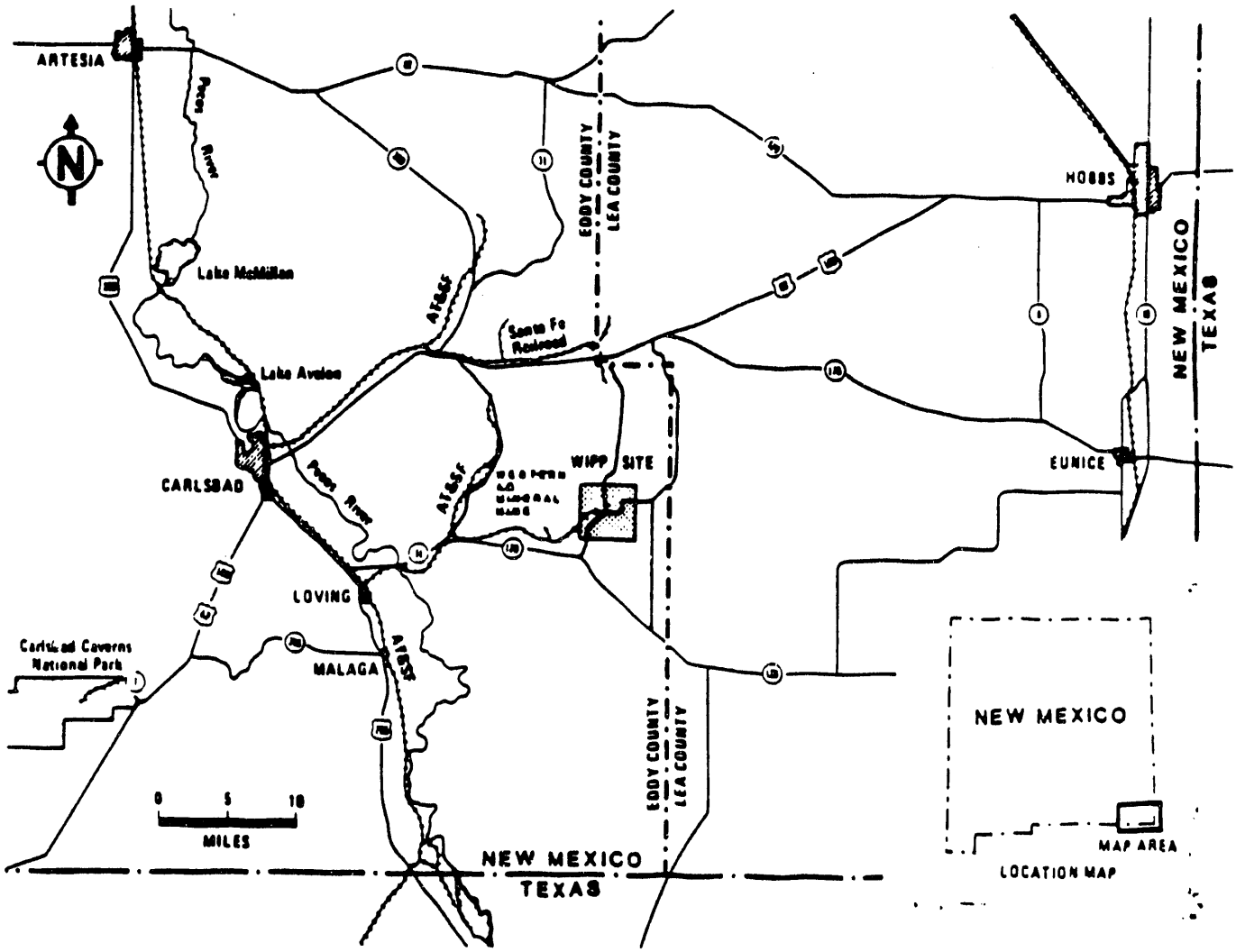

Figure 1-1. Location of the WIPP Site

Table 1-1

LONG-TERM SAMPLING SCHEDULE

Well Name	Zone *	Type of Samples** SNL	RBP	EM	Long-Term Schedule 85-93	94-2013
H-1	C	X	X	X	X	X
H-2a	C	X	X	X	X	X
H-3b3	C	X	X	X	X	X
H-3b1	M	X	X	X	X	X
H-4c	M	X	X	X	X	
H-4b	C	X	X	X	X	X
H-5b	C	X	X	X	X	X
H-5c	M	X	X	X	X	
H-6b	C	X	X	X	X	X
H-6c	M	X	X	X	X	
H-7b1	C	X	X	X	X	
H-8b	C	X	X	X	X	
H-9b	C	X	X	X	X	
H-11b3	C	X	X	X	X	X
H-12	C	X	X	X	X	
H-14	C	X	X	X	X	
H-15	C	X	X	X	X	
P-14	C	X	X	X	X	X
P-17	C	X	X	X	X	
DOE-1	C	X	X	X	X	
DOE-2	C	X	X	X	X	
WIPP-19	C	X	X	X	X	X
WIPP-25	C	X	X	X	X	
WIPP-26	C	X	X	X	X	

*C - Culebra, M - Magenta

**SNL - Sandia Site Characterization Sampling
RBP - MOC Radiological Baseline Program Sampling
EM - MOC Environmental Monitoring Samples (Baseline Parameters)

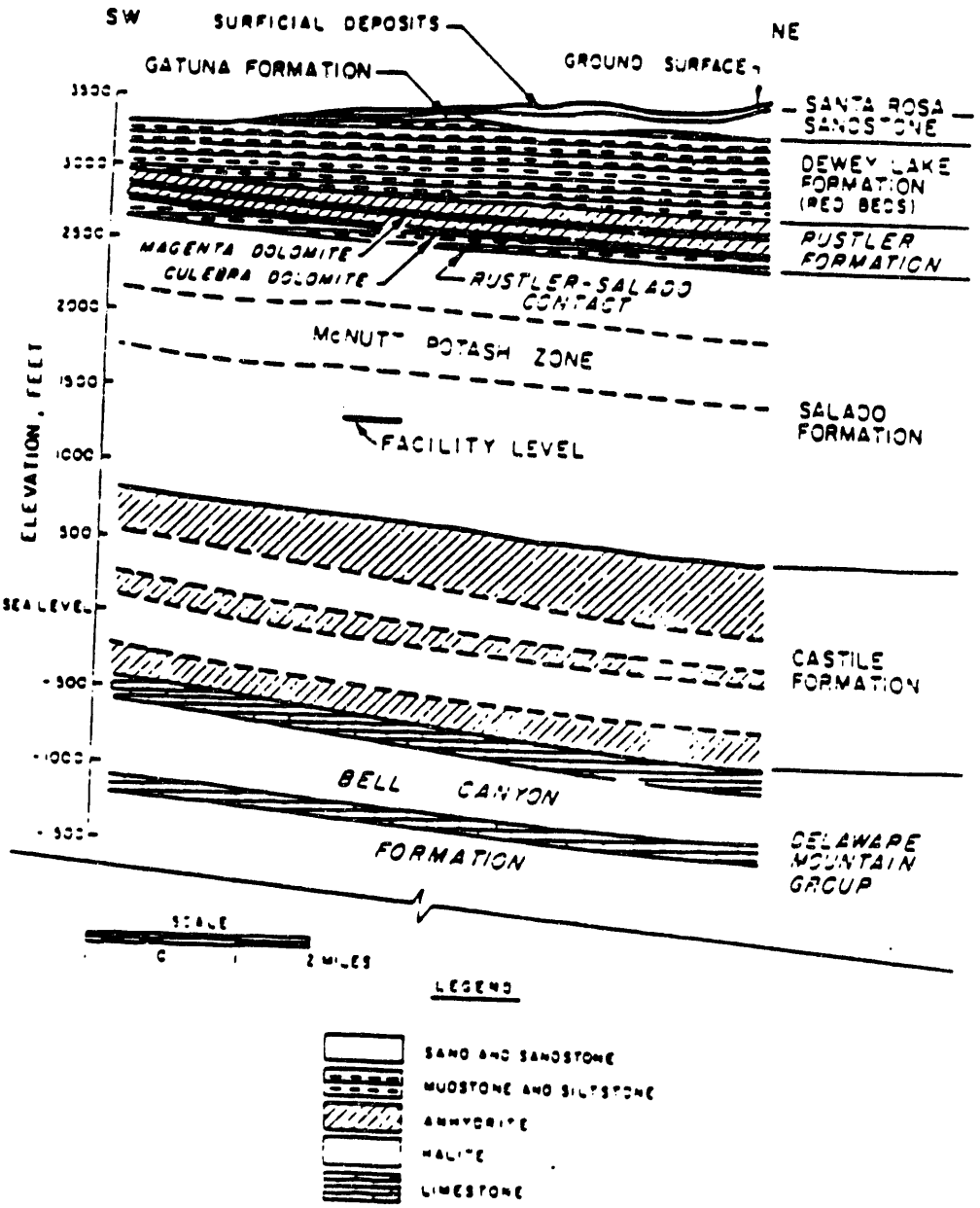

Figure 1-2. Generalized Stratigraphy of the WIPP Site

monitoring will be conducted to determine physical and chemical characteristics of pollutants known to be or suspected of entering groundwater, physical and chemical characteristics of potentially affected groundwater, groundwater movement and rates, and present and future uses of groundwater.

The WQSP will provide the basis for continued pre-operational and operational groundwater monitoring for the WIPP Project. Water quality data procured through this program will be used to support the various long- and short-term scientific programs at the WIPP. Table 1-1 presents those wells which will be sampled throughout this long-term program. Annual data summaries of the WQSP program will be issued in 1988, and during succeeding years, in an effort to insure that the results of the program are identified, reported, and that alterations to the WQSP are documented.

2.0 DESCRIPTION OF THE GROUNDWATER PUMPING AND SAMPLING SYSTEMS

The groundwater pumping and sampling systems for each site are designed to provide continuous and adequate production of water so that a repeatable groundwater sample can be obtained. The 24 wells listed in Table 1-1 vary in flow rate, production interval depth, and pumping lift. These factors affect the duration of pumping and the equipment required at each well. The wells can be placed into three categories, based upon their expected flow rate:

- o High, 10 to 25 gallons per minute (gpm)
- o Medium, 1 to 10 gpm
- o Low, less than 1 gpm

The high and medium flow rate wells may utilize a submersible pump, downhole packer, a main discharge line, and a sample discharge line. The low-volume wells require a gas-driven piston pump capable of varying the flow rate from 0.1 to 1.0 gpm. The gas-driven pump is composed of inert materials (which should minimize contamination) and offers a single discharge line. A discussion of the different pumping systems, sample collection equipment, and the field water quality laboratory is provided in the following sections.

2.1 Pump and Sampling System for Medium- to High-Volume Wells

The pump and sampling system for medium- to high-volume wells utilizes an electric submersible pump. The pump is set in the production zone and is isolated from stagnant well casing water above or below (or both) by a straddle packer and/or bridge plug combination. The expected pumping lift is between 150-900 feet. The general procedure is to install the pump, packer, and sampling assembly in the well and then set (inflate) the packer(s).

A general diagram of the submersible pump and sampling system is shown in Figure 2-1. The major components of the submersible pump and sampling system are the following:

a. Electric submersible pump

b. Air-inflatable packer and packer inflation line

c. Main discharge line and system support pipe

d. Nylon sampling line for collection of all water quality samples

e. Pressure monitoring systems above and below the packer

f. One or three-phase power cable

g. Surface-mounted flow regulating valves and flow meters for the main discharge and sample lines

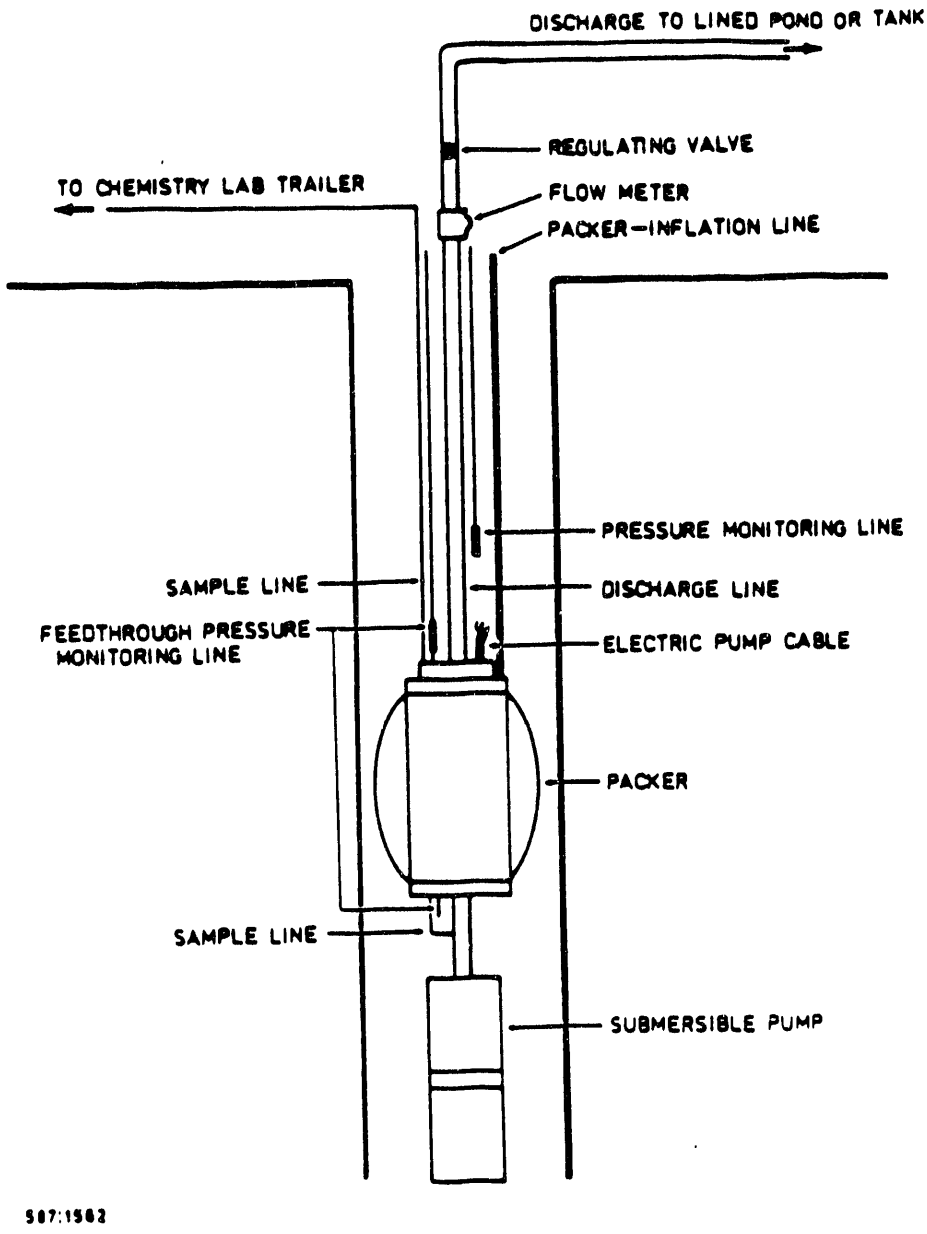

Figure 2-1. Downhole Pump, Packer, and Sampling System

h. Surface readout equipment for pressure monitoring

i. Bottled gas and pressure-regulating equipment for inflating the packer

The main discharge from the submersible pump is via a pipe that passes through the center of the packer to the surface. Flow is regulated by a ball or gate-type valve at the surface and cumulative flow is measured using a totalizing turbine flow meter. To avoid potential contamination from the metal discharge line, a separate sampling line is used. As shown in Figure 2-1, the sample line branches off from the main discharge line just above the pump. The sample line passes through the packer, to the surface, and into the mobile field laboratory. Flow from the sample line entering the mobile field laboratory is regulated by a flow control valve. The sample line and well head are insulated to minimize temperature fluctuations. In addition to the main and sample discharge lines, the electrical power cable and pressure monitoring tube are also fed through the packer.

During pumping, the pressure below the packer may fluctuate in response to the pumping. The pressure above the packer should remain constant if the packer is properly seated and not leaking. Periodic checks of pressures are conducted during field sampling to verify packer seal integrity.

2.2 Pump and Sampling System for Low-Volume Wells

The pump and sampling system for low-volume wells uses a gas-driven piston pump, with the pump intake set at a predetermined depth near or in the production zone (Figure 2-2). The low-volume wells are purged, as needed, prior to installation of the low-volume pumping system. The pumping rate is adjusted to maintain the water level in the well above the pump intake. The expected pumping lift will be 400-900 feet.

For the low-volume wells, the total volume of the water discharged is routed directly from the well to the mobile field laboratory for sample collection and operation of the constant temperature bath. The flow rate is monitored periodically. A packer may be used if, in the opinion of the task leader, it is necessary to prevent mixing of the stagnant wellbore fluid with water being drawn from the water-bearing zone. If a packer is necessary, the pressure above and below it is monitored to detect leakage, as discussed in Section 2.1. A schematic diagram of the gas-driven piston pump is shown in Figure 2-2. Note that the packer is not shown in Figure 2-2.

2.3 Pump System Operation

Continuous pumping for sample collection is started after all equipment has been installed and a system audit has been performed and completed. The flow rate is maintained at as constant a rate as possible. For high- to medium-volume wells, the flow rate is controlled by applying back pressure with the flow control valve at the surface. For low-volume

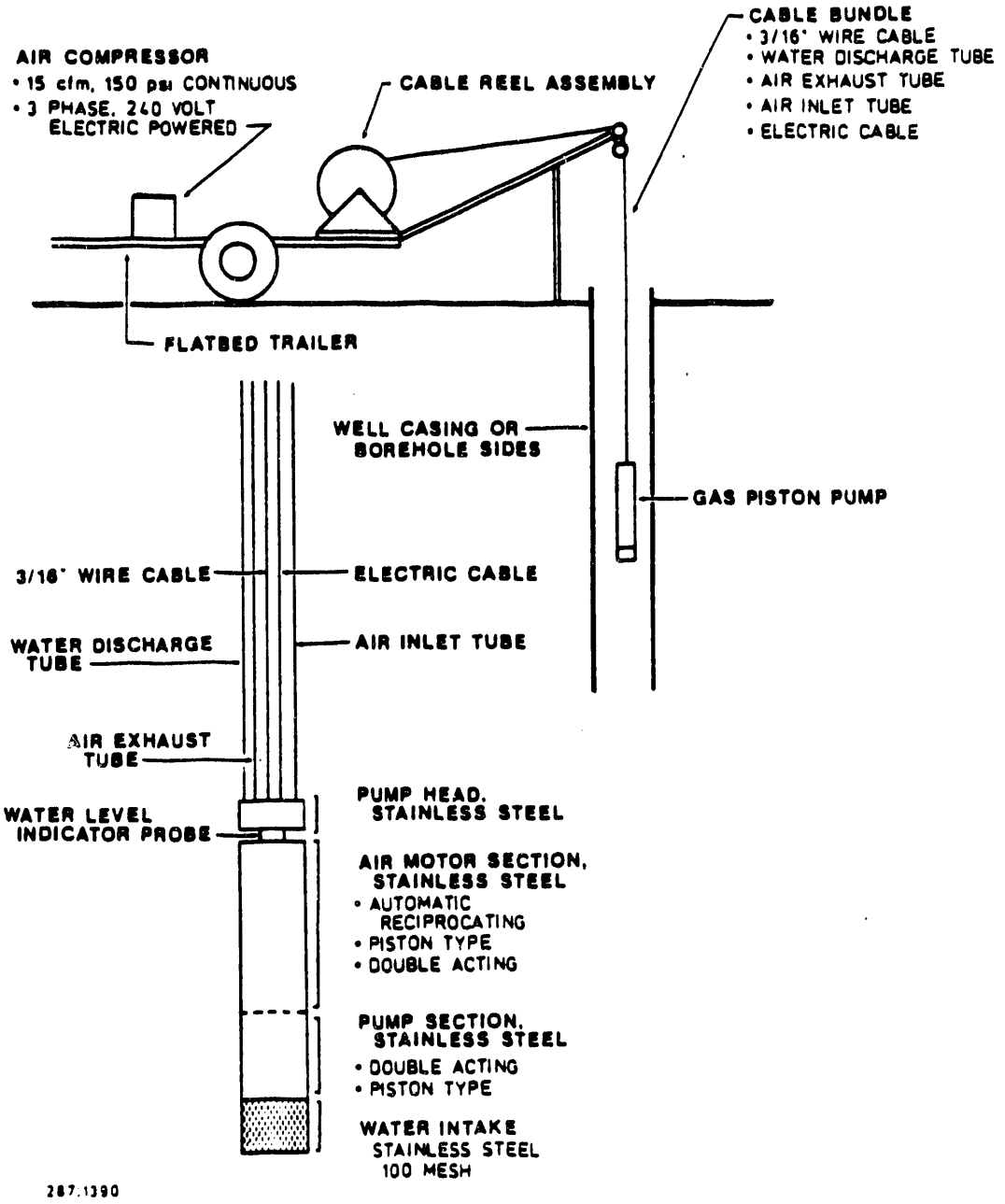

Figure 2-2. Schematic of Gas Piston Pump (Bennett Model 1800) with Exploded View of Cable Bundle

wells, the flow rate is controlled by regulating the air pressure on the gas piston pump. Water is continuously discharged into a lined pond or a water storage tank from the main discharge line and the sample line.

Flow rates and pressures are recorded in the hydrology field notebook concurrent with the serial samplings. Flow rate fluctuations, power surges, and all other disturbances to the operating performance are explained and/or noted in the field log.

2.4 Field Laboratory Trailer

The field laboratory trailer is used to conduct field sampling and analyses. The laboratory is located near the well, is climate-controlled, and contains the necessary equipment, reagents, glassware, and deionized water for conducting the various analyses.

A plan view of the sampling system and the field laboratory trailer is shown in Figure 2-3. The basic components are the following:

a. Constant temperature water bath and sample discharge lines
b. Sample line and water bath control valves
c. Sample collection and filtering equipment
d. Digital spectrophotometer
e. Fume hood and chemical resistant work area
f. Work stations for various analyses and titrations
g. Storage, supplies, and water deionizer

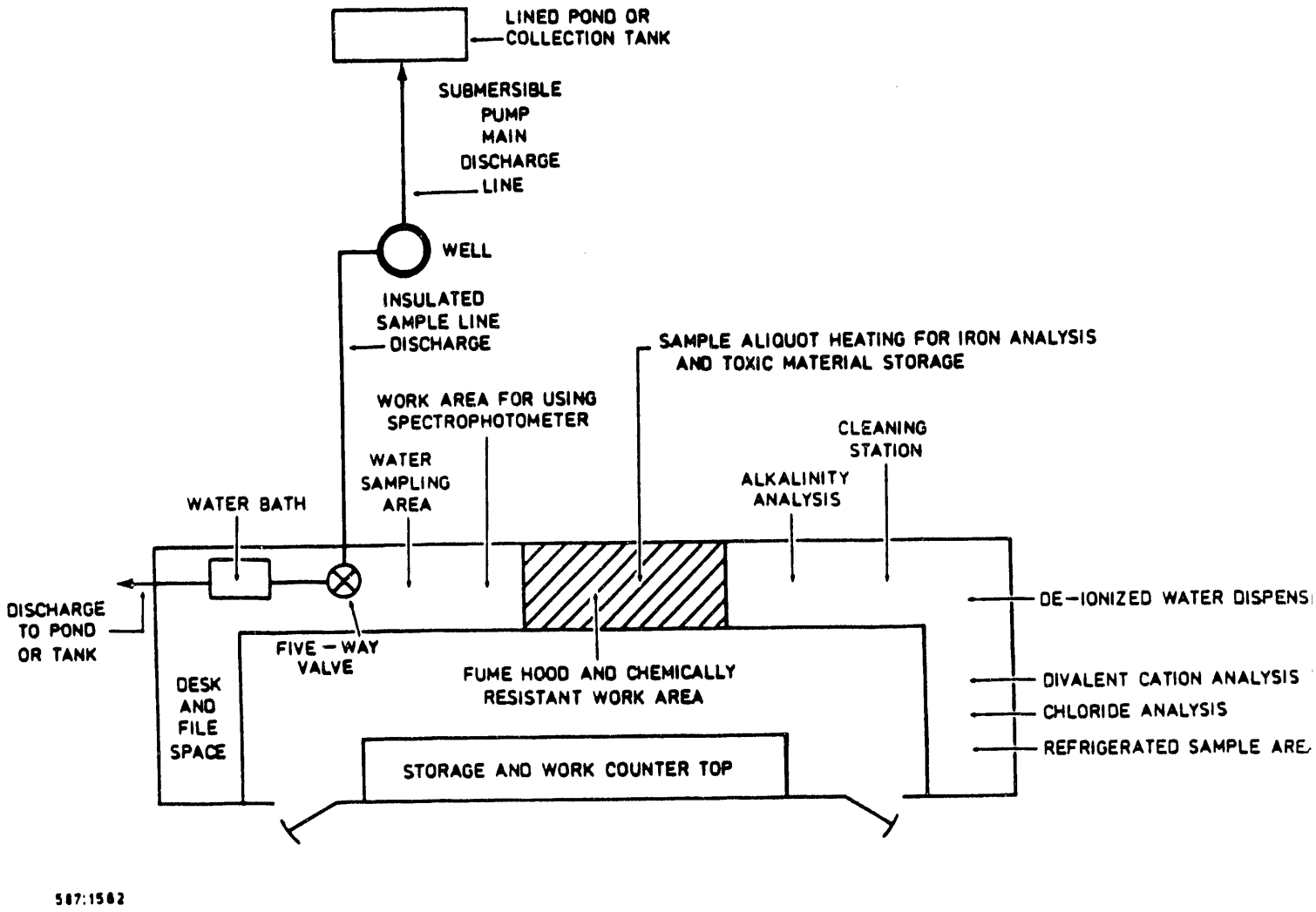

Figure 2-3. Plan View of Sampling System and Mobile Field Laboratory Trailer

3.0 SAMPLE COLLECTION

Two water sample types are collected at each WIPP well: 1) serial samples and 2) final samples. Serial samples are taken from the pumped groundwater at regular intervals, usually one per day, and analyzed in the mobile field laboratory for various physical and chemical parameters (herein called field parameters). The field parameter data obtained from serially sampling the pumped groundwater over a period of time provides the task leader with information on the chemical steady-state conditions of the groundwater, as a direct function of the purged groundwater volume. Interpretation of the serial sampling data enables the task leader to make an onsite determination of when steady-state chemical conditions are attained in the pumped groundwater.

The final samples are collected for both field and laboratory analyses when the serially sampled field parameters measured in the pumped groundwater have stabilized (i.e., attained a chemical steady-state). If, however, one or more of the field parameters does not stabilize--and there is reason to believe it never will (for instance, there may be a natural chemical variation in the groundwater through time)--the task leader may choose to collect the final sample regardless of this instability in the field parameter(s).

All field activities related to the collection of the final water sample are documented. Each analysis performed in the field laboratory is recorded on serial sampling data sheets which identify the analyst, the resultant data, the analytical procedure and the reagents used, general comments, and the date and time of analysis. In addition to the data sheets, a chemistry notebook is maintained in the mobile field laboratory to record the overall conditions at the well, the analytical difficulties or problems experienced, and any information which may be pertinent to future interpretation and scientific use of the field data. For each well, the serial sampling data sheets and copies of the pages of comments from the field notebook are compiled at the completion of final sampling. Two photocopies are made of the entire compilation--one to be filed in the MOC Geosciences office and one to be filed with SNL. The original compilation, along with the laboratory analyses of the final sample, is filed at the MOC Master Records Center (MRC) at the completion of each phase of the program.

Documentation, in the form of data sheets and notes from the field notebook from each sample analysis, is expected to highlight the inherent limitations unique to each chemical analysis. A sample can be representative for one constituent, but not for another. This condition is borne out by the fact that--during serial sampling, for example--iron stabilized with time, while alkalinity did not. In this instance, caution should be used when using this analysis in geochemical models and, in particular, when choosing bicarbonate and carbonate concentrations. Documentation should alleviate instances where chemical data are applied to a specific problem in an indiscriminate fashion, producing unfounded and misleading results and interpretations. The documentation procedures implemented in this water quality sampling program should provide information essential to the prudent use and application of a particular chemical analysis, whether that use is practical or theoretical.

The objective of this WQSP is to obtain representative water samples in a reproducible manner so that, if present, temporal variation in the groundwater composition will be documented. As stated in Section 1.0 and presented in Table 1-1, many of the wells will be resampled a minimum of four times in the next five years. Long-term projections indicate that a number of these wells will be sampled more than four times; however, the specific wells chosen for long-term sampling (and the sampling frequency) are not defined in the strictest sense and may change as dictated by data generated in the field. An expectation of this program is that it will be possible to interpret the short- and long-term sampling data, and to discern sampling and analysis reproducibility and uncertainty from the real and natural and/or induced chemical variation in the formation water.

3.1 Serial Samples

Serial samples of the pumped groundwater are collected and analyzed in the mobile field laboratory to detect and monitor the chemical variation of the groundwater. The purpose of implementing this rigorous serial sampling and analysis program is to ascertain when the pumped groundwater has reached a chemical steady-state. Once serial sampling begins, the frequency at which serial samples are collected and analyzed for the various field parameters is left to the discretion of the task leader. The serial sampling frequency is based upon the site-specific conditions existing at each well.

The field parameters to be determined in the field during serial sampling, and the approximate frequency at which they are analyzed, are as follows:

Field Parameter	Approximate Frequency
Temperature	Daily
pH	Daily
Eh	Daily
Iron (total and ferrous)	Daily
Divalent cation	Daily
Chloride	Daily
Alkalinity	Daily
Specific Conductance	First and Final Serial Sampling
Specific Gravity	First and Final Serial Sampling

The three field parameters of temperature, Eh, and pH are determined by either an "in-line" technique, using a self-contained flow cell, or an "off-line" technique, in which the samples are collected from a nylon sample line at atmospheric pressure. The iron, divalent cation, chloride, alkalinity, specific conductance, and specific gravity samples are collected from the nylon sample line at atmospheric pressure.

3.1.1 Serial Sample Collection

New polyethylene containers are used to collect the pumped water flowing from the nylon sample line. Serial sampling water collected for solute and specific conductance determinations is

filtered (0.45 μm filter membrane) utilizing a stainless steel in-line filter holder. Filtered water is used to rinse the sample bottles six times prior to serial sample collection. Unfiltered groundwater is used when determining temperature, pH, Eh, and specific gravity. Sample bottles are properly identified and labeled, according to Section 3.6.2.

The filtered sample collected for solute analyses is immediately analyzed for both iron (ferrous and total) and alkalinity, as these two solution parameters are extremely sensitive to changes in the ambient water sample pressure and temperature. The sample aliquots needed for the other chemical parameter analyses may be taken from a second filtered sample bottle. Temperature, pH, and Eh--when not measured in a flow cell--are measured at the approximate time of serial sample collection; these samples are collected from the nonfiltered sample line.

Experience gained from the serial sampling of wells has shown that samples to be analyzed for chloride and divalent cations can be stored for up to one week prior to analysis with confidence that the analytical results will not be altered.

Upon completion of the collection of the final sample suite, the serial sample bottles accrued throughout the duration of the pumping of the well may be discarded. No serial sample bottles will be reused for sampling purposes of any sort. However, serial samples may be archived for a period of time depending upon need.

3.1.2 Serial Sample Analysis

The analytical procedures and methods used in this sampling program to determine the field parameters are presented in the Water Quality Procedure Manual, WP 07-2. Included in this manual for each of the field parameters are references, a detailed summary of the methods, the reagents used in the procedure, the equipment needed, and calibration or standardization procedures (or both).

All serial sampling analytical data derived in the mobile field laboratory are recorded on the serial sampling forms, as shown in this document. For a detailed explanation of the documentation procedures followed in this WQSP, see Section 3.6.

3.2 Obtaining A Representative Groundwater Sample

The final groundwater sample is collected once evidence from the serial samples indicates that the pumped groundwater has reached a chemical steady-state (i.e., the field parameters have stabilized). This final sample is then considered to be as representative a sample of the undisturbed groundwater as can possibly be obtained considering the analytical and technical means at hand. The determination of a chemical steady-state is based upon the stabilization of the selected field parameters, presented above in Section 3.1. These field parameters are chosen not

only on the merit of their sensitivity to fluctuations in the bulk groundwater composition, but also because it is anticipated that these parameters are capable of being measured to a relatively high degree of accuracy and precision in the field. The physical and chemical state of the groundwater will be periodically monitored by analyzing for these field parameters.

3.2.1 Definition of a Representative Sample

The final groundwater sample is considered to be representative of the undisturbed groundwater only if it is chemically identical to the groundwater (i.e., completely unaltered by the effects of drilling, post drilling processes and reactions, and sampling procedures). The redox potential of the aquifer groundwater, Eh, is likely to change as a result of the decreased pressure (gas loss) and contamination by atmosphere oxygen. The ratios between the different oxidation states of a multi-valent element may change, and the total concentration of that element also may change due to precipitation.

The concept of a representative water sample is a theoretical ideal. Although in most cases this ideal is unattainable, it is nevertheless the standard toward which this sampling and analyses program strives.

3.2.2 Determination of Sample Representativeness

The determination of the representativeness of a groundwater sample can be based upon repeated sampling of each well.

3.2.2.1 Groundwater Contamination

Experience has shown that, at the onset of pumping, the chemical state of the pumped groundwater is highly variable. Field parameters such as chloride, divalent cations, alkalinity, and iron have been known to oscillate around a mean concentration and/or to decrease or increase in concentration with time. These chemical variations in the pumped groundwater may be attributed to a variety of processes such as 1) the mixing of undisturbed groundwater with stagnant and corrosion-contaminated well-casing water; 2) the mixing of undisturbed groundwater with contaminants added during drilling operations at the well (e.g., brine, greases, acid, and diesel fuel); 3) the chemical interaction between undisturbed groundwater and the downhole pump and sampling system; 4) acidification to increase permeability of the production zone; and 5) natural variations in the undisturbed groundwater chemistry.

Processes 1 through 4 result from perturbations imparted to the undisturbed system by drilling and testing operations, the impact of which must be detected and monitored. Process 5, a natural fluctuation in the groundwater, if present, must be distinguished from the first four processes if confidence is to be placed in the analytical results obtained from the final water sample.

Processes 1, 2, and 4 are capable of producing downhole contamination plumes within an aquifer. The plume created by process 1 can be expected to develop and enlarge with time. This is because the well casing offers a relatively large source of contamination. This is not the case for processes 2 and 4, whereby once the contaminants are added, and the plume created, the contaminant concentration in the plume should decrease and become diluted with time. In this case, the change in the contaminant concentration within the plume is a function of the elapsed time between contamination and final sampling. It is also a function of the hydrologic properties of the water-bearing zone (e.g., the higher the transmissivity, the faster the plume becomes diluted).

Process 3 is controlled by the materials from which the downhole pump and sampling system are made. Therefore, if both the type of assembly and the configuration of the pump and sampling system are used judiciously, the contaminant contribution from this source can be controlled, if not eliminated. Lastly, for process 5, the natural variation in the aquifer groundwater chemistry might be the most difficult of the groundwater variations to discern. However, the longer the hole is pumped, the more likely natural chemical variation in the groundwater will be noticed.

Presented below are three criteria by which the chemical variations in the pumped groundwater and the particular processes responsible for the chemical variation might be discerned, despite the probability of their superimposed influences on the groundwater chemistry. First, the history of the well being pumped should be known (this includes knowing the different types of pump tests that were performed at the well and the various types of fluids which may have been pumped down the well). Second, the chemist should have an understanding of the dynamics of both the water-bearing zone/well casing system and the mineral/fluid equilibria system. Third, the chemist must have the analytical capability to monitor the selected compositional parameters of the groundwater.

3.2.2.2 Methodology

Confidently predicting that the pumped groundwater has indeed reached a representative state requires that a considerable amount of hydrologic and analytical work be performed in the field. To obtain a final water sample representative of the undisturbed groundwater conditions demands that all contaminants be removed. This may require that, prior to collection of the final water sample: 1) a large volume of downhole water be purged from the groundwater system; and 2) the experimental means be available to analyze in the field, as a function of time (volume of water purged), an array of inorganic elements and species for their stabilization in the water. As defined in this document, an element, species, or physical parameter is deemed stable when its concentration or quantitative value varies as a function of time only within the boundaries of the precision of the analytical techniques used to measure the parameter.

Ideally, the greater the number of elements and species analyzed in the field, the broader the chemical data base on which to judge the chemical steady-state of the groundwater. This increases the chemist's confidence in predicting whether the water being pumped is truly representative of downhole conditions. The number of elements and species analyzed in the field is constrained by the size and capacity of the mobile field laboratory.

Realistically, not all the elements and species of interest in the groundwater can be analyzed in the field. Those species and elements which are analyzed must then represent, as well as possible, the major chemical group constituents in the groundwater. The four chemical group constituents are 1) major cations and anions; 2) trace and minor solutes; 3) organic compounds; and 4) radionuclides. Unless all four chemical groups are represented by one or more of the selected field parameters in the serial sampling program, there would always be doubts as to whether the groundwater had stabilized with respect to all chemical groups. Those chemical group(s) not monitored for stabilization would be neglected at the time the decision is made to collect the final water sample. This situation would leave doubt as to how representative the final water sample is, and could result in a final water sample which, though stable with regard to the chemical groups monitored, is not stable with regard to the chemical groups not monitored.

On the other hand, even if all four chemical groups are represented in the steady-state serial sampling program, and all the field parameters appear to have stabilized, it is nonetheless impossible to state unequivocally that the final water sample is truly representative of the natural, undisturbed groundwater conditions. It is conceivable that what is being measured and construed to be representative of a steady-state groundwater condition is instead a steady-state chemical condition within a downhole contamination plume.

The field parameters presently being determined in the field represent two of the four chemical group constituents expected to be present in the groundwater. The two chemical groups not represented are the organic compounds and the radionuclide elements.

Chemical Group	Field Parameter
Major Cations and Anions	Chloride, Alkalinity, Divalent Cations (Calcium and Magnesium)
Trace and Minor Solutes	Iron
Organics	None
Radionuclides	None

At present, no effort is being directed towards the field monitoring of radionuclides or organics. However, final samples are analyzed for organics and radionuclides at the contracted laboratory.

Pertinent to this WQSP is the volume of water that must be purged from the downhole system before a representative water sample is obtained. It is also important to determine if a representative sample is indeed obtained, and how it can be distinctly recognized. These are a few of the major questions the chemist confronts when collecting both serial and final groundwater samples. The WQSP is designed to address these questions and contribute to a solid, defensible water quality chemistry data base at the WIPP.

3.3 Final Samples

The final sample is collected once the pumped groundwater has achieved, in the scientific judgment of the task leader, a chemical steady-state. The final field parameter analyses for each well are performed during collection of the final sample. Sample preservation, handling, and transportation methods are designed to maintain the integrity and representativeness of the final samples.

3.3.1 Field Parameter Analyses

During collection of the final sample, a serial sample is collected and analyzed. The collection and analysis of this final serial sample can be performed either prior to or after the collection of the final sample. There are instances, however, where the final sampling takes two days to complete--due to the slow flow rate at the well. Under these circumstances, two separate serial samples are collected and analyzed: one the first day, and one on the last day of final sampling.

The field parameters analyzed are the same as those analyzed throughout the serial sampling program at the well, with the addition of two field parameters:

Specific Conductance
Specific Gravity

The analytical field procedures used for the determination of these field parameters can be found in the Water Quality Procedure Manual. The data derived from the field parameter determinations are documented and recorded on the field data sheets (Section 3.6.5).

3.3.2 Samples Collected for Laboratory Analyses

Water samples are collected at the surface (at both atmospheric and in-line pressure). A list of parameters to be analyzed by the MOC contracted laboratories can be found in Table 3-1. Two water sample collection techniques are to be utilized: 1) flow line collection of samples under atmospheric pressure and 2) uphole collection of water samples in bombs under in-line pressure.

3.3.2.1 Flow Line Sample Collection

Water samples are collected at atmospheric pressure utilizing either the filtered (0.45 μm filter membrane) or nonfiltered nylon sampling lines located off the main sample line, via the five-way valve (see Section 2.4, Figure 2-3). The samples are collected in new and unused glass and plastic containers. Prior to collection of the final sample, all metal and radionuclide sample bottles will have been acid-soaked with a 10% reagent grade Nitric Acid solution (1+9) for a minimum of 24 hours. The sample bottles are completely filled with the Nitric Acid (1+9) solution, capped, and allowed to sit. Before final sampling, the acid-soaked bottles are opened and the nitric solution poured from them into a similar set of sample bottles earmarked for the next well; the acid solution can be reused for up to six months. Immediately before the final water sample is taken, all plastic and glass containers are rinsed six times with the pumped

Table 3-1

FINAL SAMPLE ANALYTICAL SUITE

General Chemistry	Metals	Gases	Redox Couples	Radionuclides	Organics
Alkalinity	Aluminum	Argon	Ammonia	Am-243	Volatiles (Hazardous
Bromide	Antimony	Oxygen	Nitrate	Pu-242	substance list)
Chloride	Arsenic	Nitrogen	Total Iron	Am-241	
Cyanide	Barium	Carbon Monoxide	Ferrous Iron	Pu-241	Semi-volatiles
Fluoride	Beryllium	Carbon Dioxide	Arsenic (III)	Pu-239/Pu-240	(Hazardous substance
Iodide	Boron	Methane	Arsenic (Total)	Pu-238	list)
Nitrate	Cadmium	Ethane	Iodide	U-238	
pH	Calcium	C-3	Iodate	U-235	PCBs
Phenolics	Cesium	C-4	Selenium (IV)	U-234	
Phosphate, Total	Chromium	C-5	Selenium (Total)	U-233	
Residue, Filterable	Cobalt	C-6		Th-232	
Residue, Nonfilterable	Copper	Sum of CO_2		Th-230	
Specific Conductance	Iron	Total Gas		Th-228	
Sulfate	Lead			Ra-228	
Total Organic Carbon	Lithium			Ra-226	
Total Organic Halogen	Magnesium			Np-237	
	Manganese			Cm-244	
	Mercury			Pb-210	
	Molybdenum			Cs-137	
	Nickel			Co-60	
	Potassium			Po-210	
	Selenium				
	Silica				
	Silver				
	Sodium				
	Strontium				
	Thallium				
	Tin				
	Titanium				
	Zinc				

groundwater, either filtered or nonfiltered, depending upon which parameter suite the sample is analyzed for. Once the rinsing procedure is completed, the final sample is collected.

For each parameter analyzed, a sufficient volume of sample is collected to satisfy the volume requirements set forth by the analytical laboratories. This includes the additional volume of sample water necessary for maintaining quality control standards (Table 3-2).

Table 3-2 is an example of the final sample collection form used by field laboratory personnel. This table presents a detailed breakdown of the sampling protocol required for each individual parameter suite. Items within Table 3-2 are subject to occasional changes and modifications as requests from MOC contracted laboratories vary or new items are added to the Water Quality Sampling Program. The table includes

- Types, sizes, and numbers of the containers needed
- Filtered or nonfiltered requirements
- Sample preservation requirements, if any
- Water sample volume required for maintaining quality control

Samples requiring acidification are treated with either high purity nitric acid (ULTREX or equivalent) or sulfuric acid (ULTREX or equivalent), depending upon the standard method of treatment required for the particular parameter suite. Approximately 1 ml of acid is added to the first liter bottle of collected sample. The sample is agitated and the pH checked with pH paper. If the sample pH is above 2.0, another 1 ml of acid is added to the sample and its pH checked; this procedure is repeated until the sample pH is below 2.0.

This factor is used to add the proper amount of acid to each of the remaining sample bottles. For example, if it takes 2.0 ml of acid to lower the pH of one liter of sample to below 2.0, then 2.0 ml of acid is added to each remaining one liter bottles while 8.0 ml of acid is added to each four liter sample bottles. Those samples requiring basification are treated with NaOH (analytical reagent grade or equivalent), to ensure a pH greater than 12.0. NaOH pellets are used for the cyanide sample to ensure a pH of 12 and above.

Table 3-2

FINAL SAMPLES CHECKLIST

PROJECT NAME: WELL NUMBER:

PROJECT NUMBER: ZONE:

Sample Number	Parameters	Sample For	Destination	Containers Number	Containers Volume	Containers Type	Acid Wash	Sample Filter	Sample Preservative	Collection Date/Time
1	General Chem.	MOC	IT Pitts.	2	1 liter	Plastic	No	No	None	
2	Anions	MOC	IT Pitts.	2	1 liter	Plastic	Yes	Yes	None	
3	Semi-Vol. Organics	MOC	IT Pitts.	2	1/2 gallon	Amber glass	No	No	None	
4	Volatile Organics	MOC	IT Pitts.	2	40 ml.	Glass-septum	No	No	None	
5	TOC/TOX	MOC	IT Pitts.	1	500 ml.	Amber glass	No	No	H2SO4, ph<2	
6	Phenols/Phosphate	MOC	IT Pitts.	1	500 ml.	Amber glass	No	No	H2SO4, ph<2	
7	Metals/Cations	MOC	IT Pitts.	2	1 liter	Plastic	Yes	Yes	HNO3, ph<2	
8	Mercury	MOC	IT Pitts.	1	8 oz.	Glass	Yes	Yes	HNO3, ph<2	
9	Cyanide	MOC	IT Pitts.	1	500 ml.	Plastic	No	No	NAOH, ph>12	
10	General Chem.	EEG	EEG	1	1 liter	Plastic	No	Yes	None	
11	Radionuclides	EEG	EEG	2	1 gallon	Plastic	Yes	Yes	HNO3, ph<2	
12	Tritium	EEG	EEG	1	8 oz.	Glass	No	No	None	
13	General	SNL	SNL	1	1 liter	Plastic	No	No	None	
14	General	SNL	SNL	3	1 liter	Plastic	Yes	Yes	None	
15	General	SNL	SNL	3	1 liter	Plastic	Yes	Yes	HNO3, ph<2	
16	Isotopes	SNL	SNL	2	4 oz.	Glass	No	No	None	
17	Radionuclides	MOC	Westinghouse	2	1 gallon	Plastic	Yes	Yes	HNO3, ph<2	
18	Radionuclides	MOC	Archive	1	1 gallon	Plastic	Yes	Yes	HNO3, ph<2	
19	Gross Alpha/Beta	MOC	Westinghouse	1	1 liter	Plastic	Yes	Yes	HNO3, ph<2	
20	Tritium	MOC	Westinghouse	1	8 oz.	Glass	No	No	None	
21	Gases	MOC	UNC	1	500 ml.	S.S. Bomb/Teflon-Lined	No	No	None	
22	Redox Couples	MOC	UNC	2	500 ml.	S.S. Bomb/Teflon-Lined	No	No	None	
23	Archival Sample	MOC	Archive	1	1 gallon	Plastic	Yes	Yes	HNO3, ph<2	
24	Archival Sample	MOC	Archive	1	1 gallon	Plastic	Yes	Yes	None	
25	Archival Sample	MOC	Archive	1	8 oz.	Glass	No	No	None	
						Acid/Trip/Reagent Blanks				
26	Metals/Acid	MOC	IT Pitts.	1	1 liter	Plastic	Yes	Yes	HNO3, ph<2	
27	Metals/DI H20	MOC	IT Pitts.	1	1 liter	Plastic	Yes	Yes	None	
28	Purgeables	MOC	IT Pitts.	2	40 ml.	Glass-septum	No	No	None	
29	Radionuclides	MOC	Westinghouse	1	1 gallon	Plastic	Yes	Yes	HNO3, ph<2	
30	Acid Blank	SNL	SNL	2	1 liter	Plastic	Yes	Yes	HNO3, ph<2	
31	Gross Alpha/Beta	MOC	Westinghouse	1	1 liter	Plastic	Yes	Yes	HNO3, ph<2	

3.4 Sample Storage

After the samples are collected and properly preserved, the samples must be stored or transported immediately. The primary considerations for sample storage are as follows:

- The samples must be analyzed within the prescribed holding time for the parameters of interest. Samples must be stored in containers compatible with analysis for the desired constituent.

- The prescribed storage temperature for the organic samples is generally four degrees Celsius. This temperature must be maintained from the sampling location to the laboratory. However, due to the high ionic strength of the groundwaters adjacent to the WIPP site, many sample solutions are saturated or nearly saturated with respect to the minor constituents. These samples should be left at ambient temperature. Cooling such solutions to a low temperature may cause irreversible precipitation to occur.

The following equipment is needed for proper storage and transportation of collected samples:

- Refrigerator
- Ice coolers
- Ice packs or blue ice
- Packing material

3.5 Transportation of Samples

Prior to collecting the final samples, the collection team must consider the analyses to be performed so that proper shipping containers can be assembled. In addition, Chain of Custody and Analysis Request forms must be prepared (see Section 3.6).

In addition to initiating the Chain of Custody and Analyses Request forms, field personnel are responsible for uniquely identifying and labeling samples (required on the Chain of Custody form), providing proper sample preservation, and securely packaging all the samples to preclude breakage during shipment.

All samples are hand carried or shipped by overnight commercial carrier, (e.g., Federal Express). The laboratory should be telephoned as soon as the shipping containers are consigned to the shipper.

3.6 Record Management

3.6.1 Field Sample Collection Reports

Immediately after the collection of the water samples (final), the sample is recorded on the Final Samples Checklist (Table 3-2). This form documents all of the data to be collected for each sample. Information required to document sample collection includes

- Project name: WIPP WQSP
- Project number
- Sample location
- Description of sampling method: filtered or nonfiltered
- Date and time of sampling
- Person collecting sample
- Amount of sample collected
- Type of sample: Metals, Organic, Radionuclides, etc.

Information will be recorded on the form shown in Table 3-2. Photocopies of these forms are maintained at SNL and at the WIPP site. The original copy is maintained in the WQSP file at the WIPP site until turnover to the MRC.

3.6.2 Labels

As a means of identifying a sample, each sample is given a unique label. The following information is on the label:

- Project name: WIPP
- Sample location (zone sampled)
- Well number
- Sampling date
- Person collecting the sample
- Method of sample preservation
  - filtered or not filtered
  - type of preservative
- Type of sample collected (groundwater, DI water)
- Sample Number
- Parameters
- Number of bottles of sample (bottle ___ of ___)

3.6.3 Chain of Custody

An overriding consideration for resulting data is the ability to demonstrate that the samples have been obtained from the locations stated, and that they have reached the laboratory without alteration. Evidence of sample collection, shipment, laboratory receipt, and laboratory custody must be documented to accomplish this goal.

Documentation is accomplished through the use of a Chain of Custody form (Figure 3-1). This document records each sample, the individual(s) responsible for the collection of the sample, sample shipment, and receipt of the sample. A sample is considered to be in custody if it is 1) in a person's actual possession; 2) locked so that no one can tamper with it after having been in physical custody; or 3) in a secured area, restricted to authorized personnel.

Laboratories will not accept samples for analysis without a correctly prepared Chain of Custody form. Chain of Custody forms are prepared for all final samples collected, regardless of the reason for sample collection. This form is to be initiated at

CHAIN-OF-CUSTODY RECORD

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE ELECTRIC CORP.
P. O. BOX 2078
CARLSBAD, NM 88221-2078

C/C Control № 00583

R/A Control No. _____

SAMPLING PROGRAM _____

SAMPLE TEAM MEMBERS _____

LAB DESTINATION _____

CARRIER/WAYBILL NO. _____

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No

Special Instructions: _____

Possible Sample Hazards: _____

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: _____

   Received By: _____

2. Relinquished By: _____

   Received By: _____

3. Relinquished By: _____

   Received By: _____

4. Relinquished By: _____

   Received By: _____

WHITE To accompany samples
YELLOW Field Copy
PINK Other

WP 1178 (6 86)

Figure 3-1. Chain of Custody

the point of sample collection and is kept with the samples during transfer to a contract laboratory. Each individual holding the samples signs and dates the form. The form is completed upon receipt in the laboratory.

The Chain of Custody form will have been signed by each individual who, at one time or another, has had the samples in his/her possession. Preparation of the Chain of Custody form is as follows:

- For each sample, the Chain of Custody form is initiated in the field by the person collecting the sample. Samples can be grouped for shipment, in which case a common form will be maintained.

- The form is completed in the field to indicate project, sampling team, etc.

- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for Relinquished By _____, Received By _____ is completed in the field.

- The person transporting the samples to the laboratory or delivering them for shipment signs the record form as Relinquished By _____.

- If the samples are shipped to the laboratory by commercial carrier, the Chain of Custody form is placed in the shipping container, and the shipping container sealed prior to giving it to the carrier.

- If the samples are directly transported to the laboratory, the Chain of Custody form is kept in possession of the person delivering the samples.

- For samples shipped by commercial carrier, the waybill serves as an extension of the chain of custody record between the final field custodian and receipt in the laboratory.

Within all laboratories under contract to the MOC, the responsible person is usually the sample receiving clerk. The clerk's responsibilities are as follows:

- Examine all samples for possible shipping damage and loss of cooling during shipment. If samples have been damaged during shipment, examine all remaining samples carefully to determine if they too were damaged. Note on the Chain of Custody form that specific samples were damaged and that the samples were removed from the sampling program. Field personnel are to be notified as soon as possible that samples were damaged and that they must be resampled, or the analyses program changed.

- Compare samples received against those listed on the Chain of Custody form. If discrepancies occur, the samples in question are to be segregated from normal sample storage and the field personnel notified immediately.
- Verify that sample holding times have not been exceeded.
- Sign and date the Chain of Custody form.
- Send copy of Chain of Custody back to requestor.
- Place the samples in appropriate laboratory storage.
- Enter the samples in the laboratory sample log-in book which contains the following information:
  - Project identification
  - Sample numbers
  - Type of samples
  - Date received in laboratory
  - Date put into storage after analysis is completed
  - Date of disposal

  The last two items are to be added to the log when the action is taken.

3.6.4 Request for Analysis Form

A Request for Analysis form (Figure 3-2) is to be completed by the field personnel and included with the Chain of Custody form. It is imperative that the Request for Analysis form be provided, so that sample holding times are not exceeded at the laboratory due to ill-definition of the test program. SNL sends Request for Analysis forms to their subcontractors under separate cover.

3.6.5 Field Data Sheets

All serial sampling analytical data derived in the mobile field laboratory are recorded on serial sampling forms. The following forms are completed during the analysis of the field parameters:

- Figure 3-3, Serial Sampling Summary Sheet
- Figure 3-4, Serial Sampling: Eh (Redox)
- Figure 3-5, Serial Sampling: pH
- Figure 3-6, Serial Sampling: Temperature
- Figure 3-7, Serial Sampling: Specific Gravity
- Figure 3-8, Serial Sampling: Specific Conductance
- Figure 3-9, Serial Sampling: Alkalinity
- Figure 3-10, Serial Sampling: Chloride, Divalent Cations
- Figure 3-11, Serial Sampling: Trace Metals
- Figure 3-12, Spectrophotometer Worksheet
- Figure 3-13, Serial Sampling Check Printout Sheet

- Figure 3-14, Serial Sampling: Chloride and Spike
- Figure 3-15, Serial Sampling: Fe Spike
- Figure 3-16, Serial Sampling: Divalent Cations and Spike
- Figure 3-17, Chem Worksheet
- Figure 3-18, Physical Parameters Worksheet
- Figure 3-19, Standard Solution Calibration Sheet
- Figure 3-20, Spectrophotometer Worksheet; Iron Curve Calibration

REQUEST FOR ANALYSIS

R/A Control № 00583
C/C Control No. _____

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE ELECTRIC CORP.
P. O. BOX 2078
CARLSBAD, NM 88221-2078

DATE SAMPLES SHIPPED _____
LAB DESTINATION _____
LABORATORY CONTACT _____
SEND LAB REPORT TO _____

DATE REPORT REQUIRED _____
PROJECT CONTACT _____
PROJECT CONTACT PHONE NO. _____

SAMPLING PROGRAM _____

PURCHASE ORDER NO. _____

Sample Number	Sample Type	Sample Quantity	Preservative	Req't. Testing Program	Special Instructions

TURNAROUND TIME REQUIRED. (Rush must be approved by appropriate Manager.) NORMAL _____ RUSH _____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION. (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances.)

NONHAZARD _____ FLAMMABLE _____ SKIN IRRITANT _____ HIGHLY TOXIC _____ BIOLOGICAL _____ OTHER _____ (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis.) RETURN TO CLIENT _____ DISPOSAL BY LAB _____

FOR LAB USE ONLY

RECEIVED BY _____ DATE/TIME _____

WHITE Original, to accompany samples
YELLOW Field Copy
PINK Other

WP 1177 (6/86)

Figure 3-2. Request for Analysis

SERIAL SAMPLING SUMMARY SHEET

SAMPLE NO: _____ BY: _____ DATE: _____

WELL NO: _____ ROUND___CHECKED BY: _____ DATE: _____

ZONE MONITORED: _____ PROJECT NAME: WIPP WQSP

DATE SAMPLED: _____ TIME SAMPLED: _____

PARAMETER	UNITS	TEST RESULTS	ANALYST	DATE/TIME TESTED
Eh	mv			
pH	S.U.			
Temperature	°C			
Sp. Gravity "____°C	--			
Sp. Conductivity "____°C	umhos/cm	1. 2.		
Bicarbonate Alkalinity as HCO3	mg/l	1. 2.		
Carbonate Alkalinity as CO3	mg/l	1. 2.		
Chloride	mg/l	1. 2.		
D.valent Cations	mg/l	1. 2.		
Fe (total)	mg/l	1. 2.		
Fe (ferrous)	mg/l	1. 2.		

WP 1365

Figure 3-3. Serial Sampling Summary Sheet

SERIAL SAMPLING: Eh (REDOX)

PROJECT NAME : WIPP WATER QUALITY SAMPLING

WELL NAME : _____ SAMPLE No : _____ DATE : _____

ROUND : _____ CHECKED BY : _____ DATE : _____

Eh

ANALYST : _____

METER ID : MODEL _____ SERIAL # _____

ELECTRODE AND FILL SOLN : _____

THERM ID : _____ SERIAL # _____ EXP. DATE : _____

STANDARD : _____

SAMPLING METHOD : _____ TIME OF COLLECTION _____

EQUIPMENT CHECK

SOLN.	TIME	TEMP (°C)	@ EXPECTED TEMP VALUE REL TO SHE **	METER VALUE (mV)	** E. relative to SHE (mV)*

MEASUREMENT

TIME	TEMP (°C)	METER VALUE (mV)	** E. relative to SHE (mV) *

** value determined by SHARP model E55002 calculator

* METER VALUE (mV)+(199(mV)-1.0 mV/°C x (TEMP-25°C))

REMARKS : _____

WP 1379

Figure 3-4. Serial Sampling: Eh (Redox)

SERIAL SAMPLING: pH

PROJECT NAME : WIPP WATER QUALITY SAMPLING

WELL NAME : _____ SAMPLE No : _____ DATE : _____

ROUND : _____

pH ANALYST : _____

METER ID : MODEL _____ SERIAL # _____

ELECTRODE AND FILL SOLN : _____

THERM ID : _____ SERIAL # _____ EXP. DATE : _____

STANDARD : _____

SAMPLING METHOD : _____ TIME OF COLLECTION _____

	SOLN.	TIME	TEMP (°C)	METER VALUE	REMARKS
CALIBRATION CHECK					

ELECTRODE SLOPE _____

	TIME	TEMP (°C)	METER VALUE	REMARKS
MEASUREMENT				

REMARKS : _____

WP 1380

Figure 3-5. Serial Sampling: pH

SERIAL SAMPLING: TEMPERATURE

WELL NAME: _____ SAMPLE NUMBER _____ DATE _____

ROUND: _____

PROJECT NAME: WIPP WATER QUALITY SAMPLING

TEMPERATURE _____ ANALYST: _____

THERMOMETER ID: _____ SERIAL # _____ EXP. DATE: _____

SAMPLING METHOD: RAW (open line) TIME OF COLLECTION: _____

MEASUREMENT

TIME	TEMP (C°)	EQUIPMENT	METHOD

REMARKS: _____

_____

WP 1364

Figure 3-6. Serial Sampling: Temperature

SAMPLING: SPECIFIC GRAVITY

PROJECT NAME : WIPP WATER QUALITY SAMPLING

WELL NAME : _____ SAMPLE NUMBER : _____

ROUND : _____ DATE : _____

SPECIFIC GRAVITY

ANALYST : _____

THERMOMETER ID : _____ SERIAL # _____ EXP. DATE : _____

HYDROMETER ID : _____ SERIAL # _____ EXP. DATE : _____

SAMPLING METHOD : _____ TIME OF COLLECTION _____

MEASUREMENT

TIME	OBSERVED HYDROMETER READING	EQUIPMENT	TEMP (C^0)	DEGASSING TIME

REMARKS : _____

WP 13.5.7

Figure 3-7. Serial Sampling: Specific Gravity

SERIAL SAMPLING : SPECIFIC CONDUCTANCE

WELL NAME : _____ SAMPLE NUMBER _____ DATE _____

ROUND : _____ CHECKED BY _____ DATE _____

PROJECT NAME : **WIPP WATER QUALITY SAMPLING**

SPECIFIC CONDUCTANCE ANALYST : _____

METER ID : YSI Model _____ SERIAL # _____

PROBE ID : YSI # _____ : K-Icm $^{-1}$ _____

THERM ID : _____ SERIAL # _____ EXP. DATE _____

STANDARD : _____ unhos/cm : Lot # _____ / _____ umhos/cm Lot # _____

SAMPLING METHOD : _____ TIME OF COLLECTION _____

METHOD OF
TEMP. CORR. G25.0 = Gt/ (1.0-.02 (t-25.0))

G25=Specific Conductance at 25oC t=measured temperature

Gt=Specific Conductance at measured temperature

EQUIPMENT CHECK

SOLN.	TIME	TEMP (°C)	Gt	G25

MEASUREMENT

TIME	TEMP (°C)	METER VALUE (umhos/cm) = Gt

TEMP. CORR. TO 25°C

TIME	G at 25°C	

REMARKS : _____

WP 1381

Figure 3-8. Serial Sampling: Specific Conductance

SERIAL SAMPLING: ALKALINITY

SAMPLE No: _____ WELL No: _____ ROUND: _____

PROJECT NAME: WIPP W.Q.S.P. CHECKED BY: _____ DATE: _____

pH CAL.	TEMP. °C	pH STD. SOL'N	MANUFACTURER LOT #	METER VALUE	% SLOPE
Probe No:					
Meter No:					
POST TEST CHECK					

	SAMPLE IDENTIFICATION NUMBER				
A	INITIAL SAMPLE, pH				
B	SAMPLE VOLUME, mL		100 mls	100 mls	
C	TITRANT _____ N H_2SO_4 LOT# _____ STD# _____				
D	(P) PHENOLPHTHALEIN ALKALINITY (TITRATE TO pH 8.1)	TITRANT			
		FINAL VOLUME, ml			
		INITIAL VOLUME, ml			
		NET TITRANT USED, ml			
E	(T) TOTAL ALKALINITY (CONTINUE TITRATION TO pH 4.5)	TITRANT	H_2SO_4	H_2SO_4	
		FINAL VOLUME, ml			
		INITIAL VOLUME, ml			
		NET TITRANT USED, ml			
F	ALKALINITY AS CARBONATE (1), mg/l				
G	ALKALINITY AS BICARBONATE (2), mg/l				
H	ALKALINITY AS HYDROXIDE (3), mg/l				

TESTED BY: DATE/TIME CALCULATED BY: DATE

ALKALINITY RELATIONSHIPS

TITRATION RESULTS	CARBONATE CO_3	BICARBONATE HCO_3	HYDROXIDE OH
P = 0	0	T	0
P < 1/2 T	2P	T - 2P	0
P = 1/2 T	2P	0	0
P > 1/2 T	2(T-P)	0	2P - T
P = T	0	0	T

WHERE: P = TITRATION TO pH 8.1 IN ml

T = TOTAL TITRATION IN ml

NOTES

If: pH > 8.1, START WITH STEP D.

If: pH < 4.5, REPORT ZERO FOR ALL ALKALINITIES.

If: 4.5 < pH < 8.1, START WITH STEP E.

FORMULAE:

(1) $$\text{mg/l } CO_3 = \frac{(\text{ml } H_2SO_4)(\text{N } H_2SO_4)(30{,}000)}{\text{ml SAMPLE}}$$

(2) $$\text{mg/l } CO_3 = \frac{(\text{ml } H_2SO_4)(\text{N } H_2SO_4)(61{,}000)}{\text{ml SAMPLE}}$$

(3) $$\text{mg/l } CO_3 = \frac{(\text{ml } H_2SO_4)(\text{N } H_2SO_4)(17{,}000)}{\text{ml SAMPLE}}$$

WP 1269

Figure 3-9. Serial Sampling: Alkalinity

SERIAL SAMPLING: Chlorides, Divalent Cations

PROJECT NAME: WIPP WATER QUALITY SAMPLING

SAMPLE No: _____

WELL NAME: _____ ROUND: _____ CHECKED BY: _____ DATE _____

PARAMETER	ANALYSIS INFORMATION	SAMPLE NUMBER		
		BLANK	#	# DUPLICATE
CHLORIDE	(A) ALIQUOT OF SAMPLE, ml			
	(B) DILUTION FACTOR (FLASK/PIPET)			
	TITRANT _____ N $AgNO_3$ LOT No: _____ Std. No: _____			
	FINAL VOLUME, ml			
	INITIAL VOLUME, ml			
	(C) NET TITRANT USED, ml	(D)		
	(D) BLANK, ml			
	$\frac{(C-D)(N\ AgNO3)(35500)(B)}{A}$ = mg/Cl			
	TESTED BY: DATE/TIME:	CALCULATED BY:	DATE:	

DIVALENT CATIONS	(A) ALIQUOT OF SAMPLE, ml			
	(B) DILUTION FACTOR (FLASK/PIPET)			
	TITRANT _____ N EDTA LOT No: _____ Std. No: _____			
	FINAL VOLUME, ml			
	INITIAL VOLUME, ml			
	(C) NET TITRANT USED, ml	(D)		
	(D) BLANK, ml			
	$\frac{(C-D)(N\ EDTA)(2000)(B)}{A}$ = meq/l			
	TESTED BY: DATE/TIME	CALCULATED BY:	DATE	

REMARKS: _____

WP 13-1

Figure 3-10. Serial Sampling: Chloride, Divalent Cations

SERIAL SAMPLING: TRACE METALS

PROJECT NAME: WIPP WATER QUALITY SAMPLING

SAMPLE No: _____ STANDARDIZATION No: _____

WELL NAME: _____ ROUND: _____ CHECKED BY: _____ DATE: _____

PARAMETER	ANALYSIS INFORMATION	SAMPLE NUMBER		
		BLANK	#	# DUPLICATE
IRON (Total)	(A) SAMPLE VOLUME, ml			
	% TRANSMITTANCE READING			
	(B) TOTAL ug FROM STANDARD CURVE*			
	$\frac{(B)}{(A)}$ = mg/l Fe (Total)			
TESTED BY:	DATE/TIME:	CALCULATED BY:		DATE:

IRON (Ferrous)	(A) SAMPLE VOLUME, ml			
	% TRANSMITTANCE READING			
	(B) TOTAL ug FROM STANDARD CURVE*			
	$\frac{(B)}{(A)}$ = mg/l Fe^{2-}			
TESTED BY:	DATE/TIME:	CALCULATED BY:		DATE

* See calibration sheet

REMARKS: _____

WP 13-74

Figure 3-11. Serial Sampling: Trace Metals

SPECTROPHOTOMETER WORKSHEET

PROJECT NAME : WIPP WATER QUALITY SAMPLING WELL NAME : _____

DATE : _____ ANALYST _____ SAMPLE No : _____

TIME : _____ STANDARDIZATION No : _____ EXPIRATION DATE : _____ ROUND : _____

CHECKED BY : _____ DATE CHECKED : _____ INSTRUMENT MODEL : _____ SER. # _____

TEST	% TRANSMITTANCE READINGS	% TRANSMITTANCE AVERAGES	TOTAL u gr. FROM CURVE	mg/l
Fe Total	1 / 2			
Fe Total duplicate	1 / 2			
Fe + +	1 / 2			
Fe + + duplicate	1 / 2			
BLANK				
STD 1	1 / 2			
STD 2	1 / 2			
STD 3	1 / 2			
STD 4	1 / 2			

STANDARD Fe 1000 ppm USED : Mfg. _____ Lot _____

METHOD OF CURVE FORMULATION : LOTUS LINEAR REGRESSION PROGRAM

(see calibration sheet)

SLOPE : _____

Y INTERCEPT : _____

$$ug\ Fe^{+} = \left[\frac{\ln\left(\frac{\%\ trans.}{y\ int.}\right)}{slope} \right]$$

WP 1373

Figure 3-12. Spectrophotometer Worksheet

SERIAL SAMPLING CHECK PRINTOUT SHEET

SAMPLE No : _____ BY : _____ DATE : _____

WELL No : _____ CHECKED BY : _____ DATE : _____

ZONE MONITORED : _____ PROJECT NAME : WIPP WQSP

DATE SAMPLED : _____ COMPUTER/ CALCULATOR : SHARP EL 5500 II

Figure 3-13. Serial Sampling Check Printout Sheet

SERIAL SAMPLING: Chlorides and Spike

PROJECT NAME: WIPP WATER QUALITY SAMPLING

SAMPLE No: _____

WELL NAME: _____ ROUND: _____ CHECKED BY: _____ DATE: _____

PARAMETER	ANALYSIS INFORMATION	SAMPLE NUMBER		
		BLANK	#	# DUPLICATE
CHLORIDE	(A) ALIQUOT OF SAMPLE, ml			
	(B) DILUTION FACTOR (FLASK/PIPET)			
	TITRANT _____ N $AgNO_3$			
	LOT No: _____ Std. No: _____			
	FINAL VOLUME, ml			
	INITIAL VOLUME, ml			
	(C) NET TITRANT USED, ml (D)			
	(D) BLANK, ml			
	$\frac{(C-D)(N\ AgNO3)(35500)(B)}{A}$ = mg/l Cl			
	TESTED BY: DATE/TIME: CALCULATED BY: DATE:			
SPIKE	(E) ALIQUOT OF SAMPLE, for SPIKE, ml			
	(F) DILUTION FACTOR OF SPIKE (FLASK/PIPET)			
	(G) VOLUME OF SPIKE, ml			
	(H) TRUE CALCULATED VALUE OF SPIKE (Mg/l) = $\frac{M/W\ Cl}{M/W\ NaCl}$ X mg/l Std. $\frac{35.453}{58.443}$ = 60663			
	FINAL VOLUME, ml			
	INITIAL VOLUME, ml			
	(I) NET TITRANT USED, ml			
	(J) $1 - [D\frac{(E-G)}{A}]$			
	(K) AVERAGE NET TITRANT USED FOR SERIAL SAMPLE - BLANK $\frac{(C)\ SAMPLE-BLANK + (C)\ DUP - BLANK}{2}$			
	(L) NET TITRANT USED FOR SPIKE J - [(K)(E/A)] =			
	(M) SAMPLE WITH SPIKE - SAMPLE = _____ ml (M)(N AgNO3)(35500)(F G) =			
	PERCENT RECOVERY = M/H _____ X 100 = _____ %			

WP 13-3

Figure 3-14. Serial Sampling: Chloride and Spike

SERIAL SAMPLING: Fe SPIKE

PROJECT NAME : WIPP WATER QUALITY SAMPLING

SAMPLE No : _____ STANDARDIZATION No : _____

WELL NAME : _____ ROUND : _____ CHECKED BY : _____ DATE : _____

PARAMETER	ANALYSIS INFORMATION	SAMPLE NUMBER			
		BLANK	#	# DUP	SPIKE
IRON (Total)	(A) SAMPLE VOLUME, ml				
	% TRANSMITTANCE READING				
	(B) TOTAL ug FROM STANDARD CURVE*				
	$\frac{(B)}{(A)}$ = mg/l Fe (Total)				
TESTED BY :	DATE/ TIME :	CALCULATED BY :		DATE :	

IRON (Ferrous)	(A) SAMPLE VOLUME, ml			
	% TRANSMITTANCE READING			
	(B) TOTAL ug FROM STANDARD CURVE*			
	$\frac{(B)}{(A)}$ = mg/l Fe^{2+}			
TESTED BY :	DATE/ TIME :	CALCULATED BY :		DATE :

* See calibration sheet

SPIKE SOURCE AND RECOVERY : Mfg : _____ lot # _____

SPIKE DILUTION : _____ ml into 500 ml DI H_2O = _____ ug/ml Fe

SPIKE COMPOSITION : _____ ml of _____ ug/ml Fe added to _____ ml of Sample# _____

CALCULATION : average ug of sample - dup = _____ ug

$\frac{\text{spike size ml}}{\text{sample size ml}}$ * sample - spike _____ ug

- ave of sample _____ ug

ug Fe spike

RECOVERY :

$\frac{\text{_____ ug}}{\text{ug}}$ X 100 = _____ %

WP 1375

Figure 3-15. Serial Sampling: Fe Spike

SERIAL SAMPLING: Divalent Cations and Spike

PROJECT NAME: WIPP WATER QUALITY SAMPLING

SAMPLE No: _____

WELL NAME: _____ ROUND: _____ CHECKED BY: _____ DATE: _____

PARAMETER	ANALYSIS INFORMATION	SAMPLE NUMBER		
		BLANK	#	# DUPLICATE
DIVALENT CATIONS	(A) ALIQUOT OF SAMPLE, ml			
	(B) DILUTION FACTOR (FLASK/PIPET)			
	TITRANT _____ N EDTA LOT No: _____ Std. No: _____			
	FINAL VOLUME, ml			
	INITIAL VOLUME, ml			
	(C) NET TITRANT USED, ml	(D)		
	(D) BLANK, ml			
	$\frac{(C-D)(N\ EDTA)(2000)(B)}{A}$ = mg/l Ca			
	TESTED BY: DATE/TIME: CALCULATED BY: DATE:			
SPIKE	(E) ALIQUOT OF SAMPLE, for SPIKE, ml			
	(F) DILUTION FACTOR OF SPIKE (FLASK/PIPET)			
	(G) VOLUME OF SPIKE, ml			
	(H) TRUE CALCULATED VALUE OF SPIKE (ml $CaCO_3$) (M of $CaCO_3$)			
	FINAL VOLUME, ml			
	INITIAL VOLUME, ml			
	(I) NET TITRANT USED, ml			
	(J) $I - [D(\frac{E-G}{A})]$			
	(K) AVERAGE NET TITRANT USED FOR SERIAL SAMPLE - BLANK (C) SAMPLE-BLANK -(C) DUP - BLANK / 2			
	(L) NET TITRANT USED FOR SPIKE J - ((K)(E/A)) =			
	(M) SAMPLE WITH SPIKE - SAMPLE = _____ ml X M of EDTA =			
	PERCENT RECOVERY = M/H _____ X 100 = _____ %			

WP 1273

Figure 3-16. Serial Sampling: Divalent Cations and Spike

CHEM WORKSHEET

ORIGINATOR _____

DATE _____ CHECKED BY _____ DATE CHECKED _____

WELL _____ ZONE _____ ROUND _____

Mg/L UNITS, Except for DC=MEQ/L Flow=Total gallons before sample

1	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	1 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
2	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	2 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
3	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	3 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
4	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	4 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
5	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	5 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
6	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	6 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
7	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	7 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
8	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	8 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
9	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	9 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____
10	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____	10 DUP	DATE _____ TOTAL FLOW _____ BY _____ Fe(Total) : _____ Fe + + _____ Alk : _____ DC : _____ Cl : _____

WP 1373

Figure 3-17. Chem Worksheet

Page ____ of ____

PHYSICAL PARAMETER WORKSHEET

WELL _____ ZONE _____ ROUND _____

FLOW - GALLONS ph - LOG UNITS

1	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
2	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
3	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
4	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
5	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
6	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
7	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
8	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
9	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____
10	SAMPLE No. _____ DATE _____ TOTAL FLOW _____	SPEC GRAV @ ___°C ___ TEMPERATURE _____ @ °C pH _____ SU	SP. COND. @ 25 °C _____ umhos/cm Eh measured _____ mv Eh rel. to S.H.E _____ mv	ANALYZED BY _____

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Figure 3-18. Physical Parameters Worksheet

STANDARD SOLUTION CALIBRATION SHEET

PROJECT NAME : WIPP WATER QUALITY SAMPLING

SHEET ____ OF ____

STANDARD # _____ WELL : _____ ROUND : _____

TESTED BY : _____ CALCULATED BY : _____ CHECKED BY : _____

DATE : _____ DATE : _____ DATE : _____

SOLUTION REQUIRING STANDARDIZATION _____ LOT # _____

REFERENCE SOLUTION _____ LOT # _____

DATE OF EXPIRATION _____

CHEMICALS USED	WEIGHTS
_____	_____ gr.
_____	_____ gr.
_____	_____ gr.

PROCEDURE USED : W. Q. S. P.

STANDARDIZATION CALCULATIONS :

$N_1V_2 = N_1V_2$ N_1 = NORMALITY

BLANK _____

$N_1 = \frac{N_2 V_2}{V_1}$ V_2 = VOLUME

N1 _____ N2 _____ N3 _____

N1 = (_____)(_____)
( )

N2 (_____)(_____)
( )

N3 = (_____)(_____)
( )

N1 = _____
N2 = _____
N3 = _____

$\frac{N1 + N2 + N3}{3}$ = _____

% STANDARD DEVIATION _____

WP 1376

Figure 3-19. Standard Solution Calibration Sheet

SPECTROPHOTOMETER WORKSHEET

IRON CURVE CALIBRATION

PROJECT NAME : WIPP WATER QUALITY SAMPLING WELL NAME : _____

DATE : _____ ANALYST _____ SAMPLE No : _____

TIME : _____ STANDARDIZATION No : _____ EXPIRATION DATE : _____ ROUND : _____

CHECKED BY : _____ DATE CHECKED : _____ INSTRUMENT MODEL : _____ SER. # _____

TEST	% TRANSMITTANCE READINGS	% TRANSMITTANCE AVERAGES	TOTAL u gr. FROM CURVE	mg/l
Fe Total	1 / 2			
Fe Total duplicate	1 / 2			
Fe + +	1 / 2			
Fe + + duplicate	1 / 2			
BLANK				
STD 1	1 / 2			
STD 2	1 / 2			
STD 3	1 / 2			
STD 4	1 / 2			

STANDARD Fe 1000 ppm USED : Mfg. _____ Lot _____

METHOD OF CURVE FORMULATION : LOTUS LINEAR REGRESSION PROGRAM

(see calibration sheet)

SLOPE : _____

Y INTERCEPT : _____

$$ug\ Fe^{++} = \left[\frac{\ln\left(\frac{\%\ trans.}{y\ int.}\right)}{slope} \right]$$

WP 1373

Figure 3-20. Spectrophotometer Worksheet; Iron Curve Calibration

4.0 QUALITY ASSURANCE

This section defines the policies and practices that will be applied to the WQSP to ensure adequate confidence in the generated data. Quality Assurance activities associated with the WQSP include the following:

- Organization of program participants
- Indoctrination and training of personnel
- Procedure preparation and control
- Procurement of items and services
- Calibration of equipment and standardization of chemical reagents
- Documentation of field and laboratory test data and data reduction
- Verification of calculations, computer input and software, report tables and figures, and analytical results
- Sample identification, handling, preservation, and storage
- Nonconformance and change control
- Reporting
- Records Management
- Quality Assurance audits.

These Quality Assurance activities will be performed in accordance with the following documents:

- WIPP Quality Program Manual (WQPM) - Outlines the overall Quality Assurance policy for the WIPP Project. This is the controlling document for the Project, taking precedence over all other Quality Assurance documents.
- IT Engineering Services Quality Assurance Manual (ITES QA Manual) with addendum - Describes the Quality Assurance Program for IT Engineering Services personnel performing work on the WIPP Project. It functions as the IT Corporation Quality Assurance Project Plan for the WIPP Project.
- IT Analytical Services Quality Assurance Manual (ITAS QA Manual) - Defines the Quality Assurance Program used by IT Corporation Laboratories.
- Geotechnical and Geosciences Section (GGS) Implementation Procedure (WP 07-001) - Covers the general requirements necessary to control and implement the Geotechnical and Geosciences Section activities.

- o WQSP Procedure Manual - Contains the detailed procedures necessary to perform individual Water Quality Sampling activities.

- o WIPP MOC Procedure Manual - Contains the procedures applicable to general WIPP Project tasks (e.g., calibration, records management, and procurement).

Adherence to the policies and procedures in these documents will ensure compliance with federal Quality Assurance regulations including: ANSI NQA-1 "Quality Assurance Program Requirements for Nuclear Facilities" and U.S. EPA, QAMS-005/80 "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." In addition, these documents provide the specific Quality Assurance guidelines that are relevant to the WQSP, which will not be reiterated here. The following sections are intended as a summary and cross-reference between individual Quality Assurance activities related to the program and the applicable sections of the documents described above.

4.1 Organization

The organization of the WQSP and its integration within the Geotechnical and Geosciences Section is described in the GGS Implementation Procedure (Section 5.1).

4.2 Indoctrination and Training

Provisions for training of WQSP staff in their quality-related responsibilities are made in the WQPM (Section II), ITES QA Manual (Section 4.3), and the GGS Implementation Procedure (Section 5.1.4).

4.3 Procedure Preparation and Control

WQSP task are performed in accordance with documented and approved procedures. These procedures are contained in the WQSP Procedure Manual. Procedure preparation, review, approval, control, and revision are in accordance with the requirements of WIPP MOC Procedure WP 15-101.

4.4 Procurement Control

The procurement of items and services necessary to the WQSP is conducted in accordance with WIPP MOC Procedure (WP 15-009). Procurement control requirements are also specified in the WQPM (Sections IV and VII).

4.5 Calibration

Measuring and test equipment and chemical reference standards used to obtain data for the WQSP are controlled by a formal calibration program. Periodic calibration of measuring and test equipment is performed by the WIPP Calibration Laboratory in accordance with WIPP MOC Procedure WP 10-003. Operational calibration of equipment and standardization of chemical reference standards are performed in accordance with the individual procedures contained in the WQSP Procedure Manual. Calibration

requirements are also specified in the WQPM (Section XII), ITES QA Manual (Section 5.5), ITAS QA Manual (Section 6.0), and GGS Implementation Procedure (Section 5.4).

A summary of the instruments used at each well and in the mobile field laboratory and their calibration frequency follows:

EQUIPMENT	FREQUENCY
Water Level Indicator	Prior to use on the program and following any adjustments to the tape or cable
Mercury-filled Thermometers	Certified by manufacturer for 12 months and replaced
pH Meter and Electrode	Before and after each measurement by GGS staff; annually by WIPP Calibration Laboratory
Eh Meter and Electrode	Before and after each measurement
Hydrometers	Certified by manufacturer for 12 months and replaced
Specific Conductance Meter	Before and after each measurement by GGS staff; annually by WIPP Calibration Laboratory
Spectrophotometer	Calibration curve generated prior to testing at each well and every 10 days thereafter; midpoint standard check with each analysis
Mettler Balance	Annually
Pressure Gauge	Every six months
Pressure Transducer	Prior to testing at each well

Chemical reference standards used in the mobile field laboratory (e.g., EDTA, sulfuric acid and silver nitrate) are standardized prior to testing at each well and every 10 days thereafter.

4.6 Documentation

Data are acquired by the WQSP through sample collection and field and laboratory testing. These data and subsequent data processing and data reduction are fully documented according to requirements specified in

the GGS Implementation Procedure (Section 5.5). Specific documentation requirements for individual program tasks are described in the respective procedures contained in the WQSP Procedure Manual.

4.7 Verification

To provide confidence in the results of the WQSP, a formal verification program is employed for data reduction, computer programs and input, report tables and figures. The verification program is defined in the GGS Implementation Procedure (Section 5.6). Requirements for verification are also specified in the WQPM (Section III). In addition, verification of analytical laboratory test results is performed by statistical evaluation of quality control samples as defined in the ITAS QA Manual (Section 8.0).

The specific application of quality control samples to chemical analysis is described in the individual procedures contained in the WQSP Procedure Manual. The types of quality control samples used and their application are summarized below:

TYPE OF SAMPLE	PARAMETERS	FREQUENCY
Method Blank	Chloride, dications, iron	One with each serial sample set
	Metals, major and minor elements, organics	One with each final sample set
Acid and Water Blanks	Metals	One out of every 5 final sample sets
Trip Blank	VOAs	One with each final sample set
Duplicate	Alkalinity, chloride, dications, iron	One with each serial sample set
	Metals, major and minor elements, organics	One out of every 5 final sample parameters for each well
Matrix Spike	Chloride, dications, iron	One out of every 10 serial sample sets
Analytical Spike	Metals, major and minor elements,	One out of every 5 final sample parameters for each well
Surrogate Spike	Organics	One out of every 5 final sample parameters for each well

Precision and accuracy quality control charts are prepared to statistically evaluate quality control sample data for chloride, iron, dication, and alkalinity serial sample analytical results.

4.8 Sample Control

Ground water samples collected through the WQSP are identified, preserved, shipped, and stored according to requirements specified in the individual procedures contained in the WQSP Procedure Manual and in the ITES QA Manual (Section 5.3).

4.9 Nonconformance and Change Control

The method for documenting and controlling nonconformances and changes to the scope of work, plans, procedures, etc. within the WQSP is detailed in the GGS Implementation Procedure (Section 5.7). Requirements for nonconformance control are also specified in the WQPM (Section XV).

4.10 Reporting

WQSP data are reported yearly in the Annual Water Quality Data Report. In addition, a letter report containing certified final sample data is transmitted quarterly to the State of New Mexico Environmental Evaluation Group. Requirements for report preparation are defined in the GGS Implementation Procedure (Section 5.8).

4.11 Records Management

Records generated by the WQSP are controlled and retained according to the requirements of WIPP MOC Procedures WP 15-006, WP 15-030, and the GGS Implementation Procedure (Section 5.9). Requirements for records management are also specified in the WQPM (Sections VI and XVII).

Records are maintained in a WIPP site GGS office activity file pending transfer of appropriate documents to the WIPP Master Records Center. The file is organized by the following categories:

Index

A Correspondence (chronological ordering)

B Budget and Schedule

C Plans and Procedures

D Field Data/Data Processing/Laboratory Data (filed by well and sampling round)

E Computer Programs (documentation and verification materials)

F Photographs

G Reports

Index

H References

I Back-up Laboratory Data (original laboratory transmittals)

J Miscellaneous

A bound chemistry notebook is maintained in the mobile field laboratory to record comments on the overall conditions attendant at each well, the analytical difficulties or problems experienced, and any information which may be important to future interpretation of the data. Copies of the appropriate pages of the notebook are made and entered into the program file at the end of sampling at each well. Completed notebooks are also filed.

Copies of all field data are made in duplicate and one copy each submitted to the following:

- o Sandia National Laboratories
- o WIPP site MOC Geosciences files.

4.12 Audits

To verify compliance with the WIPP Quality Assurance Program and the requirements set forth in this plan, regularly scheduled audits of the WQSP are conducted in accordance with GGS Implementation Procedure (Section 5.10), WQPM (Section XVIII), and ITES QA Manual (Section 11.0).

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COLLECTION OF WATER SAMPLES FROM PRIVATE WELLS

Collection of water samples from private wells will be conducted under the auspices of the Water Quality Sampling Program. It is expected that three sets of samples will be collected as part of the preoperational baseline programs for the WIPP Project. Many of these private wells supply water for livestock watering. Water is used for human consumption at three locations.

The sampling of water from these private wells will use the existing well pumping devices (e.g., windmill, submersible pump). Many windmills pump directly from the pumping device into a stock tank. Whenever possible, samples will be "caught" prior to entering the stock tank. It is felt that contact with the stock tank is undesirable due to possible leaching of metals from the tank. It will not be possible to avoid contact with drill pipe associated with the pumping system.

All sampling locations will be sampled and analyzed for the full suite of radionuclide analyses, as well as for analysis of safe drinking water parameters. In addition, general water quality parameters will be analyzed as an integral part of this program. Splits of all samples will be provided to the State of New Mexico's Environmental Evaluation Group (EEG). Samples will also be collected for Sandia National Labs (SNL) for their analyses as part of the site characterization program.

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APPENDIX G

WIPP ENVIRONMENTAL PROCEDURES MANUAL

The WIPP Environmental Procedures Manual (WP 02-3) supports the environmental monitoring, sampling, and analysis activities conducted at the WIPP facility. These procedures control the quality of environmental measurements (meteorological, soil, water, biota, and air).

As of 03/03/88

ENVIRONMENTAL PROCEDURES MANUAL

WP 02-3

Table of Contents

I. INTRODUCTION - TBI*

II. PROCEDURES FOR RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

Procedure No.	Rev. No.	Title	Effective Date
WP 02-301	1	Radiological Environmental Surveillance (RES) Implementation	02/05/88
WP 02-302	0	NES/RES Quality Assurance/Quality Control Implementation Procedures	11/30/87
WP 02-303	0	RES Scheduling, Documentation, and Field Preparation Procedure	01/07/88
WP 02-304	0	NES/RES Sample Tracking Procedure	01/15/88
WP 02-305	0	RES Data Management Procedure	11/30/87
WP 02-306	1	NES/RES Equipment Maintenance and Control Procedures	02/15/88
WP 02-307	0	RES Soil Sampling Procedures	11/30/87
WP 02-308	1	Thermoluminescent Dosimeter (TLD) Handling Procedures	03/03/88
WP 02-309	1	RES Surface Water and Sediment Sampling Procedures	03/02/88
WP 02-310	1	Biotic Sampling Procedures	02/15/88
WP 02-311	1	High-Volume Airborne Particulate Sampling Procedures	03/02/88
WP 02-312	1	Low-Volume Airborne Particulate Sampling Procedures	03/03/88
WP 02-313	1	Environmental Radiation Monitoring Procedures	03/03/88

*TBI - To Be Issued

ENVIRONMENTAL PROCEDURES MANUAL

WP 02-3

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III. PROCEDURES FOR NON-RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

Procedure No.	Rev. No.	Title	Effective Date
WP 02-330	0	Non-Radiological Environmental Surveillance (NES) Implementation Procedure	11/30/87
WP 02-332	0	NES Scheduling, Documentation, and Field Preparation Procedure	03/02/88
WP 02-334	0	NES Data Management Procedure	11/30/87
WP 02-336	0	NES Soil Sampling Procedures	02/05/88
WP 02-337	0	NES Vegetation Sampling Procedure	03/02/88
WP 02-338	0	NES Litter Bag Handling Procedures	03/02/88
WP 02-340	0	NES Environmental Photography Procedures	11/30/87
WP 02-341	0	Ambient Air Quality Monitoring Procedures	TBI
WP 02-342	0	NES Weathertronics Station Procedure	11/30/87
WP 02-343	0	NES Sierra-Misco Weather Station Recorder Strip Chart - Model 1048	11/30/87
WP 02-344	0	Strip-Chart Recorder Operation Procedure	11/30/87
WP 02-345	0	NES Surface Water and Sediment Sampling Procedure	01/15/88
WP 02-346	0	Plant Specimen Collection and Herbarium Management	11/30/87
WP 02-362	0	NES Bird Census Procedures	02/15/88
WP 02-363	0	NES Small Mammal Census Procedure	11/30/87

ENVIRONMENTAL PROCEDURES MANUAL

WP 02-3

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IV. PROCEDURES FOR DOSE ASSESSMENTS

Procedure No.	Rev. No.	Title	Effective Date
WP 02-360	0	Dose Assessment Implementation	TBI
WP 02-361	0	Computer Program Documentation Procedures	TBI

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NO: 02-301 REV. 1 ISSUE DATE: 02/05/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE (RES) IMPLEMENTATION

1.0 SCOPE

This document defines and delineates the programmatic responsibilities for performance of Radiological Environmental Surveillance (RES) by the Radiological and Environmental Programs Section (REPS). The RES Program is conducted to measure radiation levels and quantities of radioactive materials in the environment.

2.0 DEFINITIONS

See attached glossary of terms (Attachment 1).

3.0 REFERENCES

WP 02-302, RES Quality Assurance/Quality Control Implementation
WP 02-303, RES Scheduling, Documentation, and Field Preparation
WP 02-304, RES Sample Tracking
WP 02-305, RES Data Management
WP 02-306, RES Equipment Maintenance and Control
Additional references, Attachment 2

4.0 GENERAL

Radiological Environmental Surveillance (RES) at the WIPP is a comprehensive, three-phase program designed to provide sufficient information to characterize natural background levels of radiation, and to determine the concentrations of specific radionuclides in a variety of environmental media within the potential impact zones of WIPP facilities. The atmospheric pathway is the only significant mode through which radionuclides could potentially be released from the site due to normal operations, resulting in an exposure to the general public. Therefore, the selection of environmental media for routine evaluation within the RES emphasizes this atmospheric pathway.

The first phase of RES is defined as the Radiological Baseline Program (RBP). The RBP is designed to evaluate the status of preoperational environmental levels of radiation and concentrations of radionuclides present in selected environmental media. The RBP is described in more detail in WTSD-TME-057.

The second phase of RES--the Operational Radiological Monitoring Program (ORMP)--will be implemented prior to receipt of waste at the WIPP and will be in effect throughout the facility's operational life. During this operational period of the WIPP facility, the ORMP will continue to assess environmental levels of radiation and specific radionuclide activity within the scope of the RBP assessments. In addition, measurements of samples of gaseous effluents (air emissions) from each of the potentially contaminated release points will be performed. The WIPP Safety Analysis Report provides detailed information concerning the design of the WIPP facility and the effluent release systems. Details of the ORMP will be issued in a revision to the Environmental Programs Plan, prior to receipt of waste on site.

After the operational life cycle of WIPP has been completed, a third, post-operational, phase of RES will be implemented. The details of this phase of the program will be issued in subsequent revisions to the Environmental Programs Plan, in accordance with the timely implementation of the program concurrent with closure of the site.

The following activities are included in this document:

5.1 Organizational Responsibilities
5.2 RES Personnel Training and Qualification
5.3 RES Reporting
5.4 RES Records/Document Control
5.5 Calibration of RES Equipment
5.6 Procurement
5.7 RES Planning and Scheduling
5.8 RES Procedures

5.0 PROCEDURE

5.1 Organizational Responsibilities

1. The Manager of the Radiological and Environment Programs Section (REPS) assumes responsibility for the overall design and implementation of RES, including the following areas:

   - o Approval of specific procedures for the conduct of all RES activities
   - o Establishment of minimum qualification criteria and training requirements for all program personnel
   - o Review and approval of programmatic reports
   - o Oversight of appropriate levels of cooperation and consultation between the RES program and the State of New Mexico, Environmental Evaluation Group.

1. REPS MANAGER ASSUMES RESPONSIBILITY FOR OVERALL DESIGN & IMPLEMENTATION OF RES

2. The REPS Manager appoints an RES Principal Investigator (PI), assigning the following responsibilities to the PI:

   - o Direction of RES per written approved procedures
   - o Initiation and review of programmatic plans and procedures
   - o Review and evaluation of sample data
   - o Preparation and review of programmatic reports
   - o Assurance that appropriate samples are collected and analyzed
   - o Assurance that adequate technical support is provided to the Quality Assurance (QA) Department, during audits of vendor facilities.

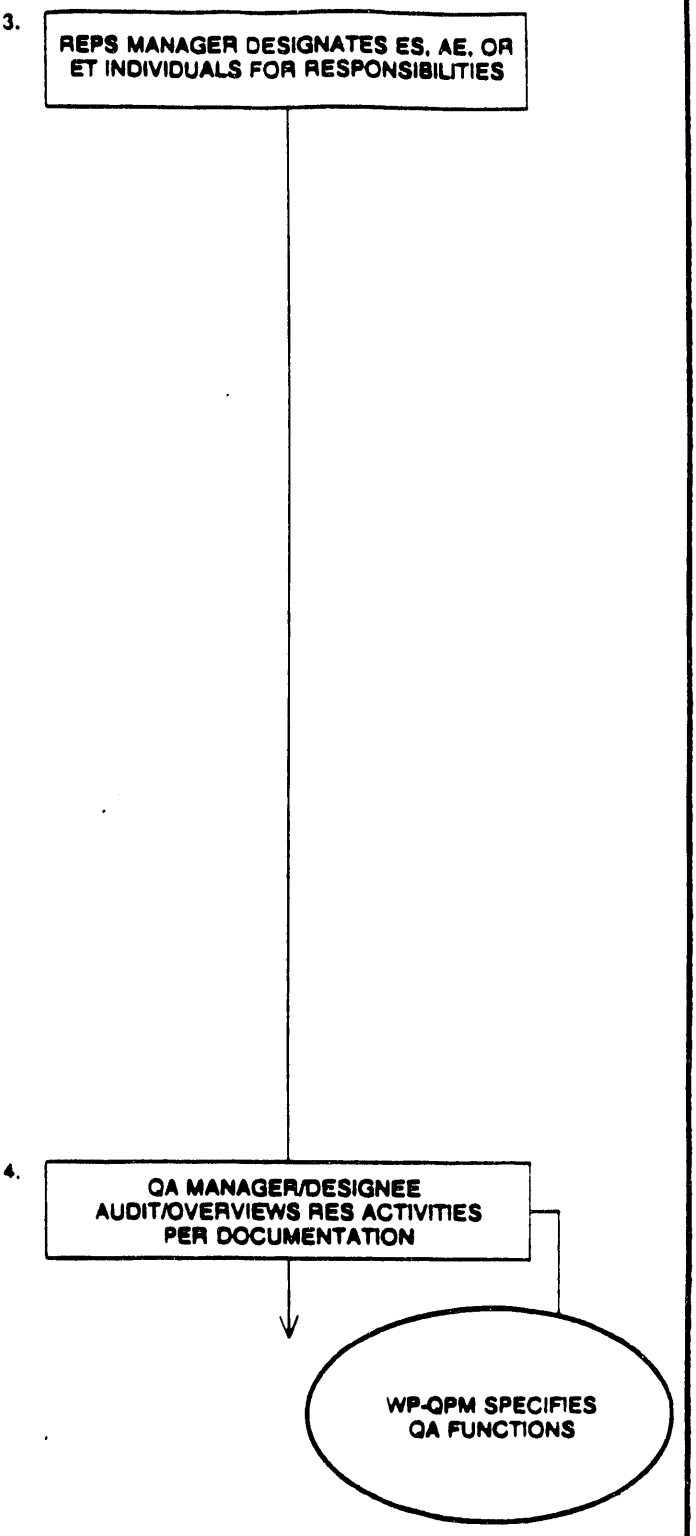


3. The REPS Manager designates one or more Environmental Scientists, Associate Engineers, or Environmental Technicians who will be responsible for the following items:

   - o Collection and subsequent distribution of samples
   - o Preparation and maintenance of appropriate data sheets and sample tracking documentation
   - o Monitoring of equipment operability status
   - o Reporting of equipment malfunctions
   - o Reporting of nonconformances to the PI or REPS Manager
   - o Initiating Quality Control (QC) checks of data
   - o Conducting field activities in accordance with written procedures.

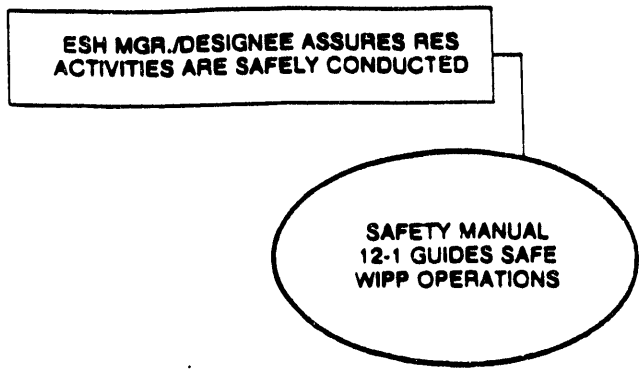
4. The QA Manager or his designee performs audits and overviews of the implementation of RES activities, per approved documentation.

   NOTE: WP-QPM sections specify the nature of these QA functions.



5. The Environment, Safety, and Health Manager or his designee assures that all RES activities are conducted in a safe manner.

NOTE: Safety Manual 12-1 provides guidance for conduct of safe operations at WIPP.



5.2 RES Personnel Training and Qualifications

1. The REPS Manager assures that basic qualifications for RES personnel are met. The following are representative of the essential levels of qualification required for RES personnel.

NOTE: A spectrum of expertise ranging above these basic qualifications would be expected among RES staff.

- Principal Investigator (PI): Technical capabilities and expertise in Health Physics or related field (M.S. degree and 3 to 5 years experience directly related to RES activities preferred); the ability to understand, analyze, and report environmental radiological data; the ability to effectively supervise the personnel conducting all phases of RES activities; the ability to respond effectively and efficiently to regulatory issues. The PI should be cognizant of applicable DOE Orders, policies, and directives, and should possess experience in QA/QC activities.

1. REPS MANAGER ASSURES BASIC PERSONNEL QUALIFICATIONS ARE MET

- o Environmental Scientist (Sr. Level): Technical expertise in ecology/environmental sciences (M.S. degree and 3 to 5 years experience preferred); ability to quickly evaluate indicated environmental impacts; demonstrated background in statistical evaluation of sampling programs and analytical results; experience in preparing, editing, and presenting technical papers.

- o Environmental Scientist (Entry Level): Technical capabilities in environmental sciences (B.S. degree and 2 to 4 years experience preferred); understanding of analytical techniques; good communication and organizational skills.

- o Associate Engineer: Technical/mechanical capabilities (B.S. degree and 2 years experience preferred) in areas of mechanical design and equipment maintenance; good organizational abilities with the capability to develop and maintain an equipment control and maintenance program; understanding of safety-related activities.

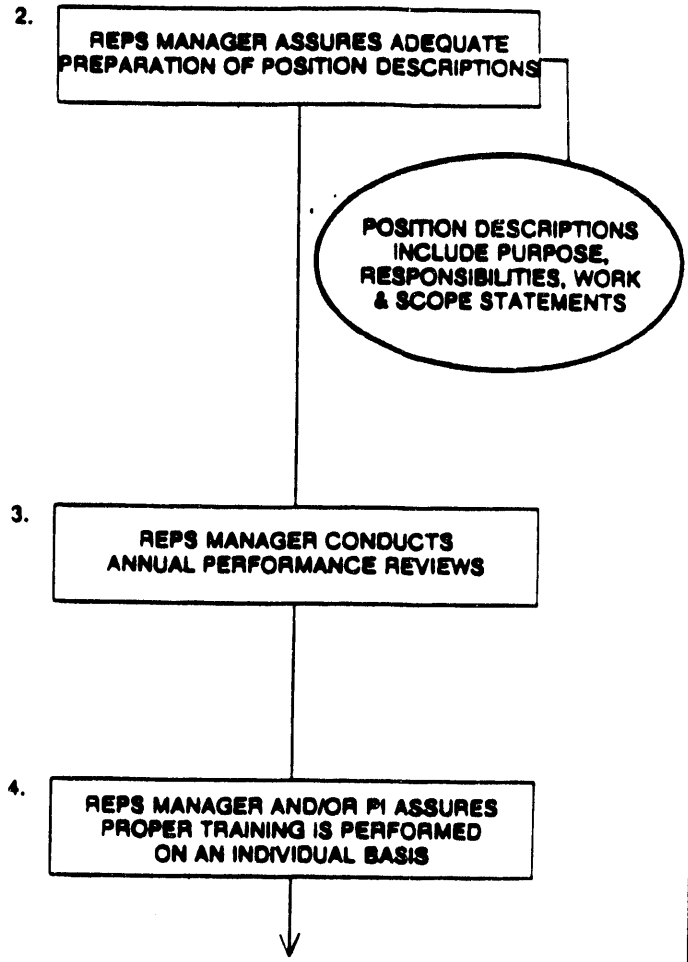
- o Environmental Technician: High school diploma or equivalent, with 2 years field experience preferred; capability to learn a wide variety of tasks; ability to work reliably and efficiently with little or no supervision after receiving training; demonstrated manual dexterity applicable to handling various types of mechanical equipment.

2. The REPS Manager assures that position descriptions for assigned RES personnel are adequately prepared.

   NOTE: Each position description should include position purpose, principal responsibilities, nature of work, and scope.

3. The REPS Manager conducts an annual performance review of personnel according to Westinghouse requirements for personnel review.

4. The REPS Manager and/or the PI assure that training is performed on an individual basis, in order to maintain an acceptable level of proficiency by all new or temporary REPS staff, and by all permanent REPS staff.



5. New RES employes shall be required to review pertinent program documentation, and shall become familiar with applicable procedures and instructions prior to undertaking any RES task.

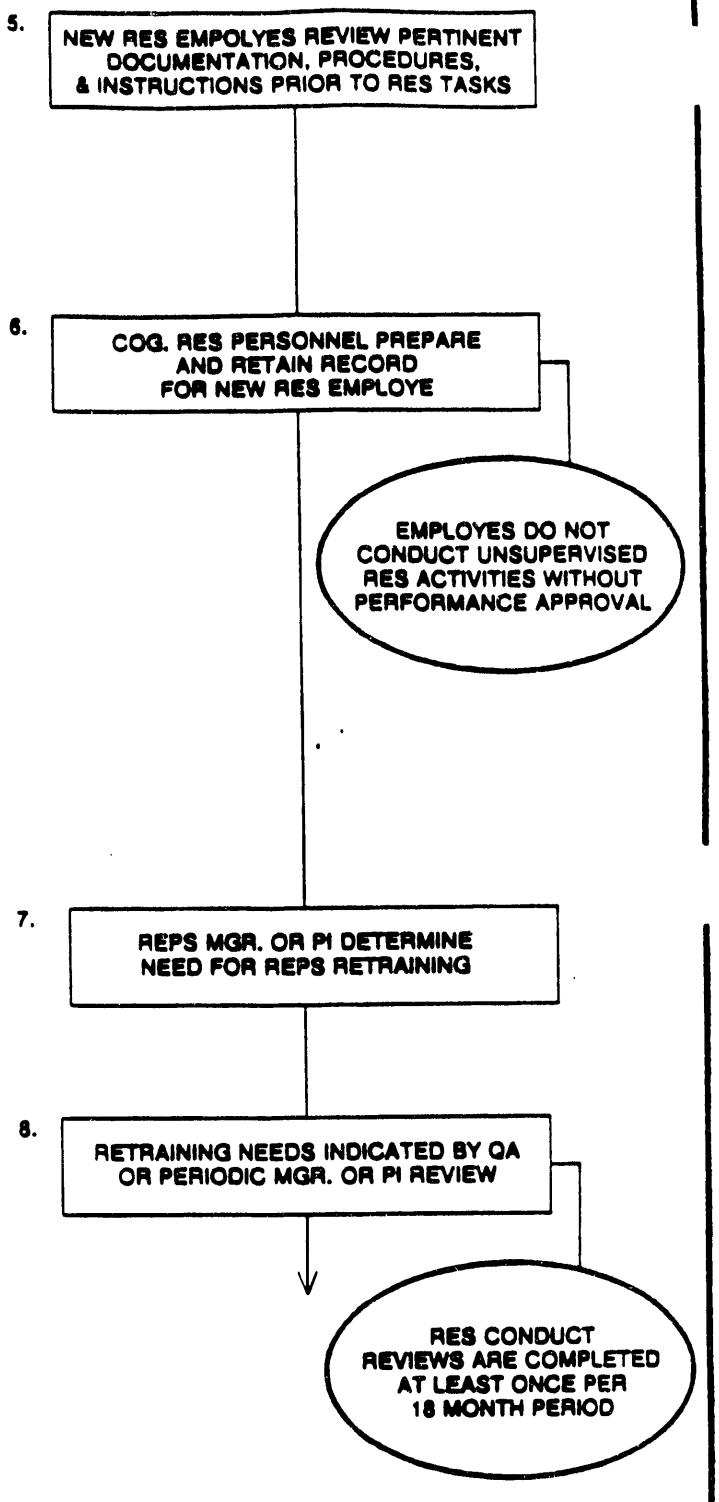
6. A record (i.e., letter-to-file) shall be prepared by the cognizant RES personnel responsible for new employe indoctrination; this record is retained in the REPS files.

NOTE: No employe shall be allowed to conduct an unsupervised or specific RES activity without documentation of prior conduct of the specific activity, with indication of satisfactory performance by a qualified REPS staff member.

7. The REPS manager and/or the PI determine the need for retraining of REPS personnel.

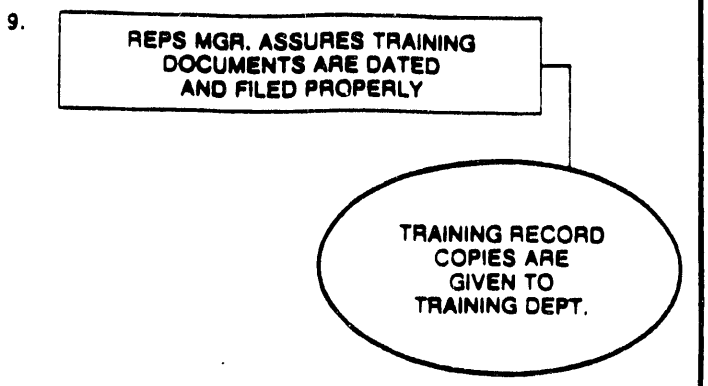
8. Indication of a need for retraining may be noted (1) by QA, during any overview or audit; or (2) during a periodic review initiated by PI or REPS Manager.

NOTE: A review of the conduct of all RES activities, either by QA overview or internal review, should be completed at least once during any 18 month period.



9. The REPS Manager assures that documents detailing all staff training are up to date and properly filed.

NOTE: Copies of training records should be given to the Training Department.



(5.3) RES Reporting

1. The REPS Manager is responsible for preparation and distribution of RES reports, in accordance with appropriate DOE Orders, policies, and directives.

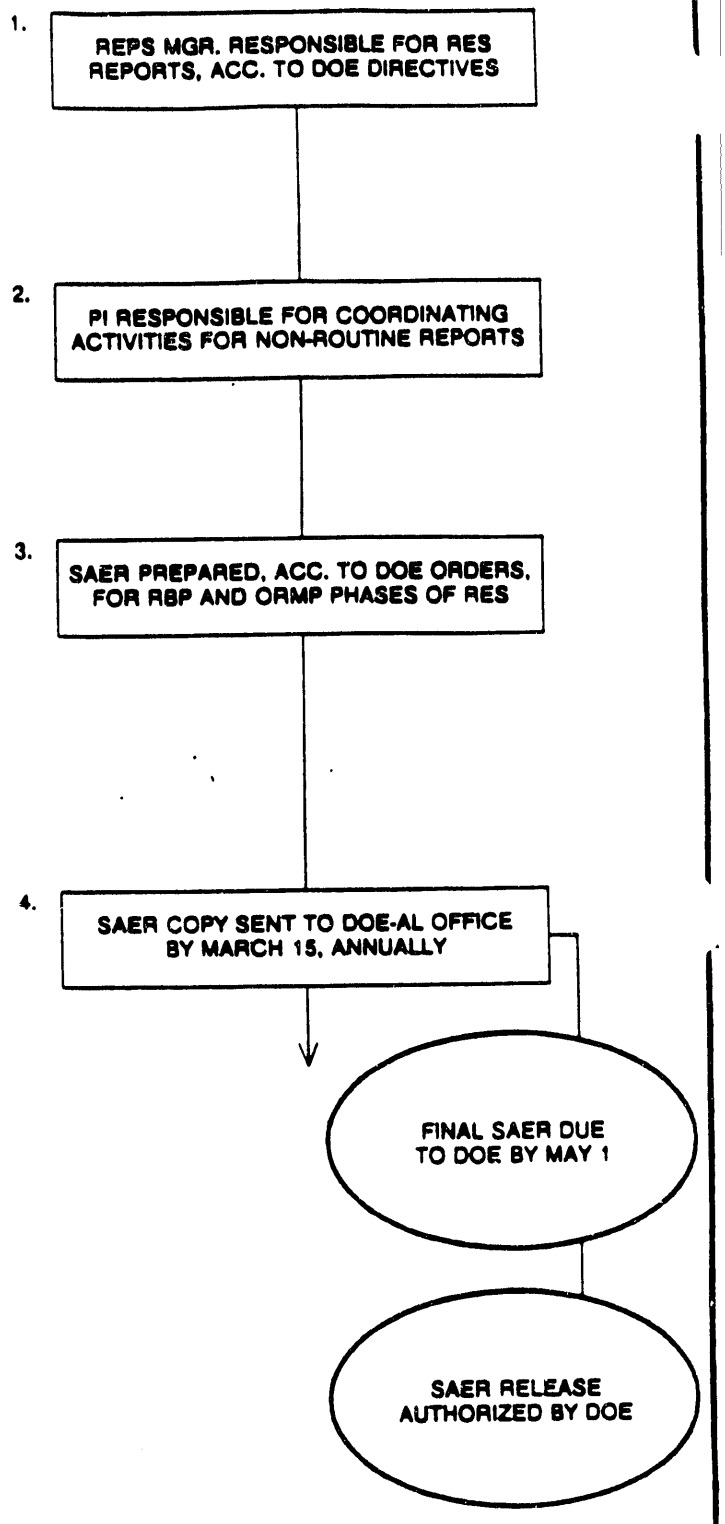
2. The PI is responsible for coordinating the preparation and review of specific routine and non-routine reports as listed below.

3. The Site Annual Environmental Report (SAER) is prepared according to DOE Draft Order 5484.1, 7/8/84, Chapter III, and DOE-AL Order 5484.1, 8/23/82; it is required during the RBP and ORMP phases of RES.

4. A draft copy of the SAER covering the previous year is due to DOE Environmental, Safety and Health Division, Albuquerque Operations Office (ESHD-AL) by March 15 of each year.

NOTE: The final SAER is due to the DOE Office of Operational Safety by May 1.

NOTE: Release of SAER for general distribution must be authorized by DOE, ESHD-AL.

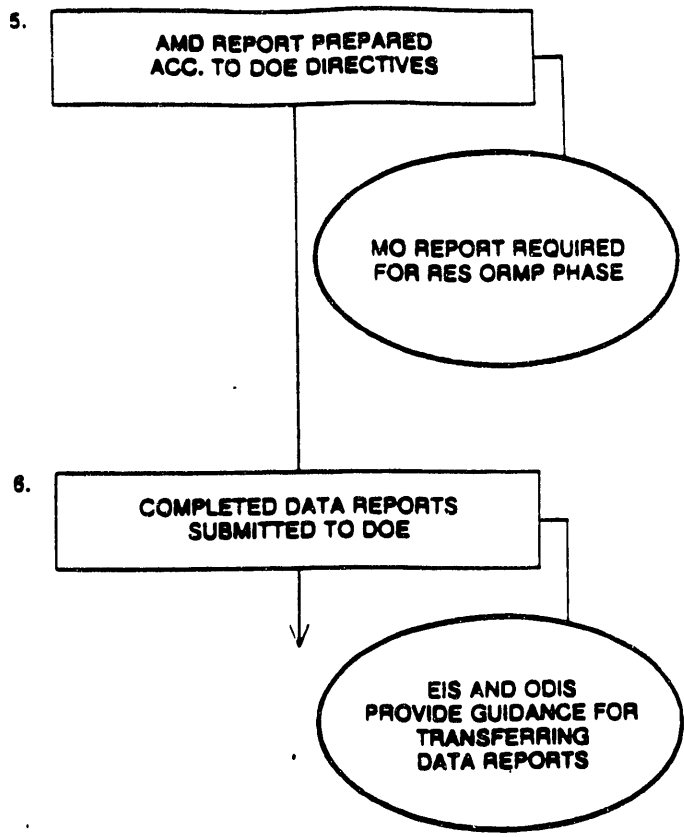


5. The Annual Monitoring Data Report is prepared according to DOE Order 5484.1, 2/24/81, Chapter IV.

NOTE: The Monitoring Data Report is required only for the ORMP phase of RES.

6. Completed data reports, Form DOE F5821.1 (Rev. 11-80) or SACNET submittal, covering the previous calendar year are due to Information System Branch, EG&G Idaho, Inc. by April 1, with a copy of cover letter to DOE Operational and Environmental Safety Division.

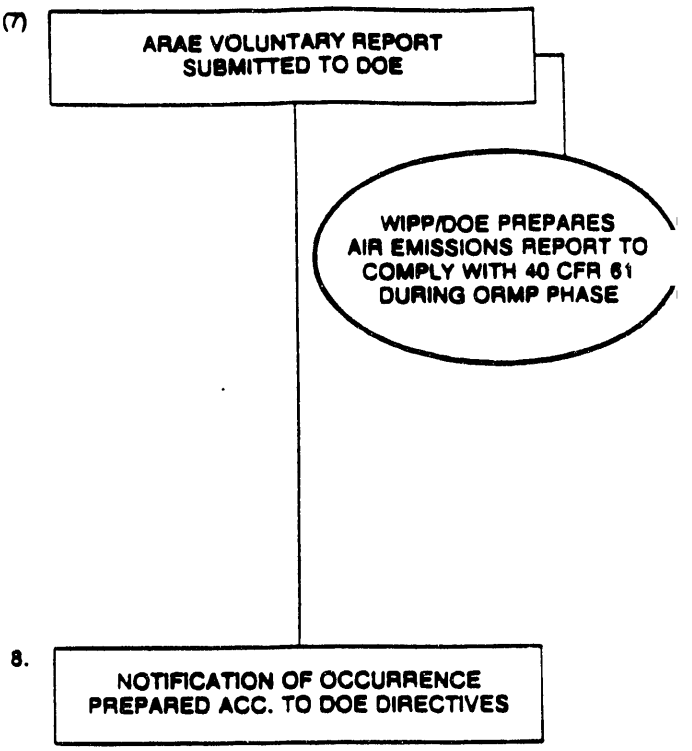
NOTE: Effluent Information System (EIS) and Onsite Discharge Information System (ODIS), Users Manual, 10177, provides guidance for compiling and transferring data reports to Idaho, etc.



(7) The Annual Radionuclide Air Emissions Report (40 CFR 61.94, Subpart H) is a voluntary report submitted by April 15 to DOE, ESHD-AL, for emissions covering the previous calendar year.

NOTE: 40 CFR 191 exempts WIPP from the requirements of 40 CFR 61. WIPP/DOE will prepare an air emissions report annually that complies with the intent of 40 CFR 61. The report will be compiled only for the ORMP phase of RES.

8. A Notification of Occurrence is prepared according to DOE Order 5484.1, 2/18/81. Chapter I, of this Order describes the categories of occurrences that require immediate notification.



(5.4) RES Records/Document Control

1. RES records are administered by the REPS Manager in accordance with guidance provided by WP 15-030.

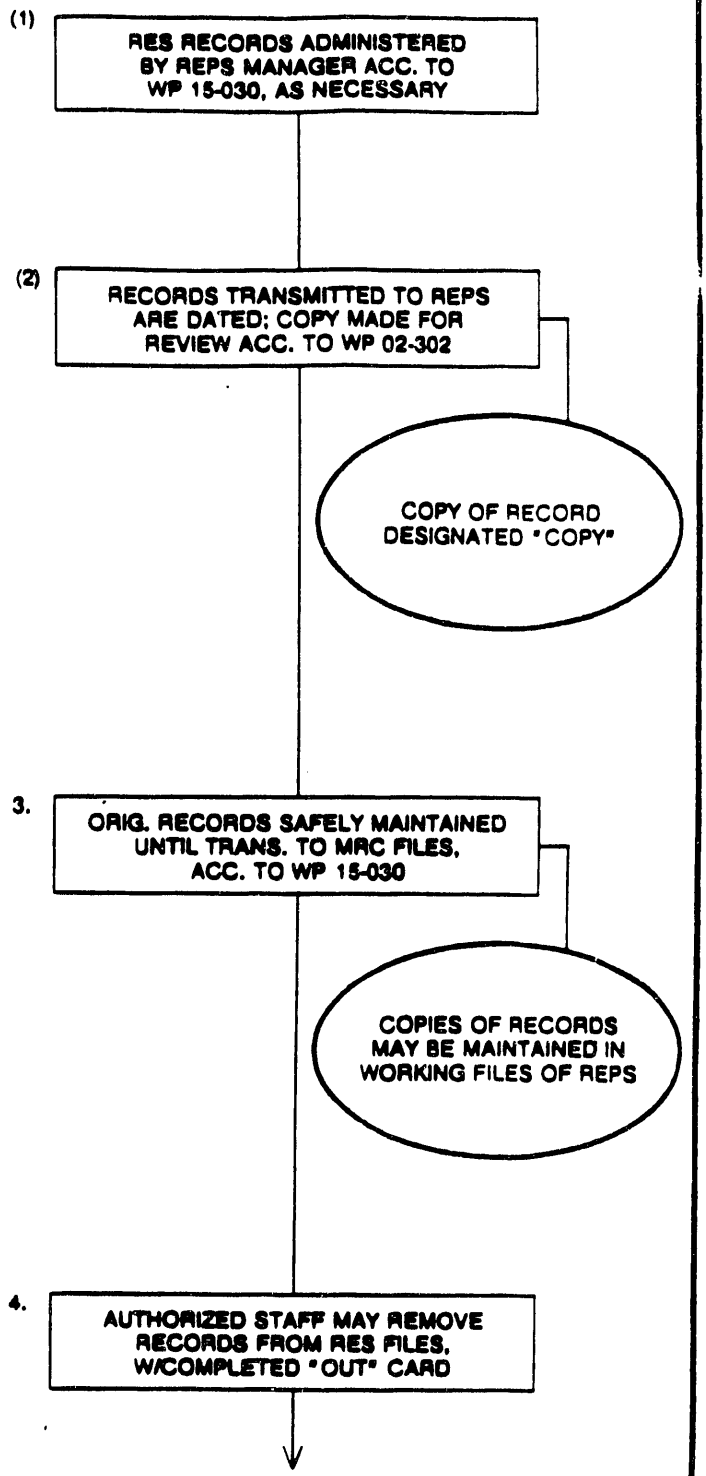
(2) Records (such as reports of analyses, sample receipt forms, etc.) transmitted to REPS by a contract analytical laboratory shall be dated upon receipt, and a copy made for subsequent QC review per procedure (WP 02-302).

NOTE: The copy of the record should be so designated (i.e., COPY).

3. The original records are maintained in a fire-proof file cabinet until transmittal to the Master Records Center for permanent filing per WP 15-030.

NOTE: Copies of records may be maintained in individual REPS working files during periods of review by cognizant personnel.

4. Removal of records from RES files shall be limited to authorized staff. An "OUT" card should be completed and filed to note any record removed from the file.



5. An RES record or document originating in the REPS shall be reviewed for technical adequacy by qualified personnel, and the review documented prior to transmittal of the originating document beyond the Environment, Safety, and Health Department.	5. RES RECORDS FROM REPS ARE REVIEWED PRIOR TO TRANSMITTAL OUTSIDE ESH DEPT.

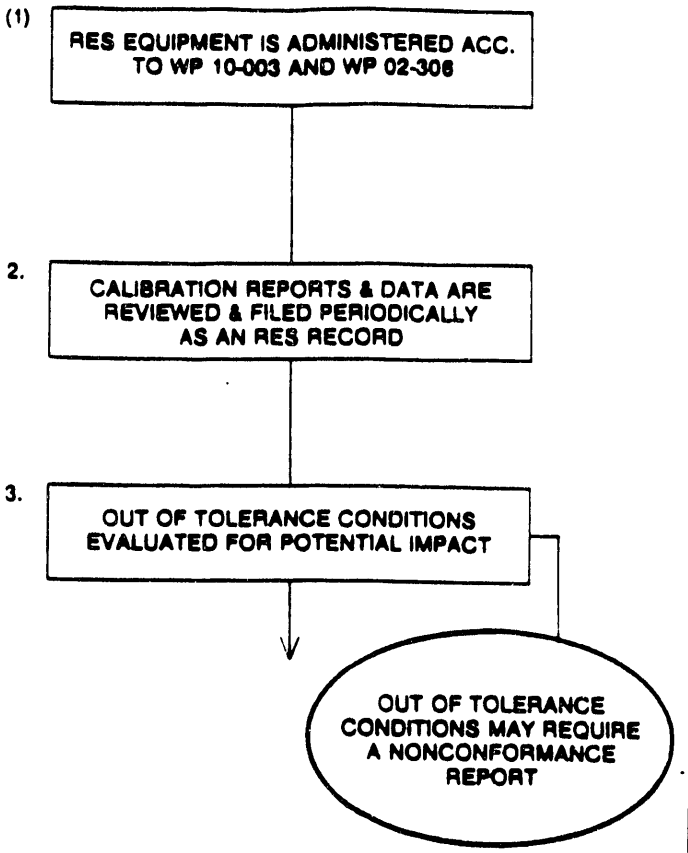
(5.5) Calibration of RES Equipment

(1) RES equipment is administered in accordance with WP 10-003 and WP 02-306.

2. Calibration reports and operability test data are reviewed at least once per quarter and filed as an RES record.

3. Any "out-of-tolerance" condition is evaluated for potential impact on the validity of data. Impact evaluation and corrective actions are initiated per specific RES instructions

NOTE: An "out-of-tolerance" condition may require a Nonconformance Report be initiated according to WP-QPM.XV.



5.6 Procurement

1. All items purchased for use in the RES will be processed in accordance with WP 15-009.

1. ITEMS FOR RES USE PROCESSED ACC. TO WP 15-009

(5.7) RES Planning and Scheduling

(1) The PI is responsible for maintaining a general schedule for sampling activities as specified in the Environmental Programs Plan, and in detailed quarterly schedules described in WP 02-303. The PI is also responsible for revising the schedule as needed to assure that the program objectives are satisfied.

NOTE: WTSD-TME-057 discusses the RBP design and presents the projected sample schedule for the program.

(1) PI RESPONSIBLE FOR ESTABLISHING & REVISING SAMPLING SCHEDULE, ACC. TO WP 02-303

WTSD-TME-57 DISCUSSES RBP DESIGN AND PRESENTS SAMPLE SCHEDULE

(5.8) RES Procedures

This section establishes the process for preparing, utilizing, revising, and controlling RES procedures, so as to provide a detailed record of the conduct of RES activities.

(1) The PI prepares/revises RES procedures in accordance with the standard format detailed in WP 15-101.

(2) The PI submits a draft of a procedure to Publications and Procedures (P&P) prior to internal or manager review.

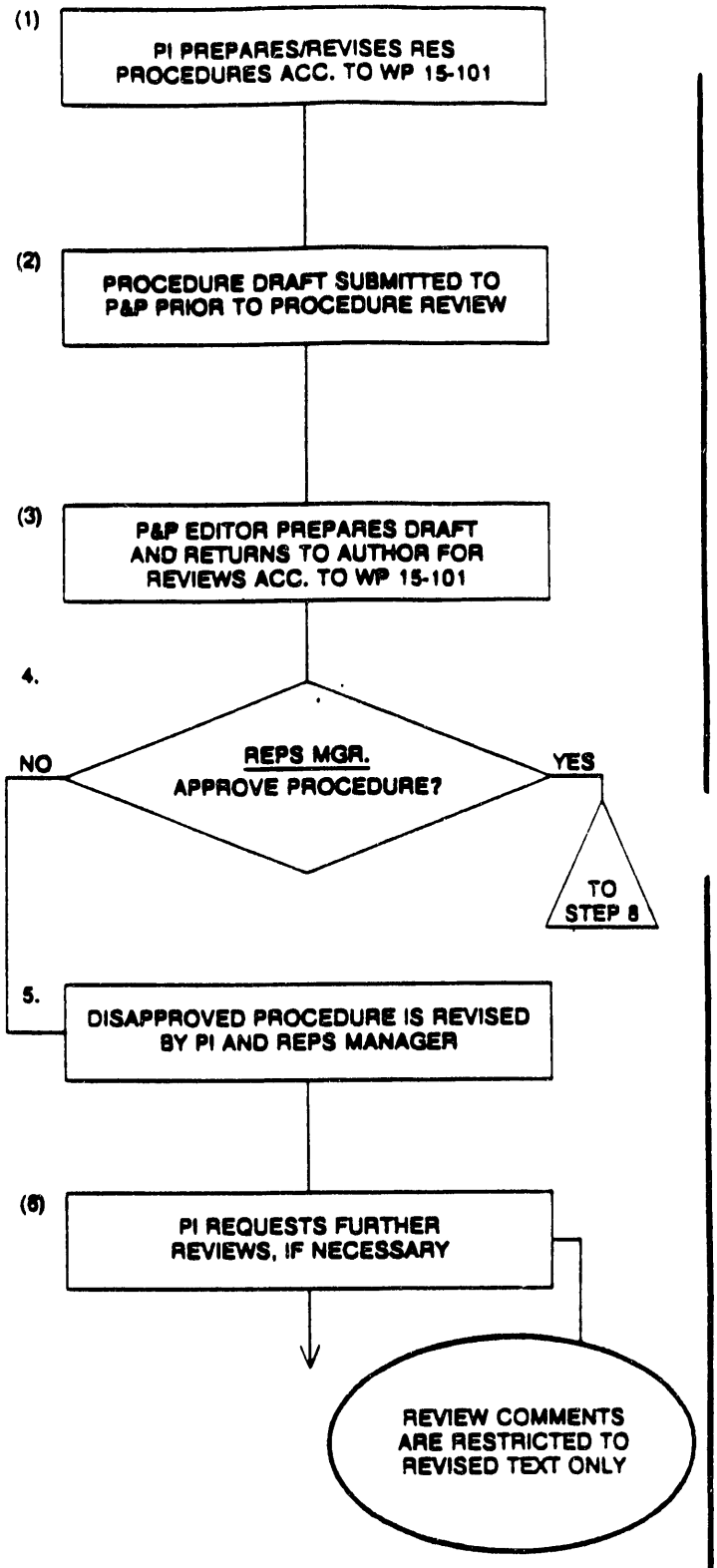
(3) A P&P editor prepares the draft for review and returns it to the author, who prepares the draft for manager review according to WP 15-101.

4. The REPS Manager reviews draft to determine approval.

5. If the draft is not approved, the PI and REPS Manager coordinate to revise draft.

(6) The PI may request review of the procedure by appropriate departmental groups.

NOTE: Review comments on procedure revisions should be restricted to changes on the revised text only.



(7) When all review comments have been resolved and incorporated, if applicable, a revised draft is submitted to the REPS Manager for review and approval.

(8) The final RES procedure, once it has been completely reviewed and once all review comments have been resolved, is sent with a letter of verification to P&P for controlled distribution.

(9) The final, signed draft of the procedure is transmitted to Document Control for issuance to the Environmental Procedure Manual, WP 02-3.

NOTE: WP 15-006, Document Control, details the process for preparing/submitting documents for controlled distribution.

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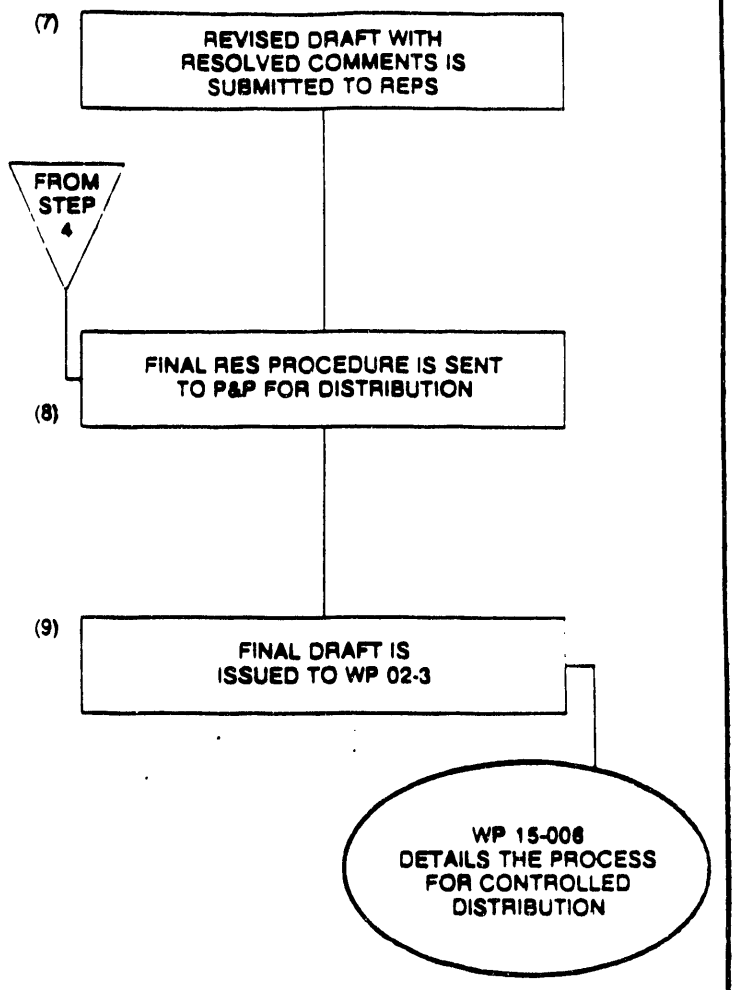

GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation - The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample - A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source - A standard radiation source that is used for calibration of a measurement system.

Check Source - A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway - The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector - A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent - The liquid or gaseous waste streams released to the environment.

Emission - Any airborne radioactive material released to the environment.

Environmental Medium - A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs - The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule - A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample - A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber - An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Particle - An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

REFERENCES AND STANDARDS
Radiological Environmental Surveillance

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Waste Isolation Pilot Plant Procedure WP 15-006, Document Control, Westinghouse Electric Corporation, Carlsbad, NM.

Waste Isolation Pilot Plant Procedure WP 15-009, Preparation and Review of Purchase Requisitions and Change Requisitions, Westinghouse Electric Corporation, Carlsbad, NM.

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FORM AND PREPARATION OF RES INSTRUCTIONS

The following documents are representative of the kinds of information used for guidance in preparing RES instructions:

- o WIPP-Safety Analysis Report
- o ANSI, applicable standards
- o DOE Orders, policies, directives and guidance documents, as applicable
- o NBS, applicable publications
- o NRC Reg. Guides, and NUREGS, applicable guidance
- o EPA Publications, applicable guidance
- o NCRP Reports, applicable publications
- o ASTM, applicable standards
- o ISO, applicable standards

DOCUMENT IDENTIFICATION

Instruction identification normally appears in the upper right corner on all pages, including the attachments. The type of information to be included in the instruction and attachments is defined below:

Front Page:

1) Instruction Number: Top right hand corner area

2) Revision Number: Top right hand corner area

3) Issue/Effective Date: Top right hand corner area

4) Authorization Signature: Top right hand corner area

5) Supersedes Number: This space is not to be used for revisions of instructions. It is to be left blank if the instructional revisions do not supersede a previous instruction.

6) Page: Total number of pages require identification

7) Title Line: Beneath form logo and items included in upper right hand corner.

Attachments, if any, and Pages Other than Front Page:

1) Identification: Use instruction number and/or attachment designator.
2) Page number of the attachment material.
3) Revision number of instruction and/or attachment.

FORMAT

Subject titles shall be entered in the appropriate location on the front page, in capital letters, and not underlined.

Standardized format of an instruction, numbering should be consistent with numbering sequence indicated as follows: 1.0 Scope; 2.0 General; 3.0 Specific Requirements; Attachments.

Major headings of sections shall be titled, arranged in sequence, and are capitalized and underlined.

Subsections should not extend lower than the third order under any major heading section.

Major Headings

1) Scope: A scope section shall be included in each instruction. It should provide a concise, clear statement concerning the RES activity directed by the instruction.

2) General: This section is optional and, when included, specifies those general requirements for the specific RES task being implemented by the instruction.

3) Specific Requirements: This section specifies that step by step narrative for successful conduct of the indicated task.

Instructions will be revised as required by the REPS Manager. Although instructions may be revised at any time, based on need, each RES instruction will be reviewed and updated, if necessary, within 12 to 18 months of the issue date of the instruction.

Distribution and control of the Environmental Procedure and Instruction Manual shall be in accordance with applicable sections of WP 15-006, Document Control.

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LIST OF REVIEWERS

Procedure Number: WP 02-301

Revision Number: 1

Procedure Title: Radiological Environmental Surveillance (RES) Implementation

Reviewer's Name	Department
T. Fischer	REPS
J. Cockman	REPS
A. Rodriquez	REPS
R. Kehrman	REPS
R. Youngman	QA

NO: 02-302 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES/RES QUALITY ASSURANCE/QUALITY CONTROL IMPLEMENTATION PROCEDURES

1.0 SCOPE

This document provides procedures for maintaining the necessary Quality Control (QC) records to document the activities associated with the Radiological Environmental Surveillance (RES) and Nonradiological Environmental Surveillance (NES) Programs conducted by the Radiological and Environmental Programs Section (REPS). This procedure provides guidance to supplement other WIPP and REPS procedures satisfying the requirements for programmatic QC.

2.0 DEFINITIONS

Refer to Attachment 1.

3.0 REFERENCES

Refer to Attachment 2.

4.0 GENERAL

This procedure describes the steps which demonstrate that daily activities not specifically controlled through implementation of other procedures are checked, traceable, and appropriately controlled to assure the validity of results.

Individual NES and RES procedures are issued to direct the appropriate level of control for sampling, planning, scheduling, collecting, tracking, and assuring equipment function.

The following procedures are presented in this document:

5.1 Information Verification
5.2 Calculations
5.3 Computer Programs
5.4 Computer Input
5.5 Figures and Tables
5.6 Internal Review and Control

5.0 PROCEDURE

5.1 Information Verification

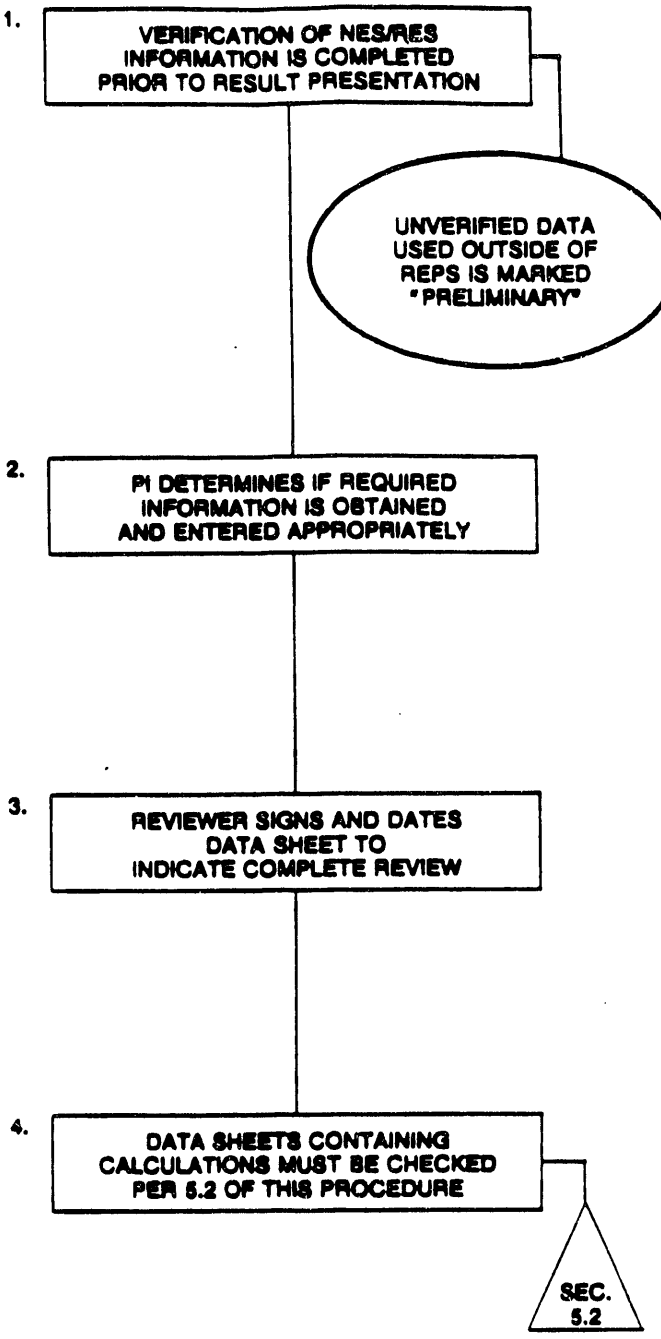
1. Verification of NES/RES information shall be completed prior to presentation of results.

   NOTE: If it becomes necessary to present unverified data for use outside the REPS, the information must be marked "Preliminary" until the verification process is completed.

2. The Principal Investigator (PI) or designee shall review data sheets for completeness and to see that the applicable information required by specific sampling procedures has been entered appropriately.

3. Reviewer signs and dates the data sheet to indicate a completed review, before the data sheet is processed per procedure WP 02-305 and WP 02-334 for data management.

4. Data sheets containing calculations must also be checked as described in 5.2 of this document.



5.2 Calculations

1. All calculation sheets will clearly indicate the originator and date of preparation.

2. The PI or designee is responsible for completing checks.

   NOTE: The checker shall not be the person who performed the original work.

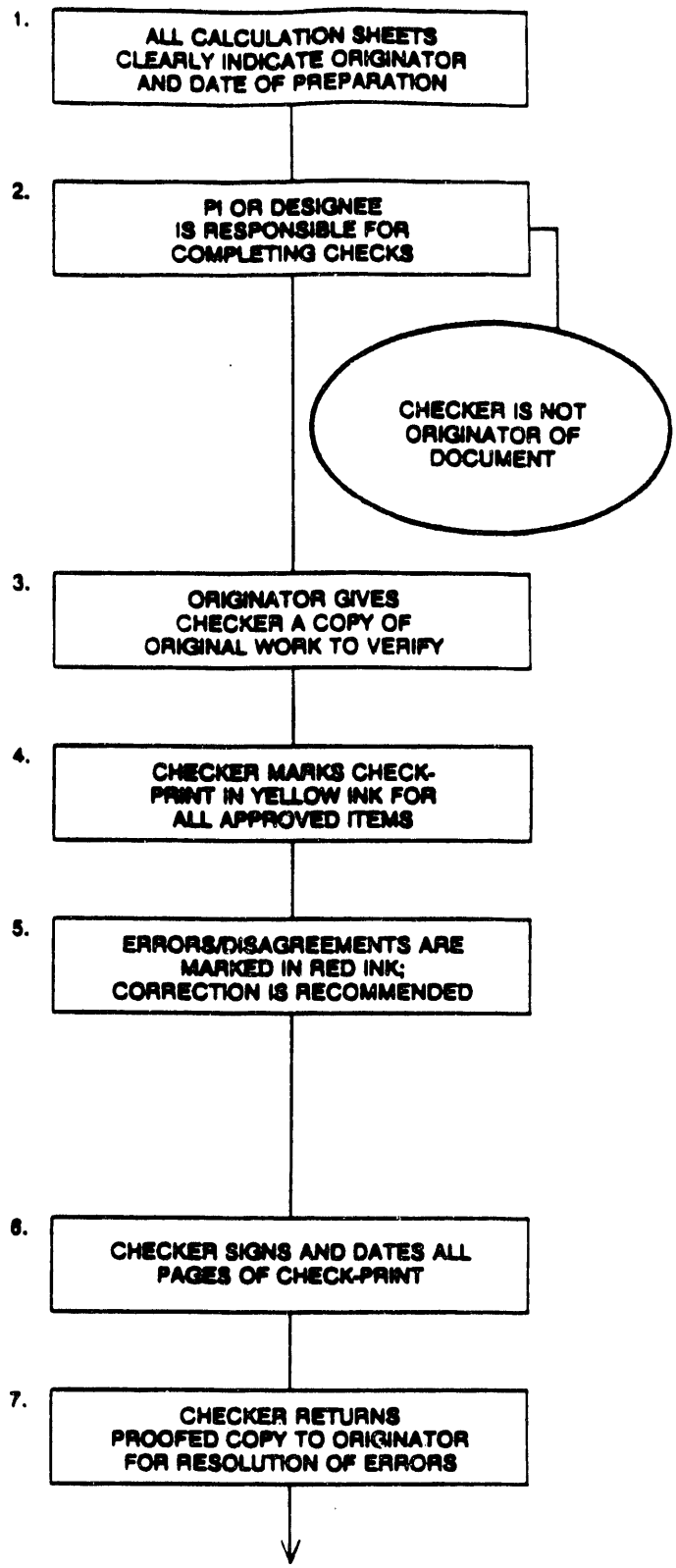
3. Originator provides a copy of the original work to the checker for purposes of verifying calculations.

4. The checker marks the check copy (check-print) with a yellow marker for all items reviewed and approved.

5. If an error is noted or the checker disagrees with calculation, the item is marked with a red marker and a written recommendation for correction is noted clearly on the check-print.

6. The checker signs and dates all pages of the check-print.

7. The checker returns the check-print to the originator for resolution of any item requiring correction.



8. The originator neatly corrects the originals to reflect the agreed upon value(s).

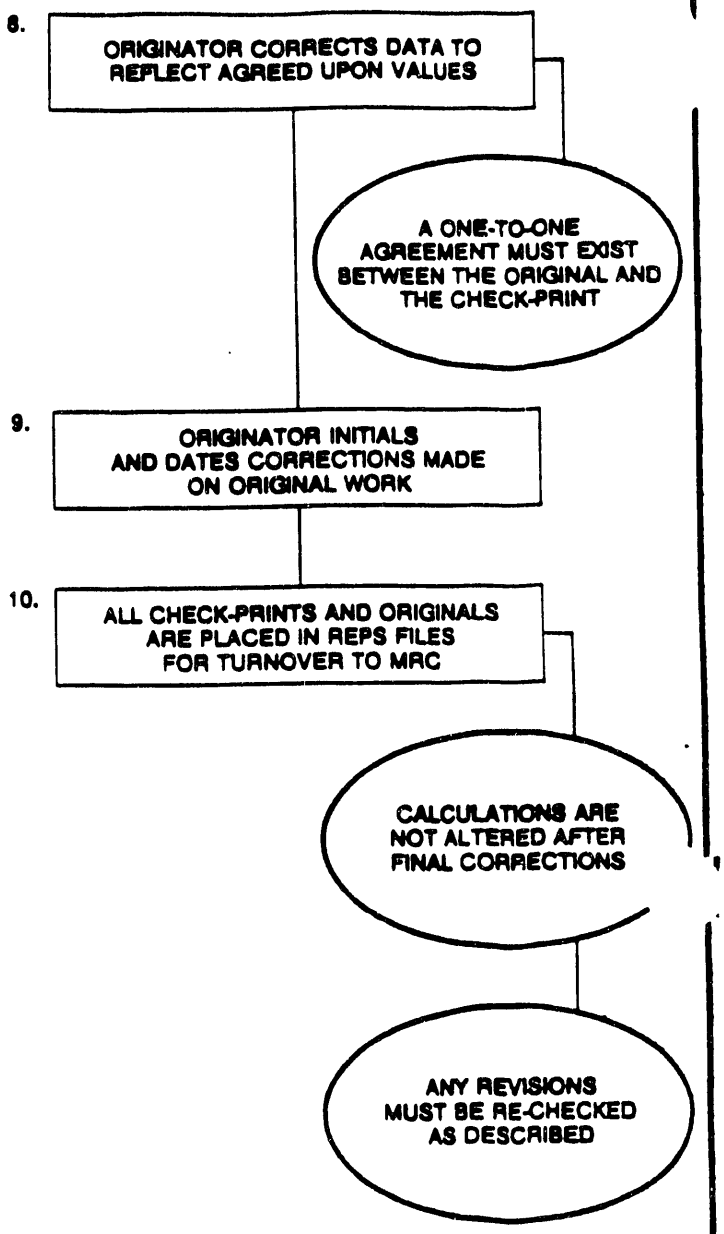
NOTE: A one-to-one agreement between the original and the check-print must exist.

9. The originator initials and dates corrections made on original work as a result of the checking process.

10. All check-prints and originals are placed in the REPS files for turnover to Master Records Center.

NOTE: Under no circumstances are calculations to be altered after final resolution of check-print corrections.

NOTE: If it becomes necessary for calculations to be revised, the new page(s) must be rechecked as described above and the previous originals voided.



5.3 Computer Programs

Each computer program is verified as necessary to satisfy the needs of REPS programs.

1. A case-by-case determination of required verification is made by the REPS Manager or PI. The verification shall be performed using one or more of the following methodologies.

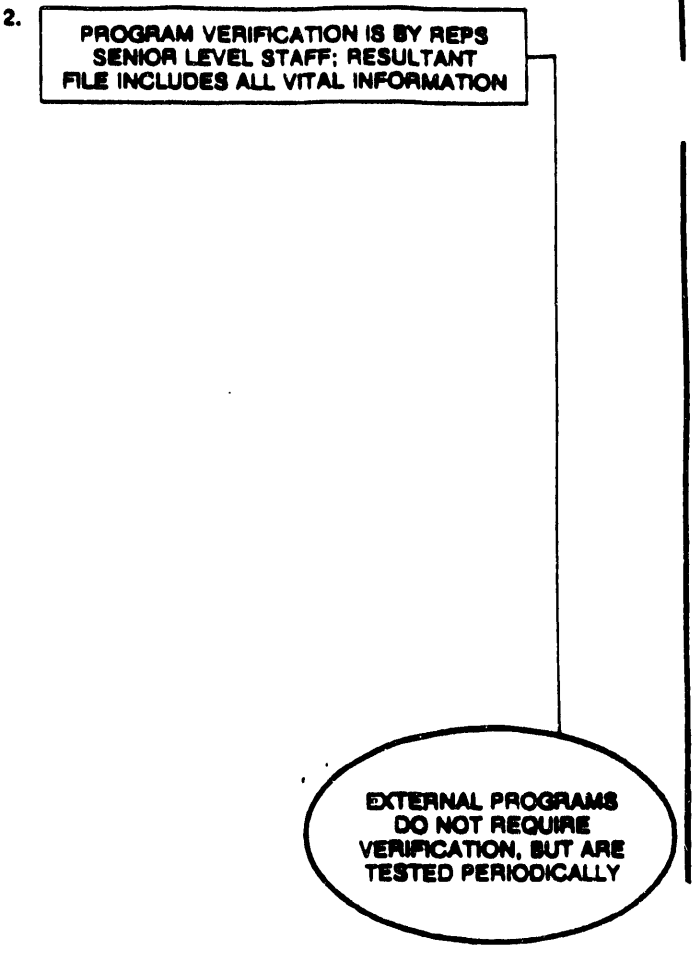
   - o Independent hand calculations to verify program results. These calculations are performed and checked in accordance with Section 5.2 in this procedure.
   - o Program results compared to the results of an independently developed program which performs the same function. Input to both programs should be independently checked in accordance with Section 5.4 of this procedure.
   - o Program results compared to analyses published in textbooks, journals, or the results of testing activities, if available. Complete reference for material used shall be provided.

1. CASE-BY-CASE DETERMINATION OF VERIFICATION REQUIREMENTS MADE BY REPS MANAGER OR PI

2. Verification of a program shall be done by REPS senior level staff. This verification shall result in a record to file containing information such as:

   - o Program version and verification status (date of revision, revision number, responsible individual(s), date of verification, and content of revision).
   - o Description and explanation of verification method.
   - o Set of comparison/ verification materials (checked hand calculations, test results, textbook reference, etc.).
   - o Copy of program verification run (original printout of program run).

   NOTE: External programs which are widely used and documented with sample problems and are considered "industry standards" do not require verification, but shall be tested periodically to demonstrate correct operation (e.g., duplicate runs with "standard" sample problems).



5.4 Computer Input

1. Computer input data is reviewed by the individual responsible for input of the data into the computer.

2. A computer-generated hard copy is checked against the original source document.

3. The checker uses a yellow marker to identify all items of input reviewed and approved.

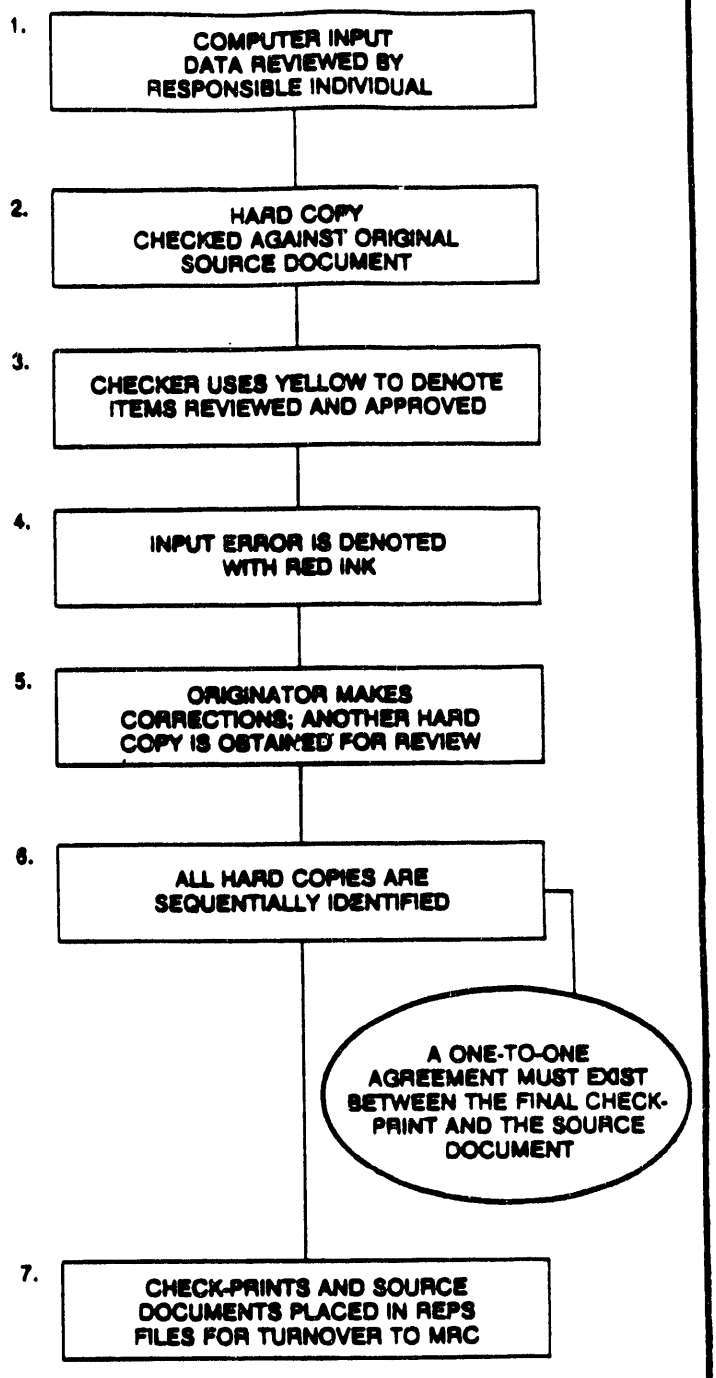
4. An error in input is noted in red on the computer hard copy.

5. The originator makes corrections and inputs values; another computer hard copy is obtained for review.

6. All hard copies are sequentially identified.

   NOTE: A one-to-one agreement between the final input check-print and the source document must exist.

7. Check-prints and source document are placed in REPS files for turnover to Master Records Center.



5.5 Figures and Tables

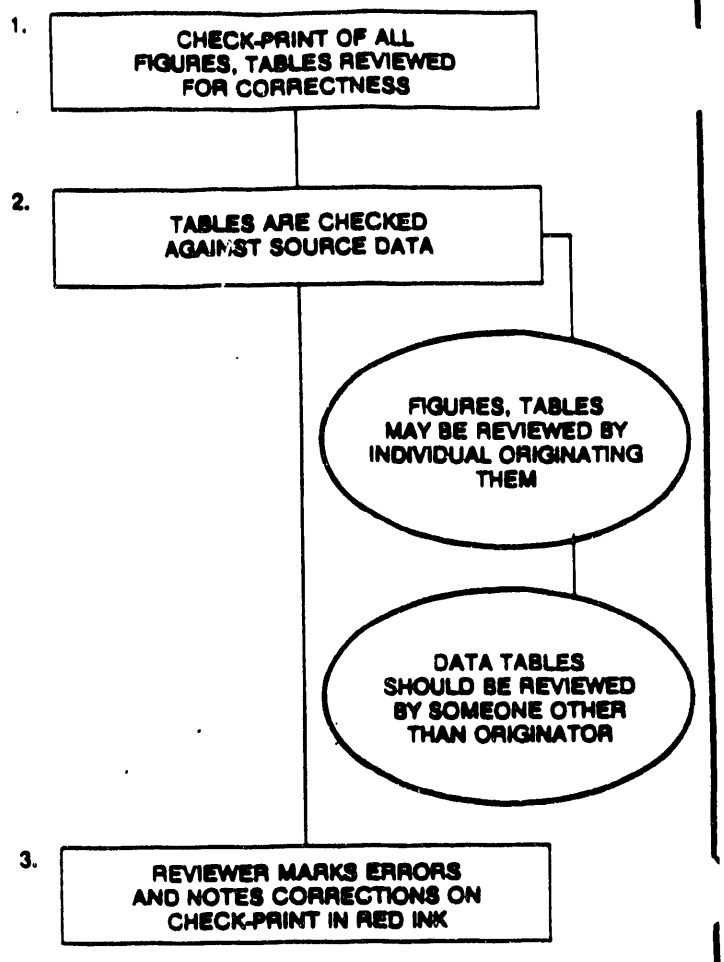
1. A check-print of all figures and tables is reviewed for correctness.

2. Tables are checked against the source data.

   NOTE: Figures and tables may be reviewed by the individual originating them.

   NOTE: It is recommended that someone other than the originator should do check-prints of data tables.

3. Reviewer will mark errors and note corrections on the check-print in red, and will sign and date each subsequent check-print until a correct print is obtained.



5.6 Internal Review and Control

1. Programmatic records received or generated by the REPS staff are marked with the date received or recorded.

2. Dated originals are placed in REPS files.

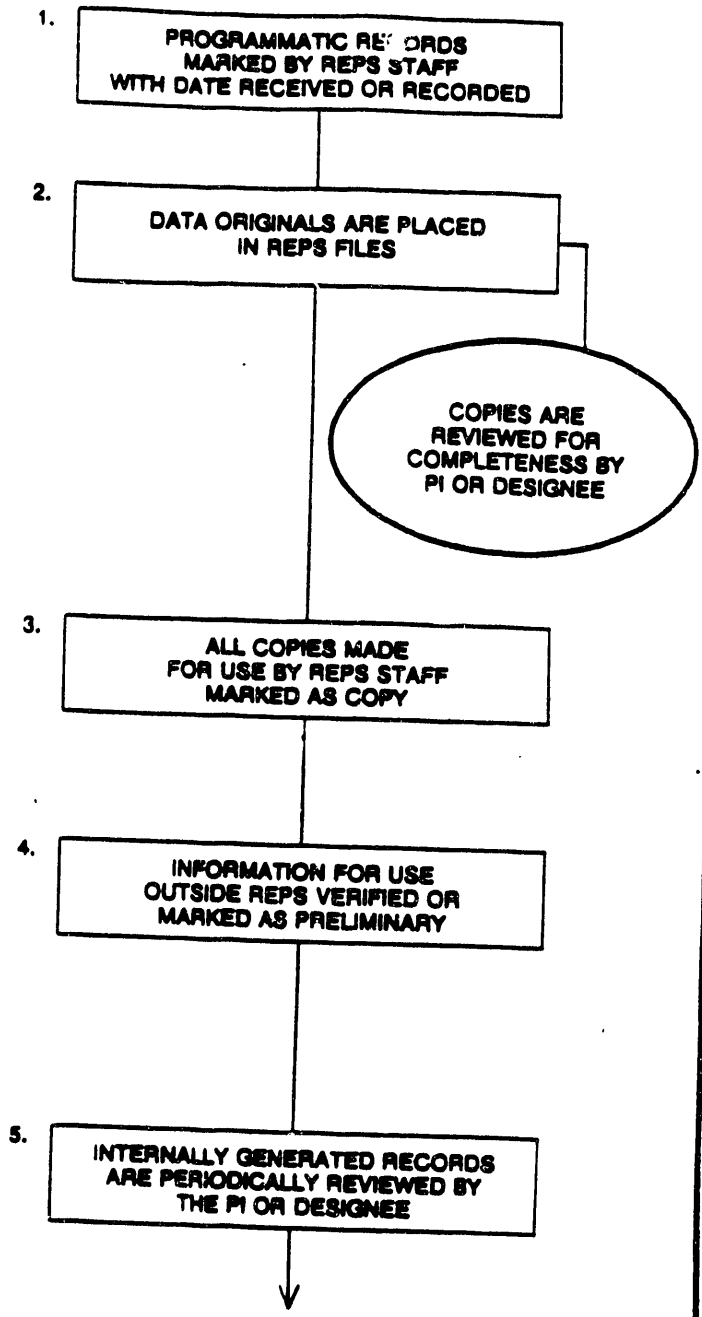
   NOTE: Copies of original record should be promptly reviewed for completeness and technical merit by PI or designee.

3. Original information in REPS files which is copied for use by REPS staff is marked as "copy."

4. Information made available for use outside REPS are verified prior to release or marked as "Preliminary."

5. Internally generated records, including but not limited to the following, are periodically reviewed by the PI or designee to evaluate performance of equipment or personnel.

   - o Equipment records
   - o Sample Analysis Quarterly Schedules and Sample Tracking Logbook
   - o Data Sheets
   - o Sample Tracking documents
   - o Data Input check sheets
   - o Computer Program verification reports
   - o Calculation check sheets



6. Field personnel who note any equipment, conditions, or activities which differ from criteria established by procedures or programmatic requirements, shall report findings to the PI.

7. Conditions, items, and activities noted during review or reported by field personnel which indicate departure from established criteria are summarized in a variance report.

8. The PI shall evaluate the impact of the variance condition on quality or reliability of environmental surveillance activities. Corrective action will be initiated as necessary.

9. The REPS Manager will be notified immediately of any variance condition which may affect the validity of data collected or impact the results of quality control activities. A determination will be made if the condition constitutes a nonconformance. Nonconformances will be reported in accordance with WP 13-002, Corrective Action Procedure, or WP 13-003, Nonconformance Control. Required steps will be taken to rectify the problem.

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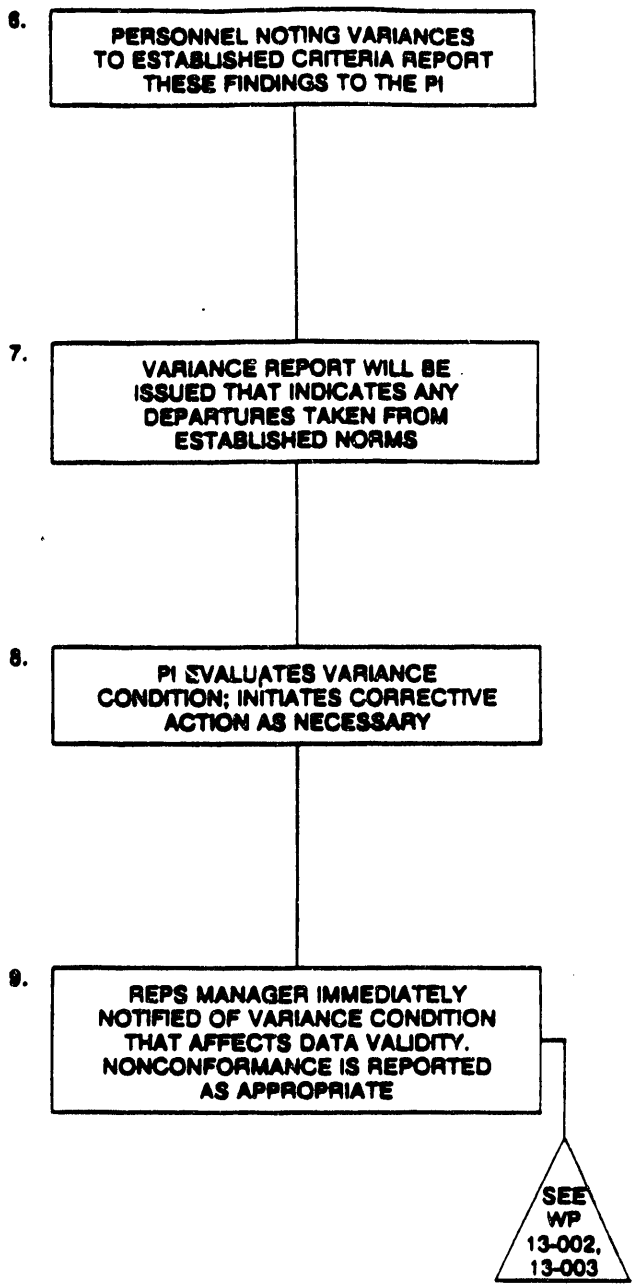

GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation - The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample - A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source - A standard radiation source that is used for calibration of a measurement system.

Check Source - A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway - The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector - A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent - The liquid or gaseous waste streams released to the environment.

Emission - Any airborne radioactive material released to the environment.

Environmental Medium - A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs - The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule - A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample - A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber - An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Particle - An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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LIST OF REVIEWERS

Procedure Number: WP 02-302

Revision Number: 0

Procedure Title: NES/RES QUALITY ASSURANCE/QUALITY CONTROL IMPLEMENTATION PROCEDUI

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriquez	REPS
R. Youngman	QA

NO: 02-303 REV. 0 ISSUE DATE: 01/07/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: RES SCHEDULING, DOCUMENTATION, AND FIELD PREPARATION PROCEDURE

1.0 SCOPE

This document describes the procedures to be followed for the scheduling of sampling activities, and for the preparation of the necessary documentation for tracking both the collected sample and information pertaining to that sample. This procedure is pertinent to sample collection activities of the Radiological and Environmental Section (REPS), in support of the Radiological Environmental Surveillance Program. These procedures are in accordance with WP 02-302.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-301, Radiological Environmental Surveillance (RES) Implementation
WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures
Refer to Attachment 1.

4.0 GENERAL

This procedure is divided into two parts. The first part includes Sections 5.1 and 5.2 and describes the preparation of the Sampling Activity Quarterly Schedule (SAQS). The second part includes Sections 5.3 and 5.4 and describes the weekly preparation of sample tracking documentation for each scheduled sample. Sections 5.1 and 5.3 provide detailed procedures for scheduling, labeling, and sample documentation performed manually. Sections 5.2 and 5.4 describe the use of RADCOMP, a REPS scheduling and data management software program used in performing these tasks.

The RES Principal Investigator (PI) or designee will assure that a Sampling Activity Master Schedule (SAMS) for the RES Program is maintained in accordance with the program plan. This master schedule will be reviewed periodically to assure that the overall objectives of the program are achieved. SAMS will contain two types of information for each sampling activity:

- o A description of the frequency or periodicity with which each sampling activity will normally be performed, or specific times during which the sampling activity will take place.

- o A list of potential sampling locations, or sample location "suite" at which the sampling activity will normally take place.

The following activities are described in this document:

5.1 Manual Preparation of the Sampling Activity Quarterly Schedule (SAQS)
5.2 Preparation of SAQS Using RADCOMP
5.3 Manual Preparation of Sample Tracking Information
5.4 Preparation of Sample Tracking Information Using RADCOMP

5.0 PROCEDURE

5.1 Manual Preparation of the Sampling Activity Quarterly Schedule (SAQS)

When RADCOMP software is used to schedule sampling activity, follow the steps described in Section 5.2.

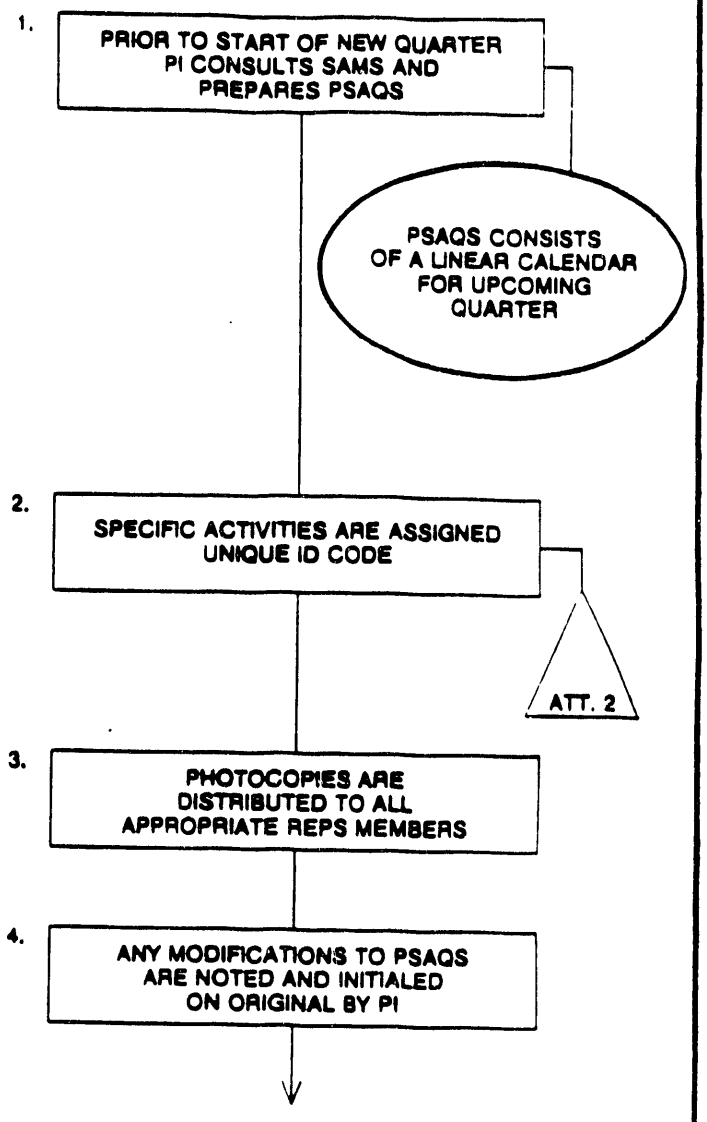
1. Approximately two weeks prior to the beginning of a new quarter, the PI or designee consults the SAMS and prepares a Preliminary Sampling Activity Quarterly Schedule (PSAQS).

   NOTE: PSAQS consists of a linear calendar for the upcoming quarter and the associated sampling activities.

2. Specific sampling activities in each program are assigned a unique identity code listed on Attachment 2. The PSAQS assigns sampling activities to be performed on a specified date, or during the week beginning on a specified date.

3. Photocopies of the PSAQS are distributed to all appropriate REPS staff members. The original is retained by the PI.

4. As the quarter progresses, modifications to the PSAQS are noted and initialed on the original by the PI.

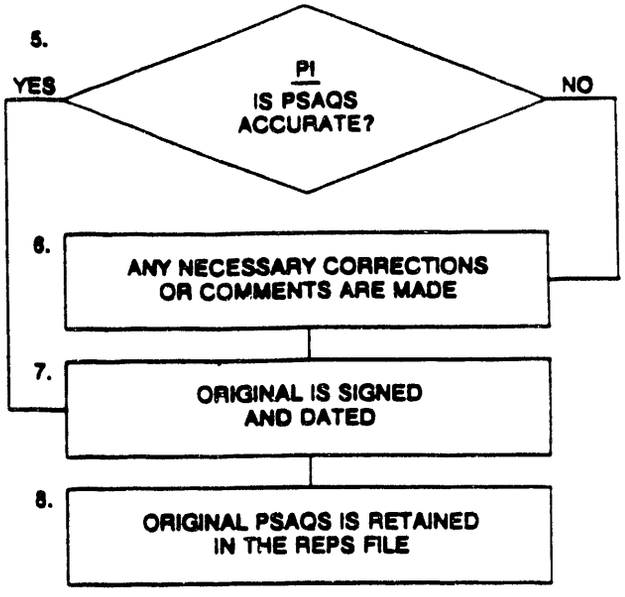


5. At the end of the quarter, the PI reviews the annotated original PSAQS to determine if it accurately reflects performed sampling activities.

6. Any necessary corrections or comments are made.

7. The original is signed and dated.

8. The original PSAQS is retained in the REPS file.



5.2 Preparation of Sampling Activity Quarterly Schedule Using RADCOMP

This procedure replaces 5.1 when sampling activity scheduling is being performed using the RADCOMP computer software package.

1. Approximately two weeks prior to the beginning of the quarter, the PI consults the SAMS to determine upcoming sampling activities.

2. The PI or designee enters all projected sampling activities for the quarter into the RADCOMP scheduling file.

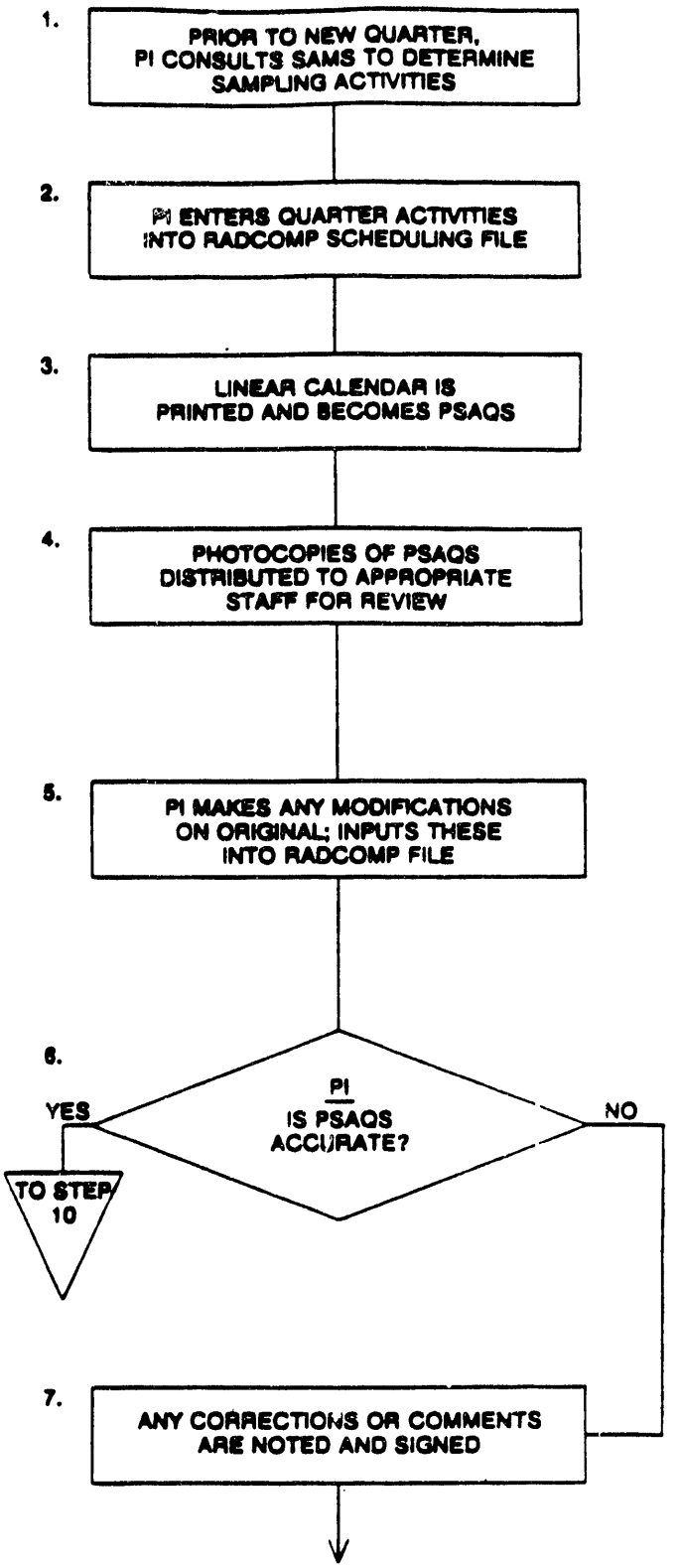
3. A linear calendar for the quarter is printed following the RADCOMP menu items. This linear calendar becomes PSAQS.

4. Photocopies of the PSAQS are distributed to all appropriate REPS staff members for review. The PI retains the original PSAQS.

5. As the quarter progresses, the PI makes any needed modifications to the PSAQS on the original and inputs these modifications into the RADCOMP scheduling file. Changes on the PSAQS will be dated and initialed by the PI.

6. At the end of the quarter, the PI reviews the annotated original PSAQS to determine if it accurately reflects performed sampling activities.

7. Any necessary corrections or comments are noted and signed.

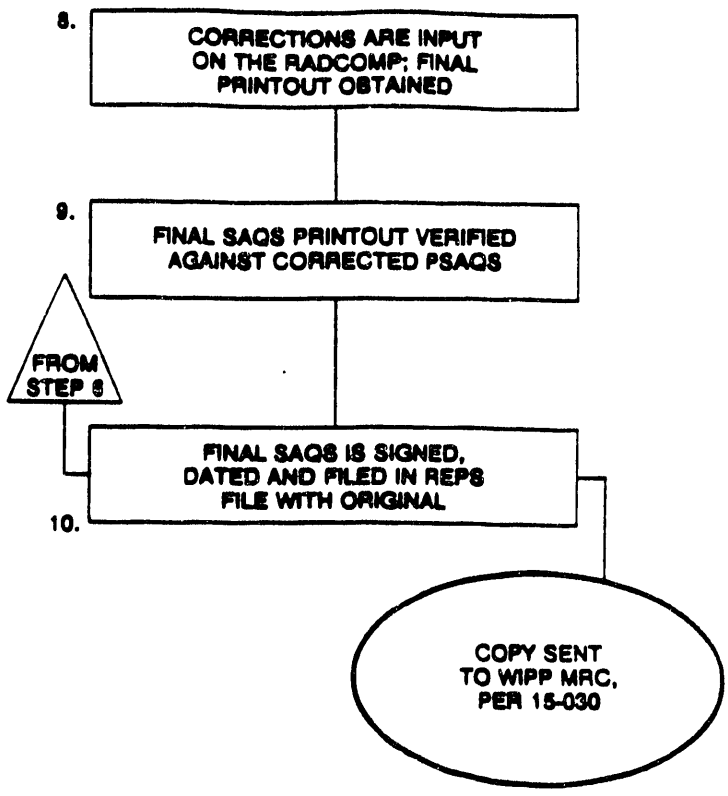


8. Corrections are input on the RADCOMP scheduling file and a final printout of the RADCOMP SAQS is generated.

9. The final SAQS printout is checked against the corrected original PSAQS per WP 02-301.

10. The Final SAQS is signed, dated, and filed in the REPS file with the corrected original attached.

NOTE: A copy of the final SAQS is sent to the WIPP MRC, per WP 15-030.



5.3 Manual Preparation of Sample Tracking Information

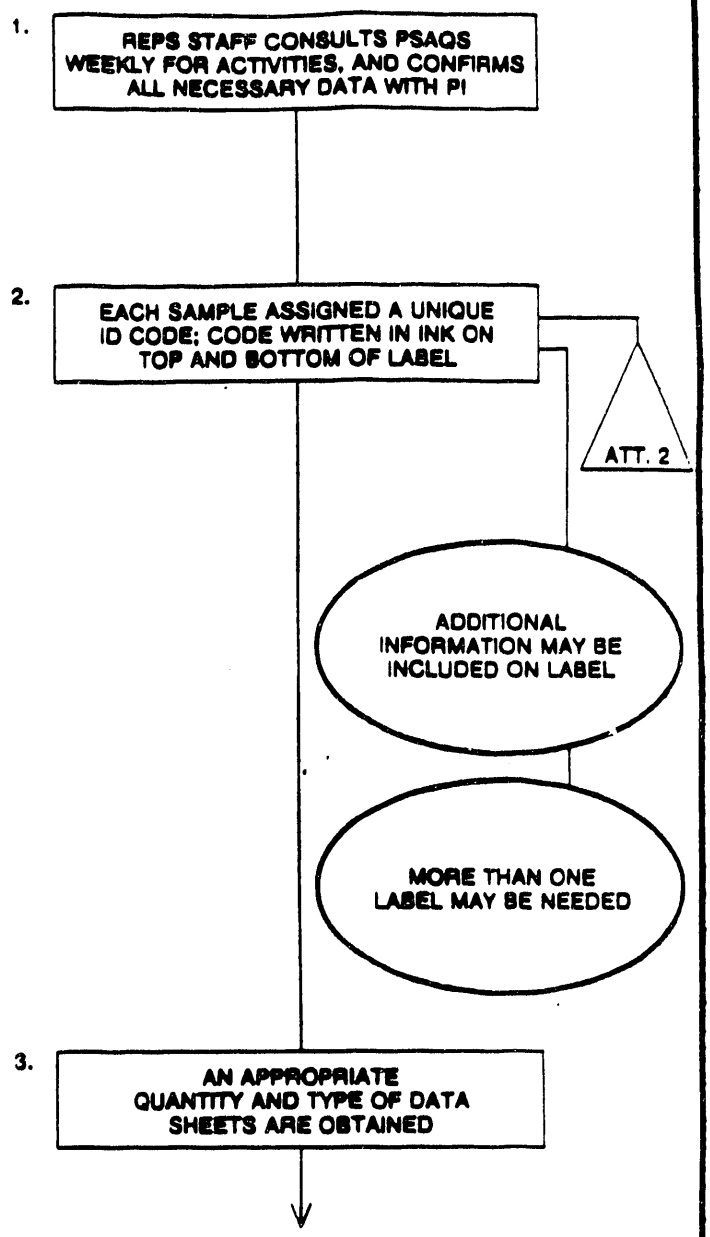
1. Each workweek, the REPS staff consults the PSAQS for sampling activities scheduled for that week. Staff members confer with the PI to confirm scheduled activities and to be advised of sampling locations, the need for multiple samples, or any modifications to the normal sampling schedule.

2. Each sample to be collected is assigned a unique identity code using the method described in Attachment 2. This unique sample identity code is written in ink on both the top and bottom of an adhesive label.

   NOTE: Additional information may be included on the label for clarification.

   NOTE: More than one label per sample may be needed if the sample will require more than one container.

3. Data sheets specified in sampling procedures are obtained for the samples to be collected.



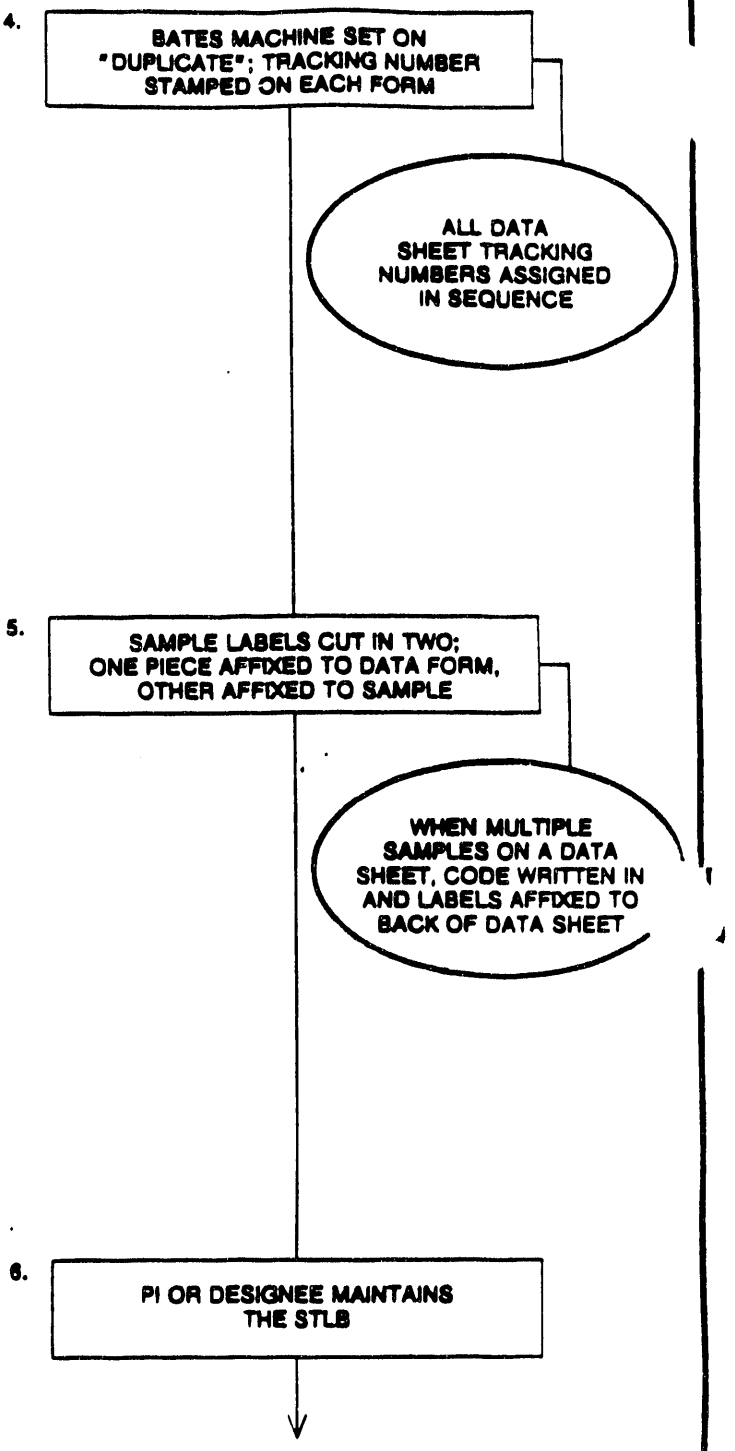
4. The Bates numbering machine is set on the "duplicate" numbering position and a data sheet tracking number is stamped in the upper right-hand corner of each form. The duplicate number is stamped onto the first open line of the Sample Tracking Log Book.

NOTE: All data sheet tracking numbers are assigned in sequence irrespective of the RES or NES sample program identification. Once numbered the form will be referred to as a data sheet.

5. The prepared sample labels are cut into two pieces, each with the same unique sample identity code. One piece is affixed to a blank data form while the other is retained to attach to the sample itself.

NOTE: When more than one sample is included on a data sheet (e.g. thermoluminescent dosimeters) the sample identity codes are written on the data sheet in the appropriate spaces; coded labels for all samples in the "suite" are then affixed to the back of the data sheet.

6. The Sample Tracking Log Book (STLB) is maintained by the PI or designee and contains information on the status of samples sent for analysis or held for archiving.



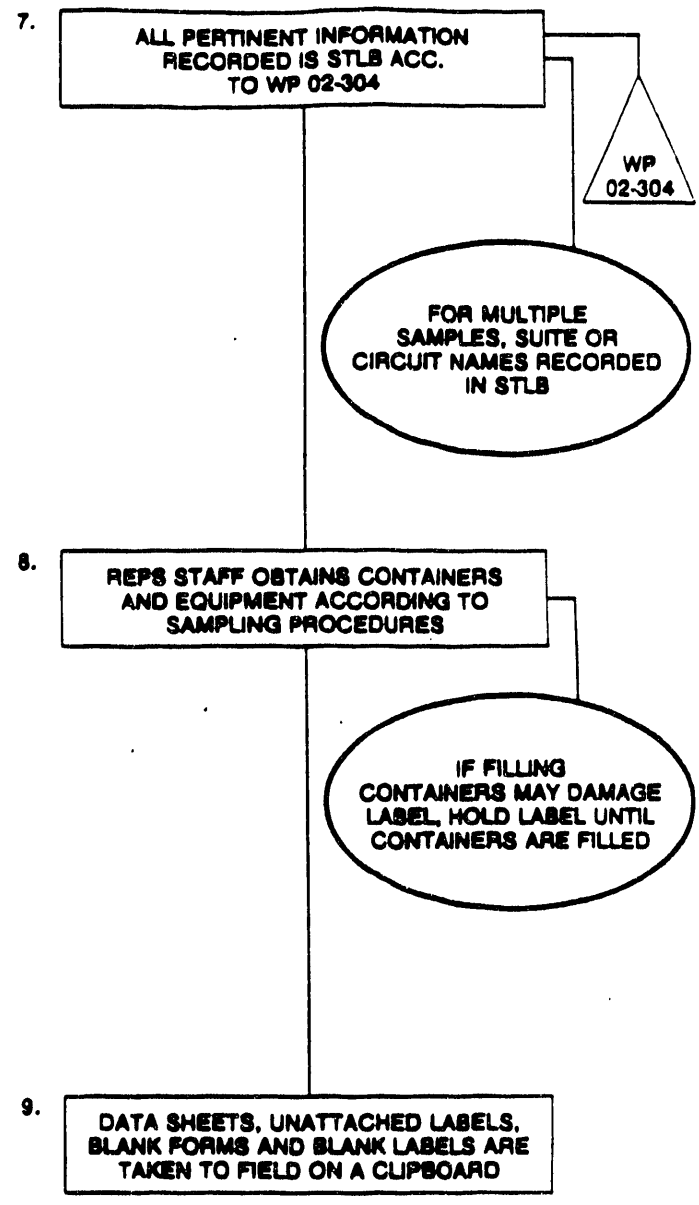
7. Data sheet numbers, corresponding unique sample identity codes and date of collection information is recorded in STLB, in addition to tracking information described in sample tracking procedure WP 02-304.

NOTE: When more than one sample is included on a data sheet, suite or circuit names may be recorded in the STLB, with sample identity codes listed individually.

8. REPS staff carrying out sampling activity will obtain appropriate containers and equipment as specified in the applicable sampling procedure. The remaining piece of the sampling label will be placed on the appropriate sample container.

NOTE: If filling the container may damage the label, it may be retained with the data sheet in the field until the container is filled.

9. Data sheets, any unattached labels, blank unnumbered forms and blank labels (to be used as spares in case a label or data sheet is lost or destroyed) are taken to the field on a clipboard.



5.4 Preparation of Sample Tracking Information Using RADCOMP

1. Each workweek, REPS staff consults the RADCOMP schedule file and notes the sampling activities scheduled for that week.

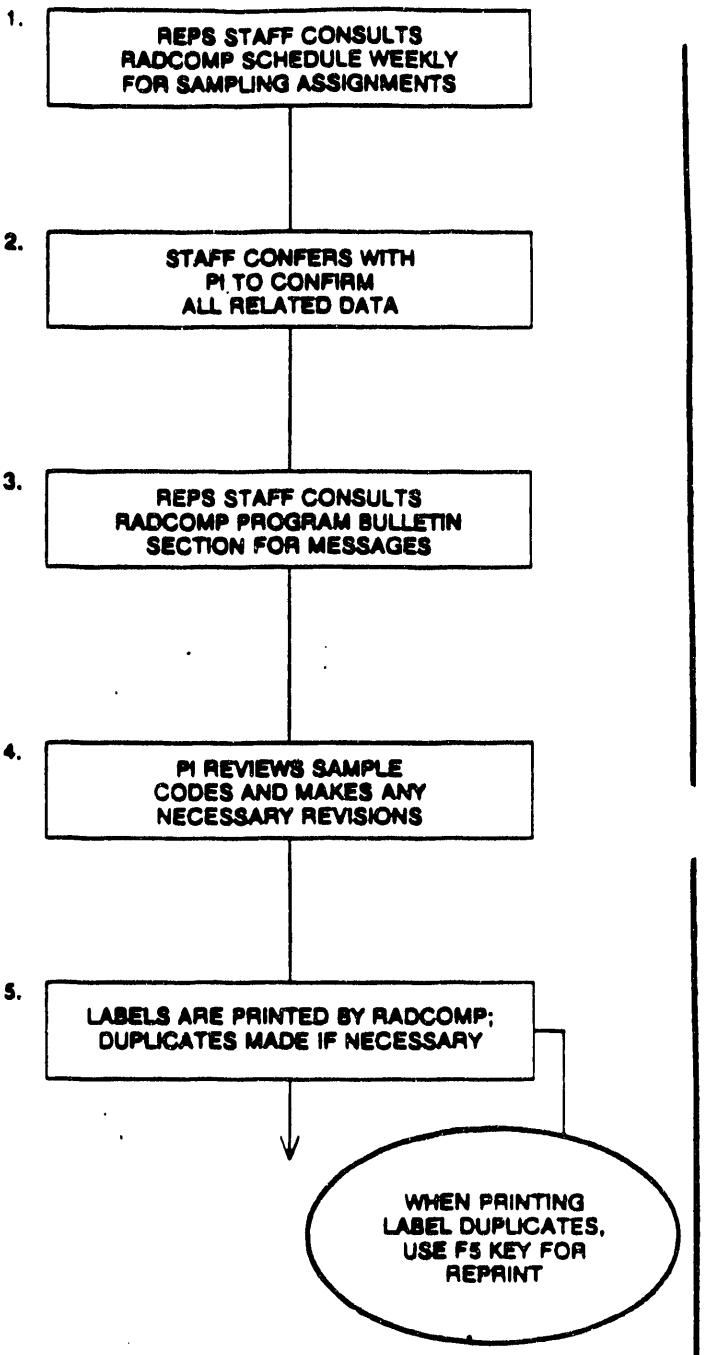
2. Staff members confer with the PI to confirm scheduled activities and to be advised of sampling locations, the need for multiple samples, or any modifications to the normal sampling schedule.

3. REPS staff consults the RADCOMP program bulletin section for reminders and messages.

4. The PI or designee reviews the sample codes in the Tracking/Labels section of RADCOMP and makes any necessary modifications.

5. The labels for designated sampling activities are printed by RADCOMP. If required, the PI or designee requests any duplicate labels, and then exits from the Labels section of the program.

NOTE: When printing duplicate labels, be sure the reprint mode is "on" using the F5 function key to toggle reprint mode.



6. Each sample to be collected is assigned a unique identity code using the method described in Attachment 2. This unique sample identity code is written in ink on both the top and bottom adhesive label.

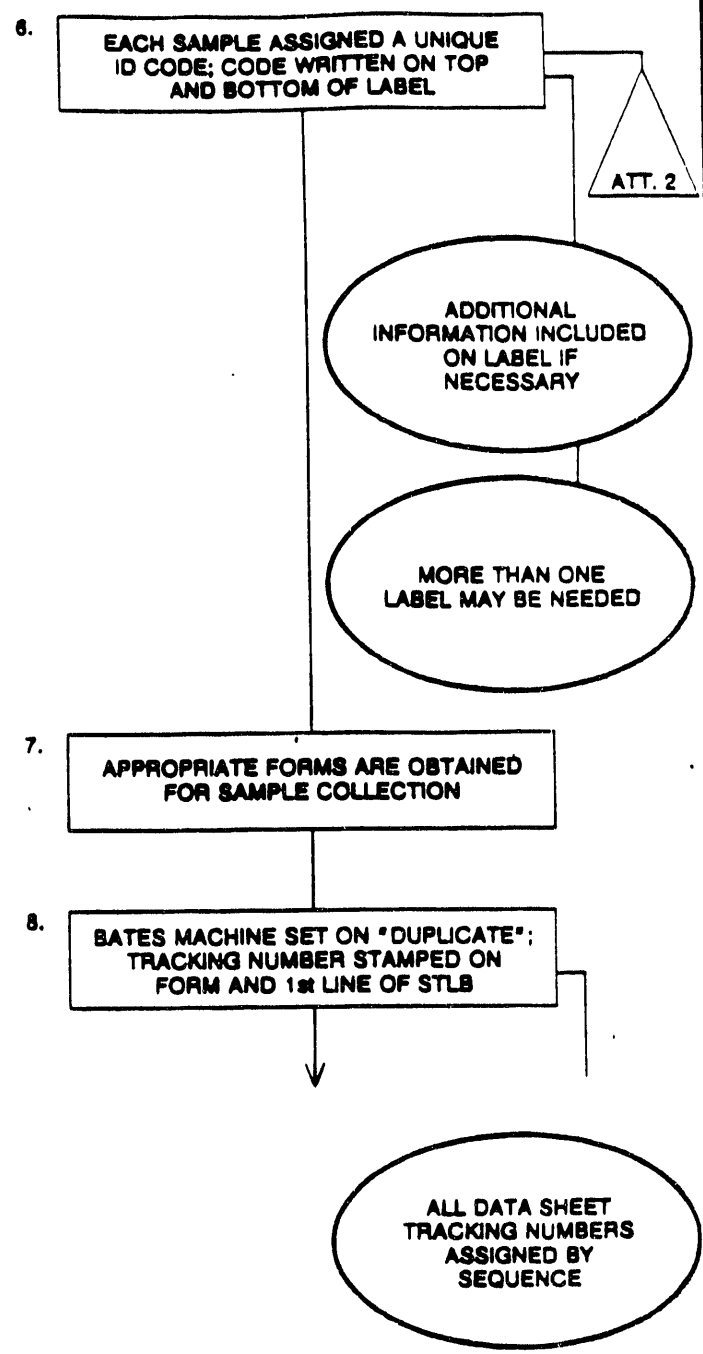
NOTE: Additional information is included on the label for clarification if necessary.

NOTE: More than one label per sample may be needed if the sample will require more than one container.

7. Appropriate forms are obtained for the samples to be collected.

8. The Bates numbering machine is set on the "duplicate" numbering position and a data sheet tracking number is stamped in the upper right-hand corner of each form. The duplicate number is stamped onto the first open line of the Sample Tracking Log Book.

NOTE: All data sheet tracking numbers are assigned in sequence irrespective of the RES or NES sample program identification. Once numbered, the form will be referred to as a data sheet.



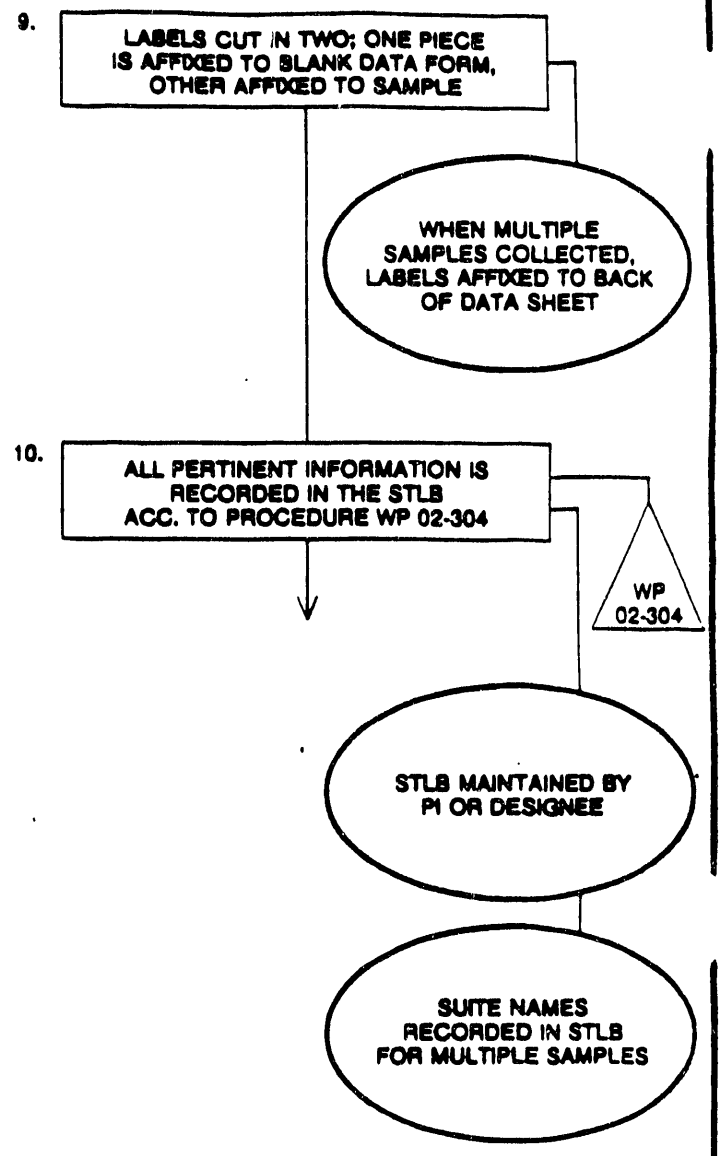
9. The prepared sample labels are cut into two pieces each with the same unique sample identity code. One piece is affixed to a blank data form while the other is retained to attach to the sample itself.

NOTE: When more than one sample is included on a data sheet (e.g., thermoluminescent dosimeters) the sample identity codes are written on the data sheet in the appropriate spaces; coded labels for all samples in the "suite" are then affixed to the back of the data sheet.

10. Data sheet numbers, corresponding unique sample identity codes and date of collection information is recorded in the STLB, in addition to tracking information described in sample tracking procedure WP 02-304.

NOTE: The Sample Tracking Log Book (STLB) is maintained by the PI or designee and contains information on the status of samples sent for analysis or held for archiving.

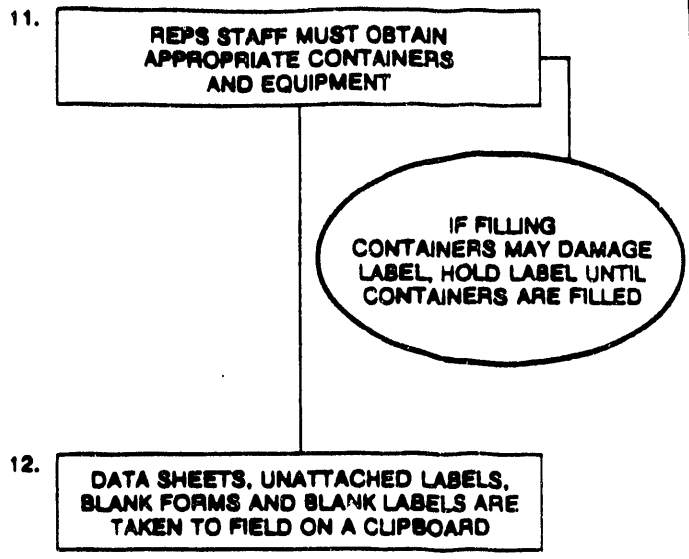
NOTE: When more than one sample is included on a data sheet, suite or circuit names are recorded in the STLB, with sample identity codes listed individually.



11. REPS staff carrying out sampling activities must obtain appropriate containers and equipment as specified in the applicable sampling procedures. The remaining piece of the sampling label will be placed on the appropriate sample container.

NOTE: If filling the container may damage the label, it may be retained with the data sheet in the field until the container is filled.

12. Data sheets, any unattached labels, blank unnumbered forms and blank labels (to be used as spares in case a label or data sheet is lost or destroyed) are taken to the field on a clipboard.



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INSTRUCTIONS FOR ASSIGNING UNIQUE SAMPLE IDENTITY CODES

The sample identity codes used in the Radiological Environmental Surveillance and the Ecological Assessment programs in the Radiological and Environmental Programs Section are unique to each individual sample prepared for potential analysis. An individual sample may consist of the entire quantity of material collected at a single location and time, a composite of materials which will be analyzed as a single unit, one of a group of replicate samples which were independently collected at a single location and time for separate analysis, a portion, or "split," of a sample prepared for independent analysis, or some other analyzable quantity of material (e.g., a "blank" sample).

The unique sample identity codes are structured as a four-tiered hierarchy of sample-specific information. The four tiers are arranged in descending order of importance to the identification of the sample. They are: (1) Subprogram, (2) Location, (3) Date, and (4) Specification. A list of the subprogram and location codes used in the program will be maintained by the Program Leader.

Subprogram: The Subprogram code consists of two alphabetic characters which identify the sample type. Typically the first letter is an identification of the general subprogram (e.g., A for air, H for hydrologic, B for biotic) and the second letter is a specifier of the type of sample within that subprogram (e.g., AC = Continuous Air sampling, HS = Surface Hydrologic sampling, BF = Fish Biotic tissue sampling).

Location: The Location code consists of three alphanumeric characters which identify the site from which the sample was collected. The first character of this code is alphabetic, the other two may be either alphabetic or numeric. Abbreviations of accepted location names are preferred. Establishment of standardized codes is recommended, for example, the use of the letter "R" as the last character has been reserved to indicate a ranch name (SMR = Smith Ranch). It is also preferred that the same location code be used for all subprograms when the location is a point of multiple sample acquisition.

Date: The Date consists of six or eight numbers specifying the year, month, and day, in that order, for which the sampling activity is scheduled. This is not necessarily the exact date of collection (see WP 02-020 for scheduling procedure). The year may be either four digits or abbreviated to the last two (1986 or 86). Both the month and day are two digit, with "0" preceding any single digit numbers. No spaces are used between these three numbers (for example, September 1, 1986 would be either 19860901 or 860901).

Specification: The Specification code is used to identify a particular sample from a possible group of samples of a single type, collected at a single location, and scheduled for the same date.

The specification is a numeric code consisting of two numbers separated by a decimal point. The first number identifies the sample from all other samples in the group and the second number indicates the number of samples in the group. For example, a sample specification of 2.10 indicates that it is sample number 2 of a group of 10 which were all taken from the same location and time (possibly 10

replicate samples, or 5 replicates with 2 splits of each, etc.). A specification of 1.1 indicates that only one sample was scheduled for that time and location. Note that no information is given detailing the group of samples. This information is to be recorded on the appropriate data sheet.

An example of a complete sample code is as follows:

AC-SMR-19860901-1.2

indicating that the sample is the first of two continuous air samples scheduled for collection from the Smith Ranch on September 1, 1986.

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LIST OF REVIEWERS

Procedure Number: WP 02-303

Revision Number: 0

Procedure Title: RFS SCHEDULING, DOCUMENTATION, AND FIELD PREPARATION PROCEDURE.

Reviewer's Name	Department
J. Cockman	REPS
T. Fisher	REPS
B. Kehrman	REPS
A. Rodriquez	REPS
R. Youngman	QA

NO: 02-304 REV. 0 ISSUE DATE: 01/15/88

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NES/RES SAMPLE TRACKING PROCEDURE

1.0 SCOPE

This document describes the procedures for tracking samples taken by the Radiological and Environmental Programs Sections (REPS) in support of the Radiological Environmental Surveillance (RES) and Nonradiological Environmental Surveillance (NES) Programs in conformance with the Quality Control guideline WP 02-302.

2.0 DEFINITIONS

Chain-of-Custody (COC) Form - The COC (WP 1178) is used to document the transfer of control (custody) of samples through a sequence of recipients. The COC is a standard, three-part form consisting of an original (white) page and two copy pages (one yellow and one pink). Each sample covered by the form is listed. The signature and date of receipt of each individual relinquishing or accepting custody of the listed samples must appear on each original. A sample is provided on Attachment 1.

Transmittal Letter (TL) - The TL is sent to the recipient of samples to provide information for the continued tracking of the sample. The TL may be sent separately from samples, thus alerting the recipient of impending sample transmittal. The TL may include a request for an Acknowledgment of Receipt (AOR), a request for return of the original COC after sample disposal, and any special instructions of supplementary data required for sample analysis. A sample is provided on Attachment 2.

Request for Analysis (RFA) Form - The RFA (WP 1177) is a standard, three-part form used to notify offsite analytical laboratories of the analyses to be performed on samples. It contains an original page (white) and two copy pages (one yellow and one pink). The RFA may be sent with the TL separately from the samples. A sample is provided on Attachment 3.

Acknowledgment of Receipt (AOR) - The AOR is a record of receipt of samples. The AOR originates with the recipient and is transmitted to the REPS as specified by the TL. In most cases, the AOR will be specified as a photocopy of the COC showing the signature of the recipient.

Sample Tracking Log Book (STLB) - The STLB is a central reference record for tracking sample status maintained by REPS. A sample page of the STLB is included on Attachment 4.

Third Party Recipient - Any group or individual to which a sample is transmitted, but which is not required by contract to report analytical data to Radiological and Environmental Programs.

3.0 REFERENCES

49 CFR 179
WP 02-301, Radiological Environmental Surveillance (RES) Implementation
WP 02-302, RES Quality Assurance/Quality Control Implementation
WP 02-303, RES Scheduling, Documentation, and Field Preparation
WP 02-305, RES Data Management Procedures
WP 02-332, NES Scheduling, Documentation, and Field Preparation
WP 02-334, NES Data Management Procedures

4.0 GENERAL

This procedure has four parts, each of which outlines sample tracking requirements for samples going to a different destination. Samples may be sent to an offsite analytical laboratory, analyzed on site, archived, or sent for third-pa :y analysis. When samples are to be shipped, they will be placed in containers suitable for shipping, compatible with intended analysis and properly preserved for analysis. Samples destined for offsite analysis will be packaged in accordance with the requirements of the carrier per DOT regulation 49 CFR 179.

To maintain control of sample tracking, a chain-of-custody (COC) system is used. Chain-of-custody documentation procedures vary for each designated recipient. Samples sent for third-party analysis are not tracked in the REPS file after transmittal, and the pink copy of the COC form may be discarded. For archived samples, a photocopy of the original COC is retained with the samples; the original and the copies are placed in the Section file and are available for transmittal with samples removed from the archive at a later date for analysis. For samples analyzed or discarded, the yellow and pink COCs are retained in the Section file until disposal, after which the pink copy can be discarded. The original of COC accompanies samples sent to an offsite analytical laboratory. The yellow copy is retained in the Section file, and the pink COC is sent to Section Accounting. All sample tracking documentation is maintained in the REPS file to provide complete information of the progress of each sample. In addition, documentation is logged at points in the tracking process, giving quick access to the status of any given sample. All tracking information is maintained in accordance with WP 02-302, WP 02-303, and WP 02-332 the Quality Control and sample documentation procedures. Qualified personnel shall perform the tasks of this procedure as described in WP 02-301.

Flow charts of sample tracking requirements are provided in Attachment 5.

The following activities are included in this document:

5.1 Samples Sent For Third Party Analysis
5.2 Sample Archived
5.3 Samples Sent to an Offsite Analytical Laboratory
5.4 Samples Analyzed On Site

5.0 PROCEDURES

5.1 Samples Sent For Third-Party Analysis

1. When a sample is shipped to a third-party recipient for analysis, it shall be accompanied by the original COC.

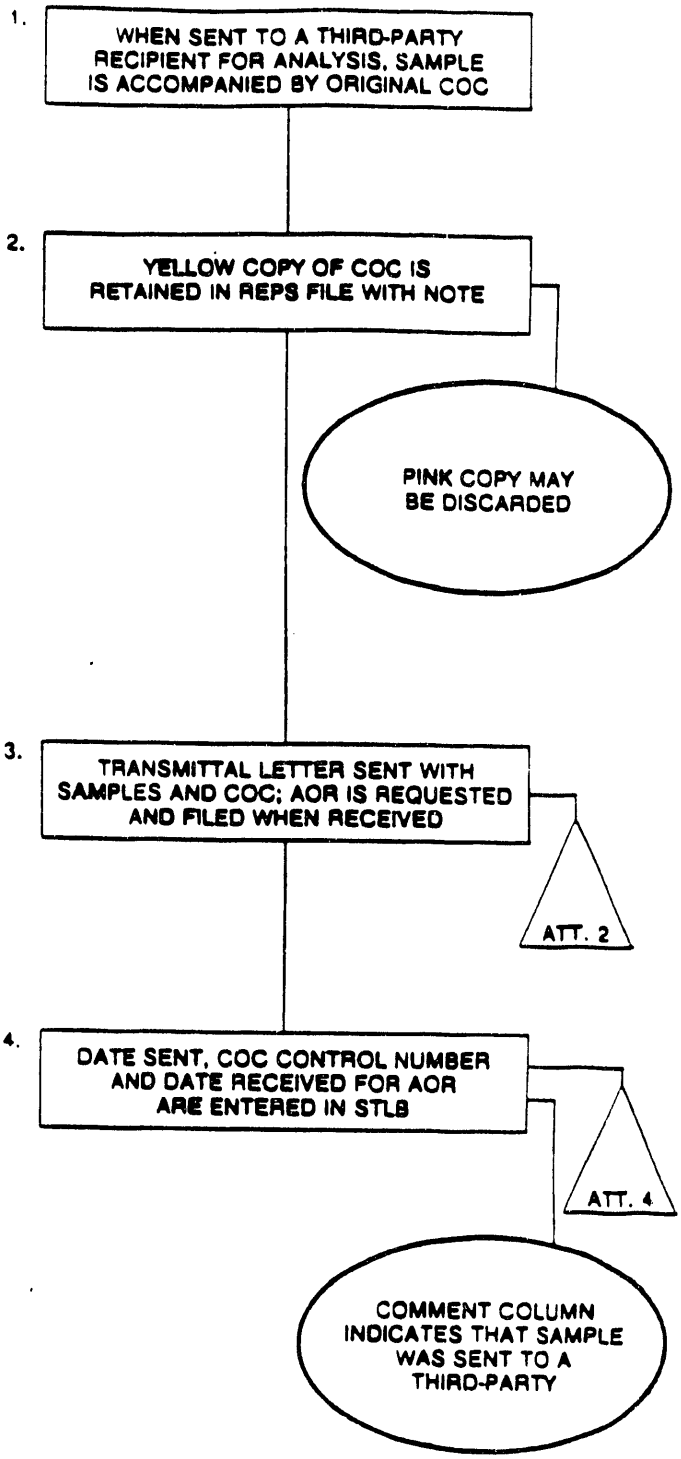
2. The yellow copy of the COC is retained in the REPS file with a note that further custody of the sample is no longer required.

   NOTE: The pink copy may be discarded.

3. A transmittal letter is sent with the samples and original COC to the party who will receive the samples (Attachment 2). The letter requests an AOR which is also filed in the REPS file when received.

4. The date the sample was sent, the COC control number, and the date of receipt for the AOR are entered in the STLB (Attachment 4).

   NOTE: The comment column will indicate that the sample was sent to a third-party recipient.



5.2 Samples Archived

1. A photocopy of the original COC accompanies samples to be archived. The original and the yellow and pink copies are retained in the REPS file.

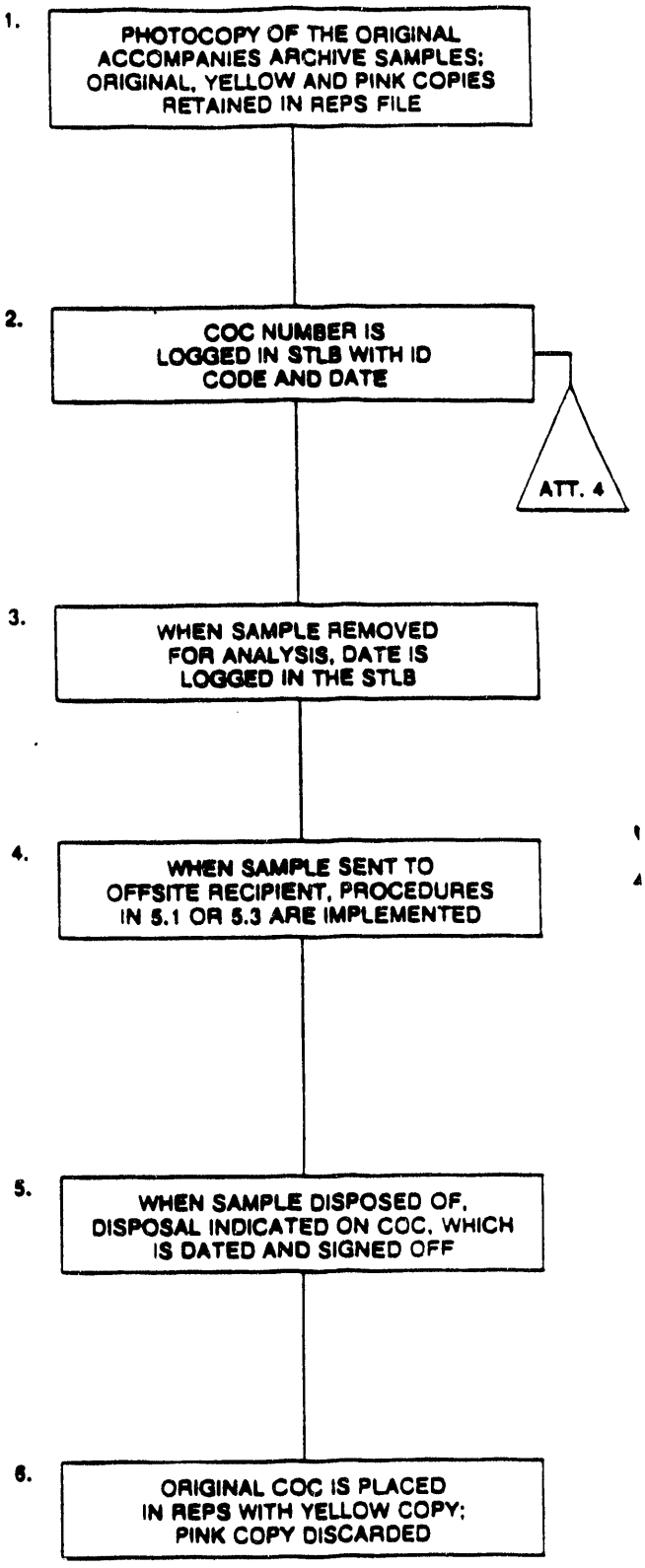
2. The COC number is logged in the STLB (Attachment 4), with the unique sample identity code and the date the sample was archived.

3. When the sample is removed from the archive for analysis, the date is logged in the STLB.

4. If the sample removed from the archive is sent to an offsite recipient, the procedures covering that sample track (Section 5.1 or 5.3) shall be followed.

5. If the sample removed from the archive is disposed of, disposal is indicated on the original COC, which is then signed off and dated by the person handling the disposal.

6. The original COC is placed in the REPS file with the yellow copy and the pink copy may be discarded since it will not be needed to establish ultimate disposal.



5.3 Sample Sent to Offsite Analytical Laboratory

1. The original COC (Attachment 1) accompanies the samples sent to offsite labs for analyses.

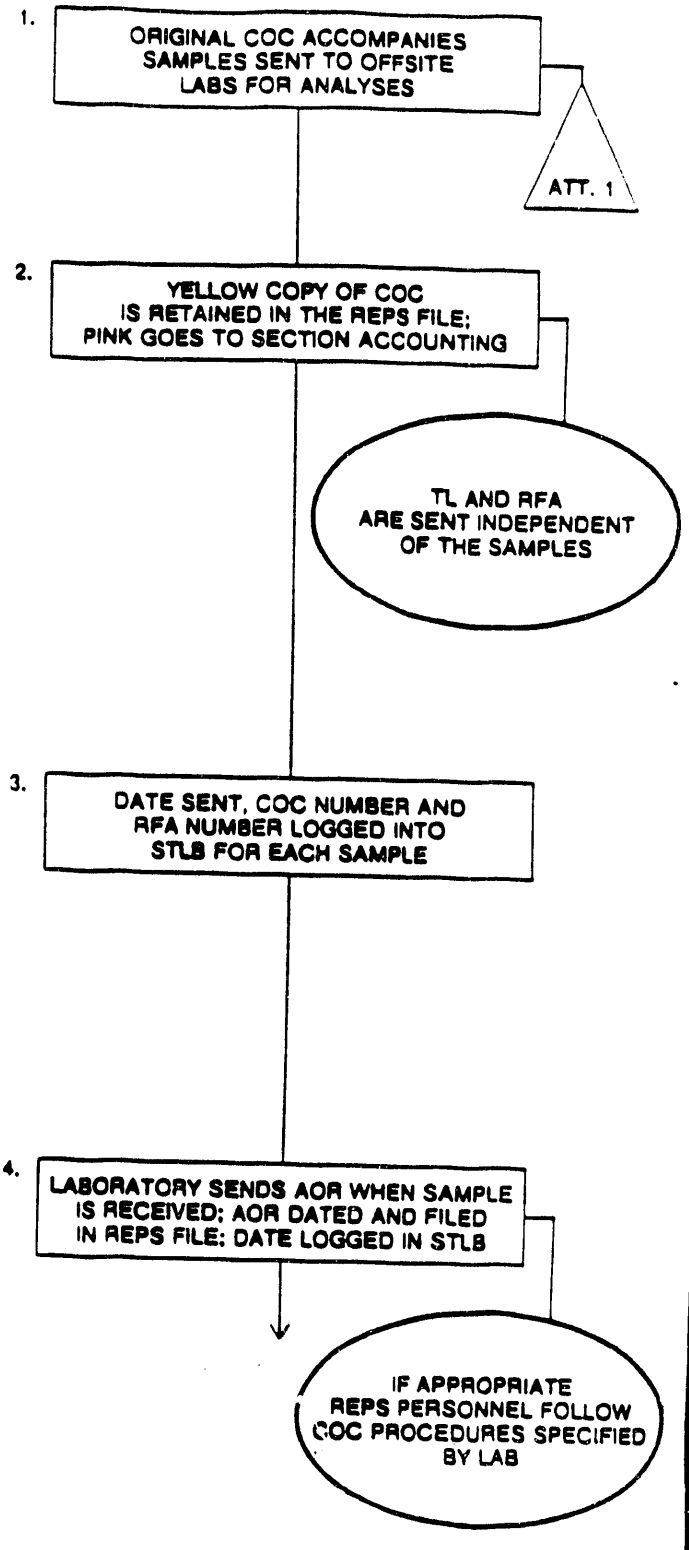
2. The yellow copy of the COC is retained in the appropriate section of REPS file. The pink copies go to Section Accounting.

   NOTE: A TL (Attachment 2) and RFA (Attachment 3) should be sent to the lab independent of the samples.

3. The date the sample was sent, the corresponding COC number and the RFA number are logged in the STLB (Attachment 4) for each sample in the transmission.

4. The laboratory is requested in the TL to send an AOR. Upon receipt, this AOR will be dated and filed in the appropriate section of the REPS file and the date of receipt entered in the STLB for each sample listed on the AOR.

   NOTE: In cases when samplers originate from an offsite lab (e.g., TLDs), the COC may also originate from the lab. In this case, REPS personnel will follow the COC procedures specified by the analytical lab.



5. If an AOR from the analytical lab is not received within two weeks after samples have been shipped from WIPP site, REPS personnel shall initiate a tracer.

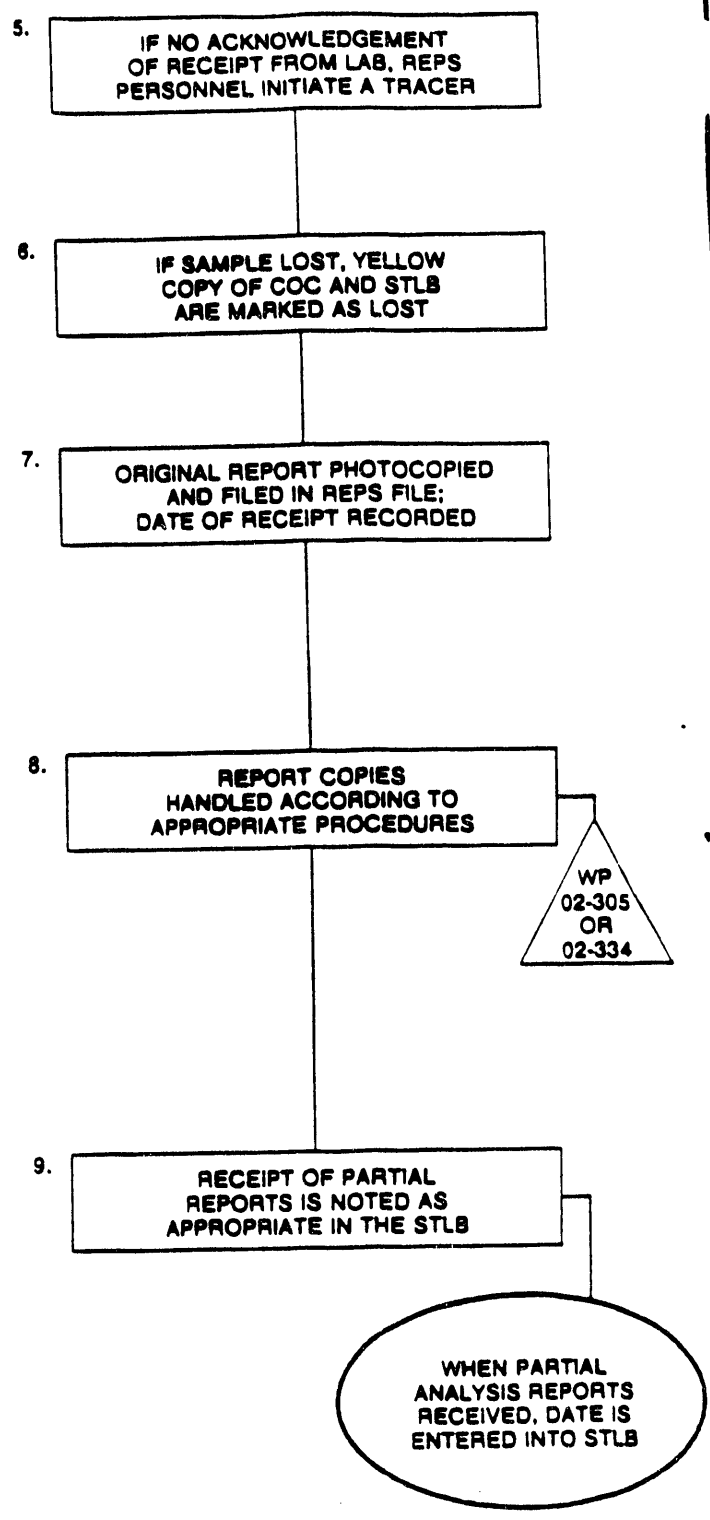
6. If the sample cannot be found, that information is noted on the yellow copy of the COC and noted in the STLB comments.

7. The original laboratory analytical report will be photocopied upon receipt and then filed in the REPS file. The date of receipt shall be entered in the STLB for corresponding samples.

8. The copy of the analytical report will be handled in accordance with the RES or NES Data Management procedure WP 02-305 or WP 02-334.

9. In some cases, partial analysis reports are sent by the lab as analyses are completed. The receipt of a partial report shall be noted by writing "over" in the comments column of the STLB and radionuclide data received to date are indicated on the reverse page. The Lab Report column will not be dated until all analytical results for the sample have been reported.

NOTE: The date when the partial analysis reports are received should be entered on the reverse side of the STLB sheet, in the column corresponding to the type of results received.



5.4 Samples Analyzed Onsite

1. The COC remains with the sample to be analyzed on site.

2. The individual who takes custody of the sample(s) when the analysis is performed shall sign the original COC.

3. The original COC is filed in the appropriate section of the REPS file.

4. The date and COC number are entered in the STLB (Attachment 4). The AOR column in the STLB will indicate "on site."

5. The date on which analytical results are obtained for the sample shall be entered in the STLB with analytical results handled according to WP 02-305 and WP 02-334.

6. COC tracking shall continue until final disposal of the sample. Final disposal will be documented on the original COC.

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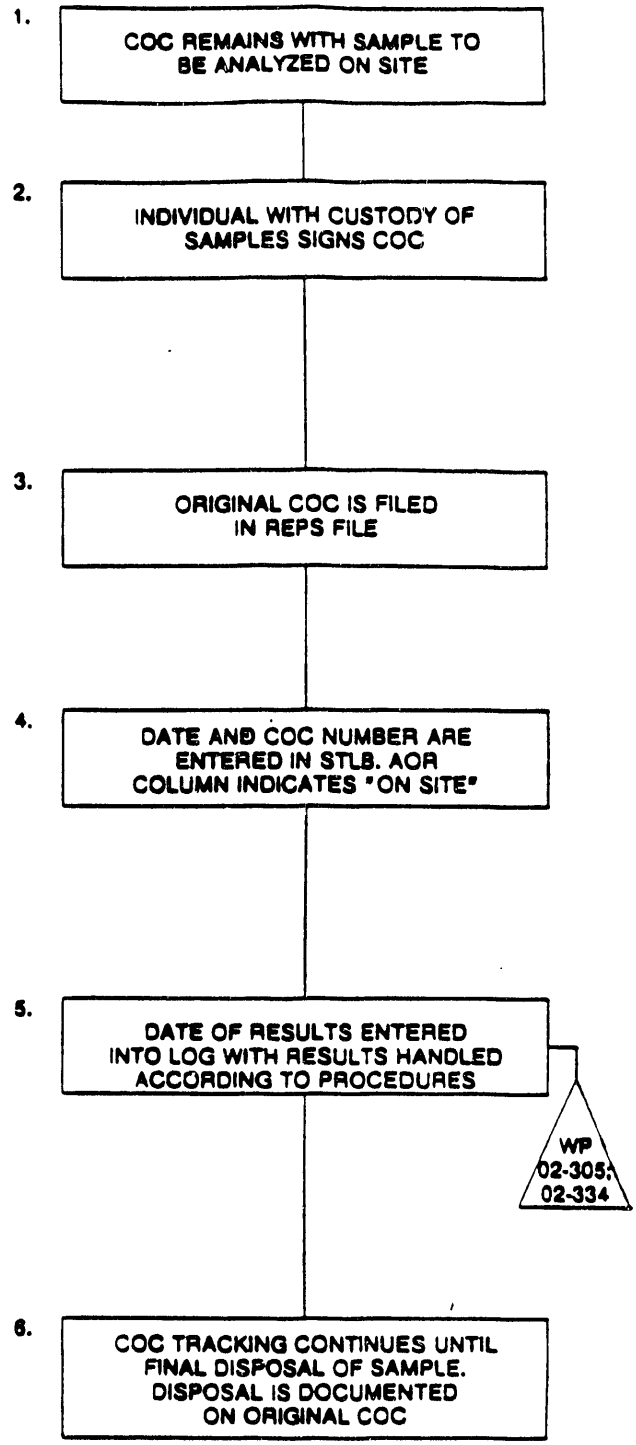


CHAIN-OF-CUSTODY RECORD

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE ELECTRIC CORP.
P. O. BOX 2078
CARLSBAD, NM 88221-2078

C/C Control № 00603

R/A Control No. _____

SAMPLING PROGRAM _____ LAB DESTINATION _____

SAMPLE TEAM MEMBERS _____ CARRIER/WAYBILL NO. _____

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No

Special Instructions: _____

Possible Sample Hazards: _____

SIGNATURES: (Name, Company, Date and Time)

1 Relinquished By: _____ 3. Relinquished By: _____

Received By: _____ Received By: _____

2 Relinquished By: _____ 4. Relinquished By: _____

Received By: _____ Received By: _____

Form [illegible]

WHITE To accompany samples
YELLOW Field Copy
PINK Other

WP 1178 (6 86)

ATTACHMENT 1
WP 02-304
Page 1 of 1

TRANSMITTAL LETTER

Westinghouse Electric Corporation
Advanced Power Systems Divisions

[redacted]

CA:87:3143

April 24, 1987

Mr. C.A. Blackburn
Westinghouse Analytical Laboratory
Waltz Mill Site, Rt. 70, Madison Exit
Madison, PA 15663

SUBJECT: Low-Volume Continuous Aerosol Samples

Dear Mr. Blackburn:

Enclosed are the low-volume continuous aerosol samples. These samples were taken 4/15/87 thru 4/22/87. Please refer these samples to Request for Analysis No. C0045, which is being sent under a separate cover. Listed below are the data generated from each sample.

Filter No.	Weight of Particulates(mg)	Volume of Air sampled m³
AC-CBU-19870415-2	21.6	584.51
AC-SAIR-19870415-8	26.7	598.76
AC-MLR-19870415-3	14.9	556 cc
AC-NNW-19870415-13	39.5	587.70
AC-NE-19870415-15	11.0	547.71
AC-WSS-19870415-14	172	6042.5
AC-WEE-19870415-11	14.9	548.04
AC-ESE-19870415-12	22.4	544.32

If any questions arise about the data listed, please call Annabelle Rodriguez or myself at (505) 887-8094. We will assist you in any way possible.

Sincerely,

W. Stewart Byers

for Stewart B. Jones
Environmental Technician

Enclosure

cc: File 5.2.3

REQUEST FOR ANALYSIS

R/A Control № 00603
C/C Control No. _____

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE ELECTRIC CORP.
P. O. BOX 2078
CARLSBAD, NM 88221-2078

DATE SAMPLES SHIPPED _____
LAB DESTINATION _____
LABORATORY CONTACT _____
SEND LAB REPORT TO _____

SAMPLING PROGRAM _____

DATE REPORT REQUIRED _____
PROJECT CONTACT _____

PURCHASE ORDER NO. _____

PROJECT CONTAGT PHONE NO. _____

Sample Number	Sample Type	Sample Quantity	Preservative	Req't. Testing Program	Special Instructions

TURNAROUND TIME REQUIRED. (Rush must be approved by appropriate Manager.) NORMAL _____ RUSH _____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION. (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances.)

NONHAZARD _____ FLAMMABLE _____ SKIN IRRITANT _____ HIGHLY TOXIC _____ BIOLOGICAL _____ OTHER _____
(Please Specify)

SAMPLE DISPOSAL. (Please indicate disposition of sample following analysis.) RETURN TO CLIENT _____ DISPOSAL BY LAB _____

FOR LAB USE ONLY

RECEIVED BY _____ DATE/TIME _____

WHITE - Original to accompany samples
YELLOW - Field Copy
PINK - Other

WP 1177 (6/86)

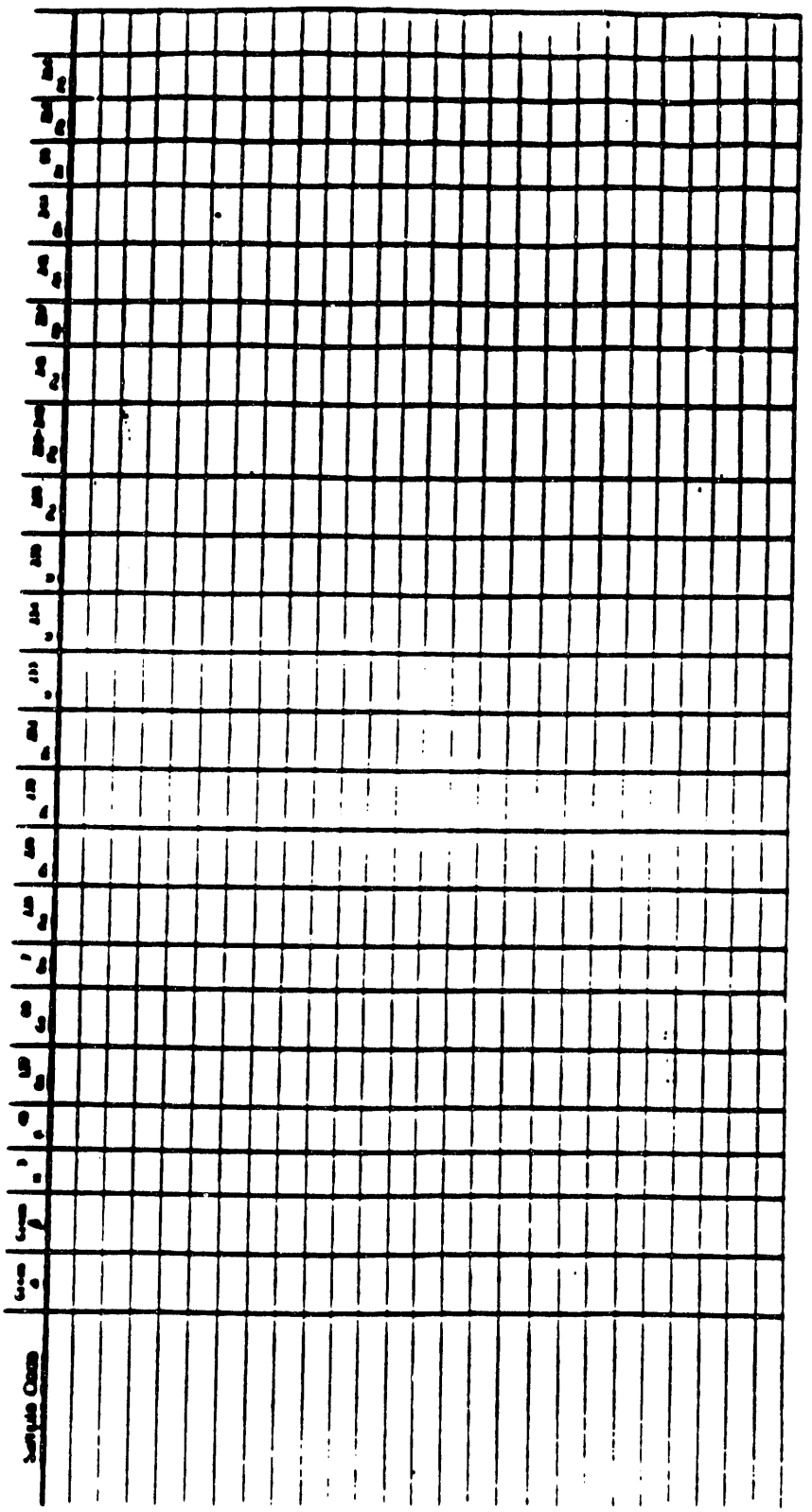
ATTACHMENT 3
WP 02-304
Page 1 of 1

ATTACHMENT 4
WP 02-304
Page 1 of 2

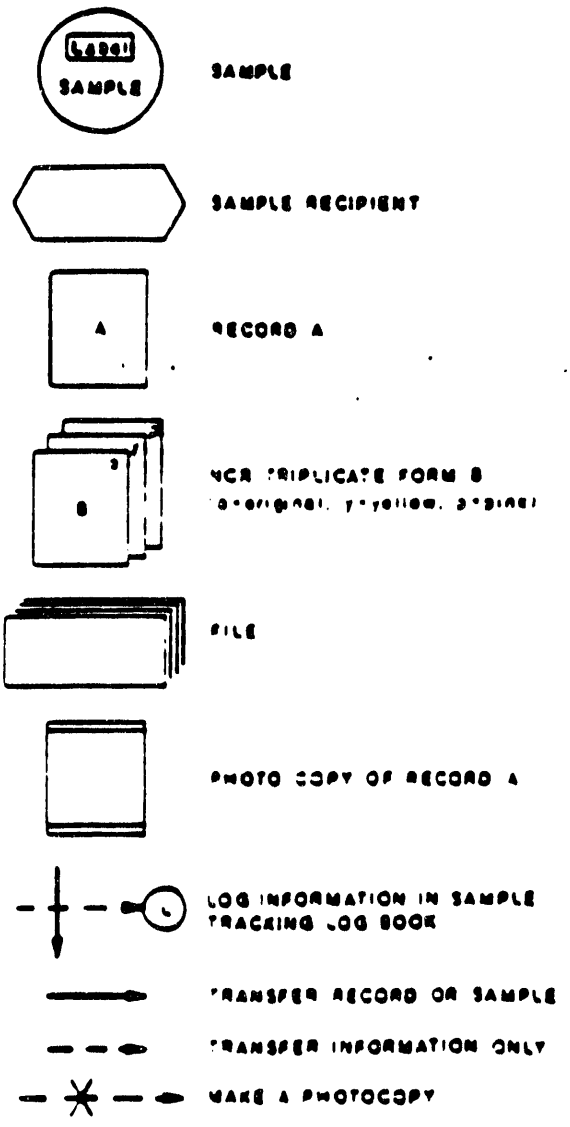
SAMPLE OF THE SAMPLE TRACKING LOG BOOK

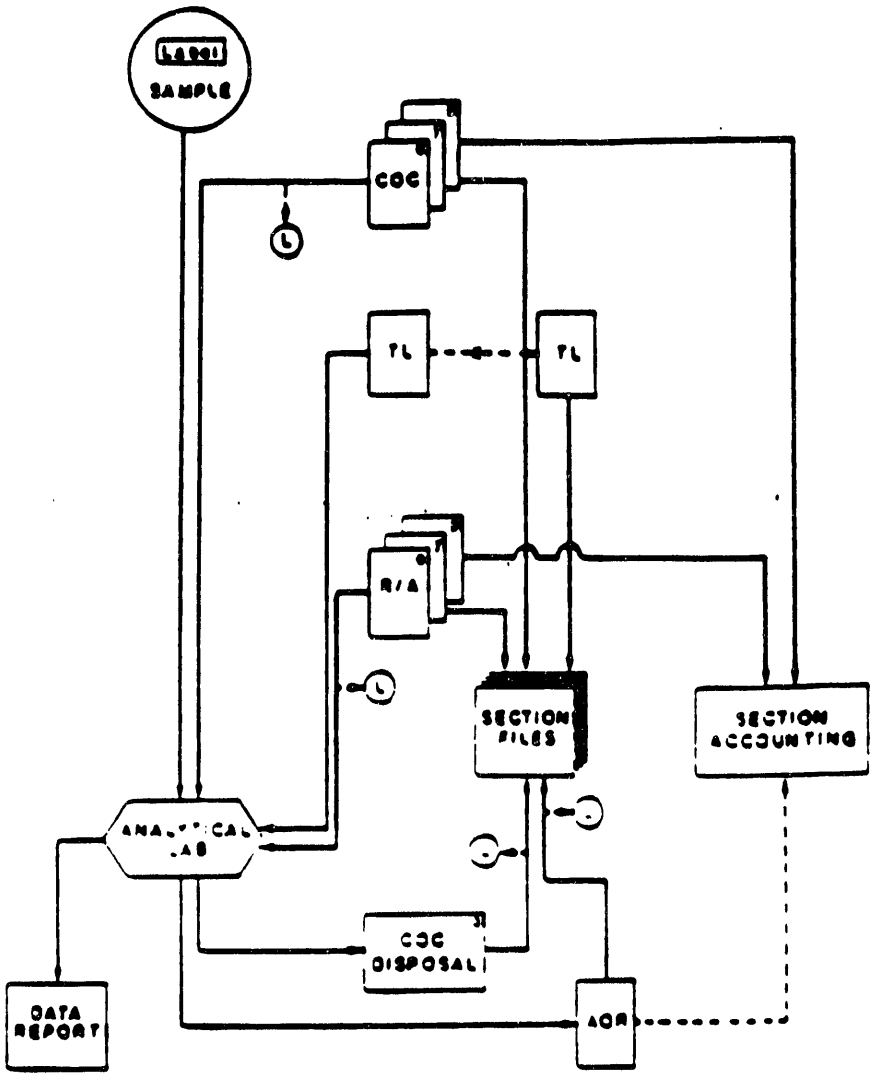
Data Sheet Number	Sample Code(s) Included	Chain of Custody #	Archive Begin (date)	Archive End (date)	Request for Analysis #	Ackn't of Receipt (date)	Lab Rep't (date)	Comments

SAMPLE OF THE SAMPLE TRACKING LOG BOOK

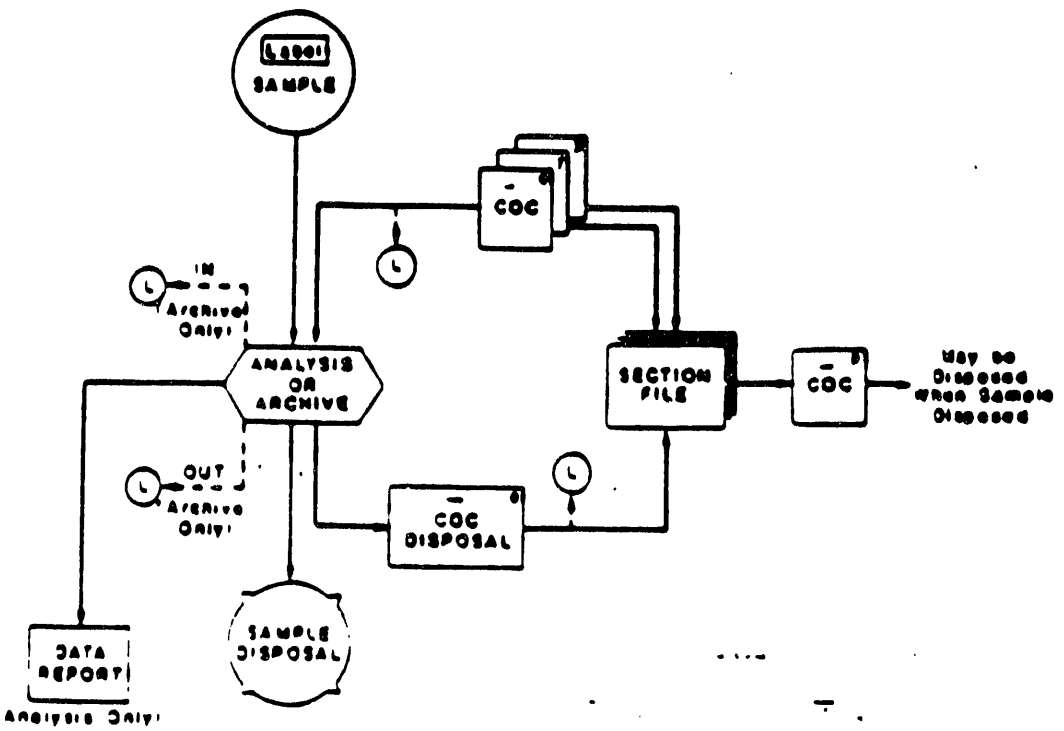


FLOW DIAGRAM LEGEND

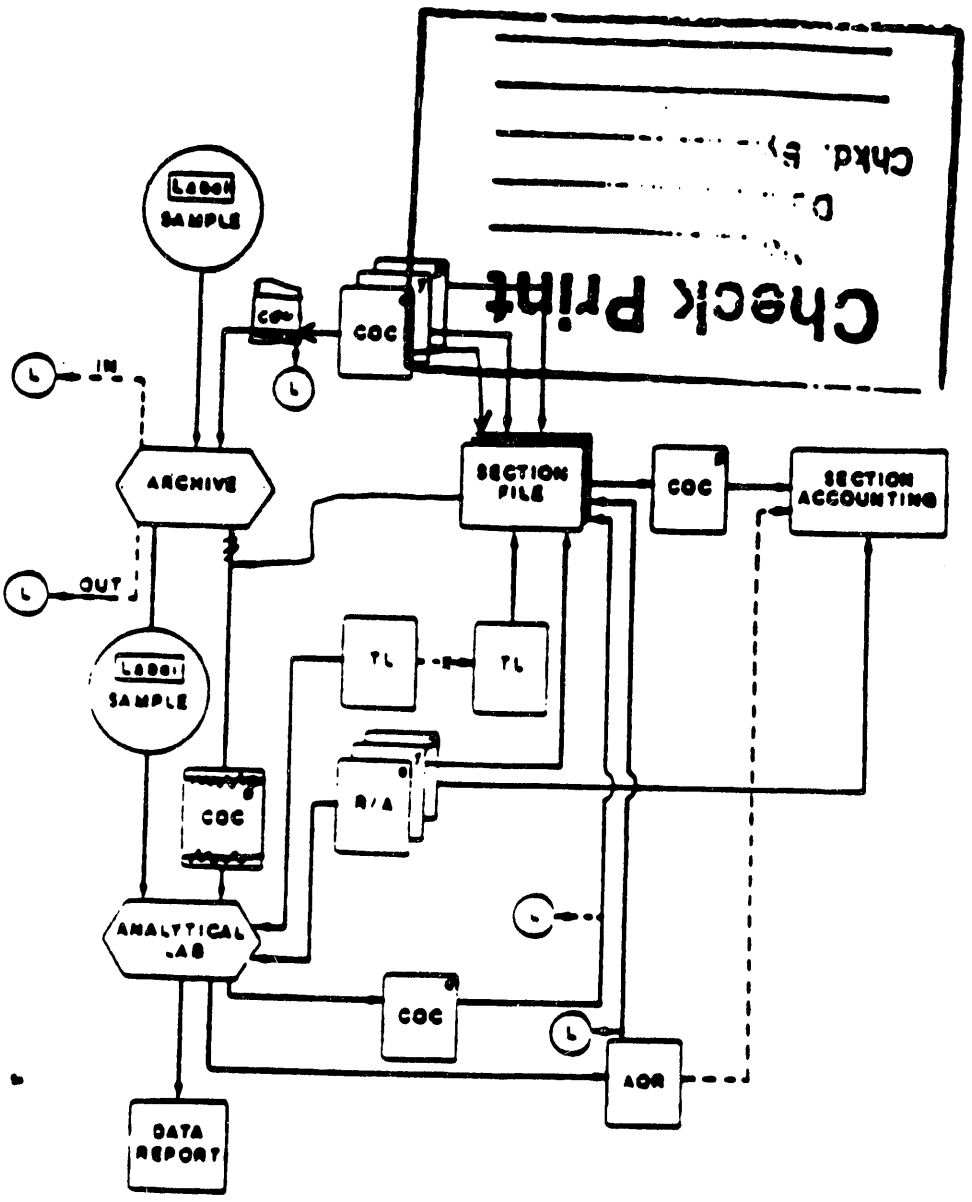




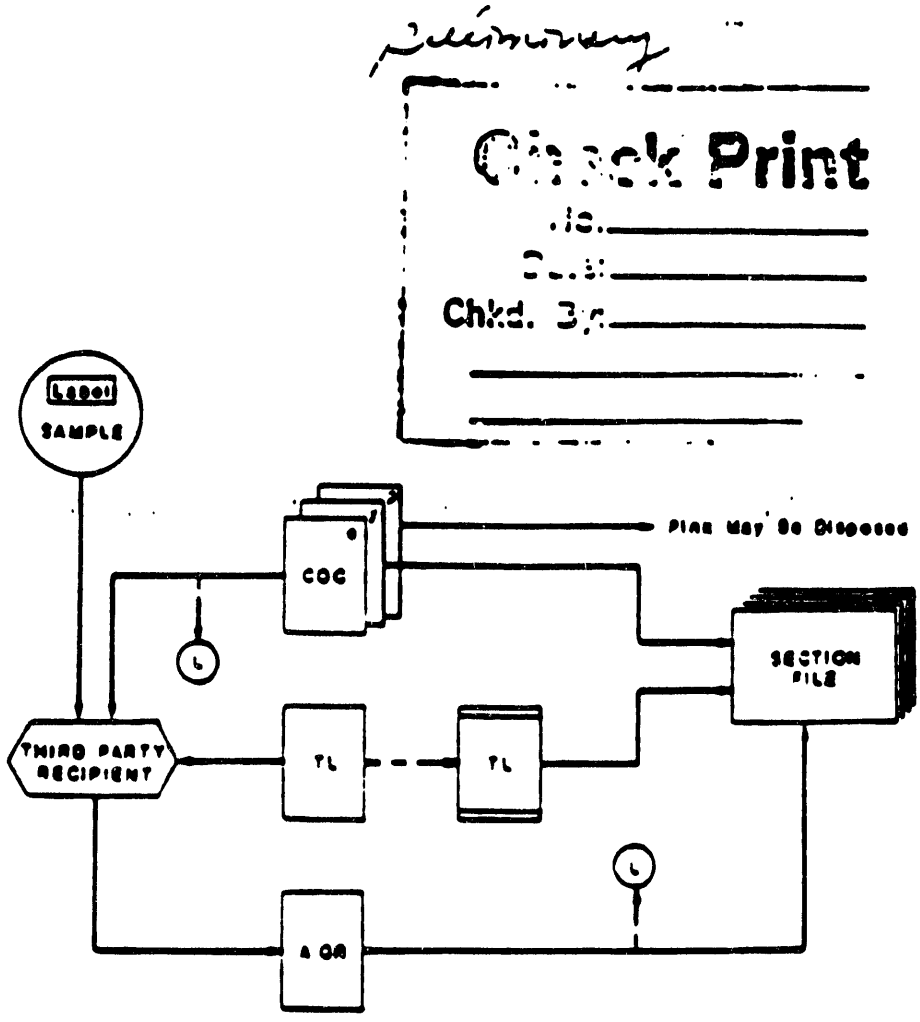
SAMPLE TRACKING FLOW DIAGRAM
CASE 1: SAMPLE SENT TO OFF-SITE ANALYTICAL LABORATORY



SAMPLE TRACKING FLOW DIAGRAM
CASE 2: SAMPLE ARCHIVED AND DISPOSED
OR SAMPLE ANALYZED ON-SITE



SAMPLE TRACKING FLOW DIAGRAM
CASE 3: SAMPLE ARCHIVED AND
SENT FOR OFF-SITE ANALYSIS



SAMPLE TRACKING FLOW DIAGRAM
CASE 4: SAMPLE SENT FOR THIRD-PARTY ANALYSIS

LIST OF REVIEWERS

Procedure Number: WP 02-304

Revision Number: 0

Procedure Title: NES/RES Sample Tracking Procedure

Reviewer's Name	Department
T. Fischer	REPS
J. Cockman	REPS
A. Rodriquez	REPS
R. Kehrman	REPS
R. Youngman	QA

NO: 02-305 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: RES DATA MANAGEMENT PROCEDURE

1.0 SCOPE

This document describes procedure for managing Radiological and Environmental Programs Section (REPS) data in support of the Radiological Environmental Surveillance (RES) program in accordance with Quality Control Procedure WP 02-302.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-301, Rev. 1, Radiological Environmental Surveillance (RES) Implementation
WP 02-302, RES Quality Assurance/Quality Control Implementation
WP 02-303, RES Scheduling, Documentation, and Field Preparation
WP 02-304, RES Sample Tracking Procedures

4.0 GENERAL

These procedures are broken into four sections corresponding to various types of data which are handled by the RES Program. Section 5.1 outlines procedures for handling data from the field data sheets which are defined in WP 02-302. Section 5.2 outlines management protocols for analytical results of RES samples. Section 5.3 describes the management of TLD location photographs. Management of RES data output from continuous monitors is outlined in Section 5.4. A flow chart for RES data management is shown in Attachment 1. Data management shall be performed in conformance with WP 02-302, which documents QC requirements for the RES Program. Data sampling shall be assured by conformance with WP 02-303 and WP 02-304, the sample planning and tracking procedures.

Procedure WP 02-302 defines REPS Quality Assurance review when WIPP Quality Assurance Department is to be notified of nonconformance requiring corrective actions.

5.0 PROCEDURES

5.1 Management of Field Data Sheets

1. REPS field personnel shall collect all RES data on data sheets which are handled in accordance with specific sampling, documentation, and tracking procedures.

2. Original data sheets required by WP 02-303 will be photo-copied then filed in the REPS file.

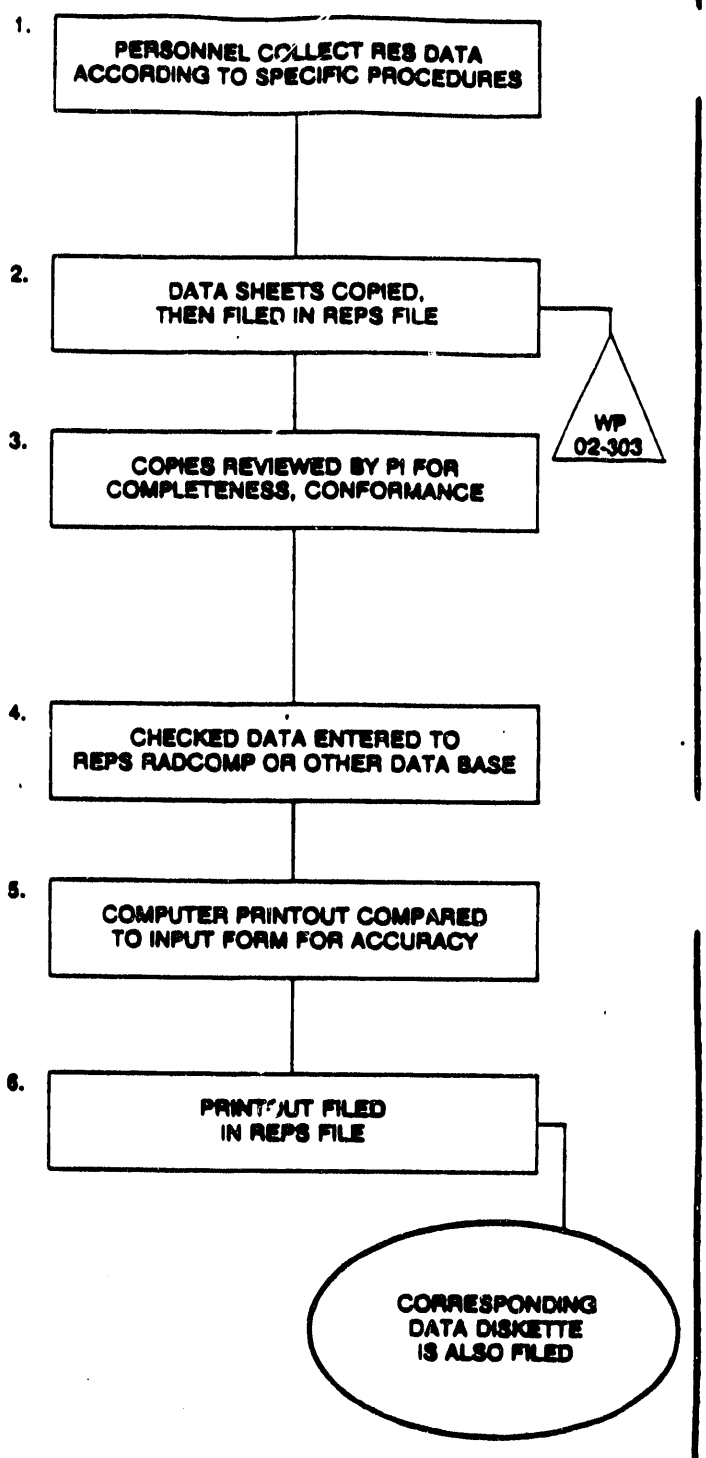
3. Copies shall be reviewed by the Principal Investigator (PI) or designee (as defined in WP 02-301) for completeness and conformance to specific sampling instructions.

4. Final checked data will be entered into REPS RADCOMP or other computer data base as directed by PI.

5. The computer printout shall be compared to the input per WP 02-302.

6. The printout will be filed in the appropriate section of the REPS file.

NOTE: Corresponding data diskette should also be filed with printout.



5.2 Management of Analytical Results

Soil, sediment, water, air, biotic samples, and TLDs may be sent off site for analysis. Some measurements may be made on site at the discretion of the PI.

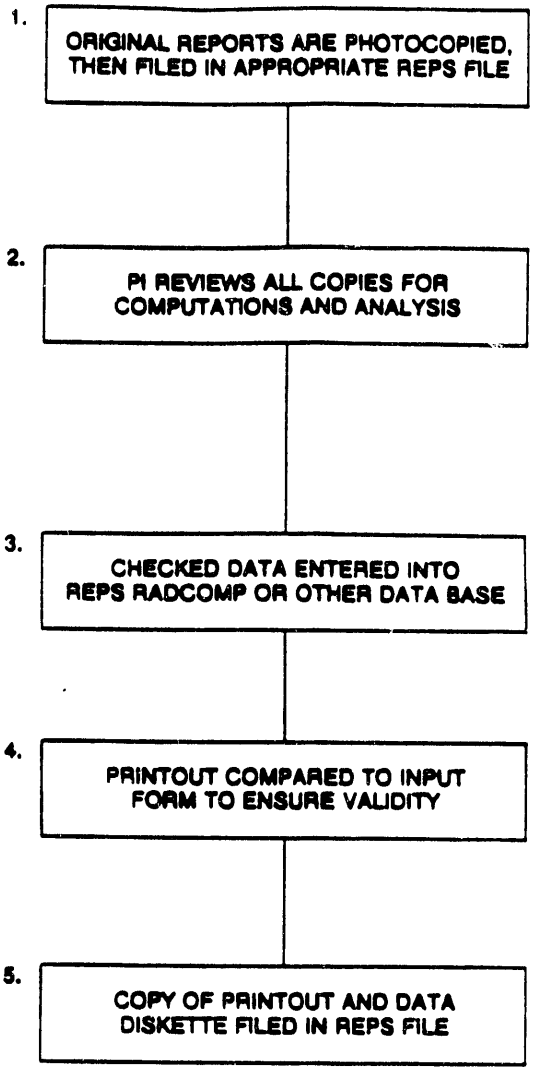
1. Original analytical reports shall be photocopied and filed in the appropriate section of the REPS file.

2. The copy of analytical results and any required data reductions, computations, or analyses performed will be reviewed by the PI or designee in accordance with WP 02-302.

3. Final checked data will be entered into the REPS RADCOMP or other computer data base as directed by PI.

4. An additional check will then be performed comparing a computer printout with original input form to ensure accuracy in accordance with WP 02-302.

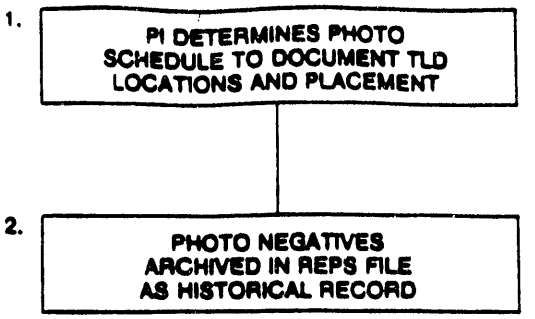
5. A copy of the printout will be filed with the data diskette in the appropriate section of the REPS file.



5.3 Management of TLD Location Photographs

1. The PI determines the photo schedule to document TLD locations and placement in field.

2. Negatives of the photographs shall be archived in the REPS historical record file.



5.4 Management of Continuous Monitor Output Data

1. Environmental radiation monitoring data shall be collected on a continuous basis and recorded automatically as a Ruetor Stokes computer printout.

2. Daily averages are automatically computed by Sum X.

3. Printouts are reviewed by the PI or designee for flagged values and gaps in the record.

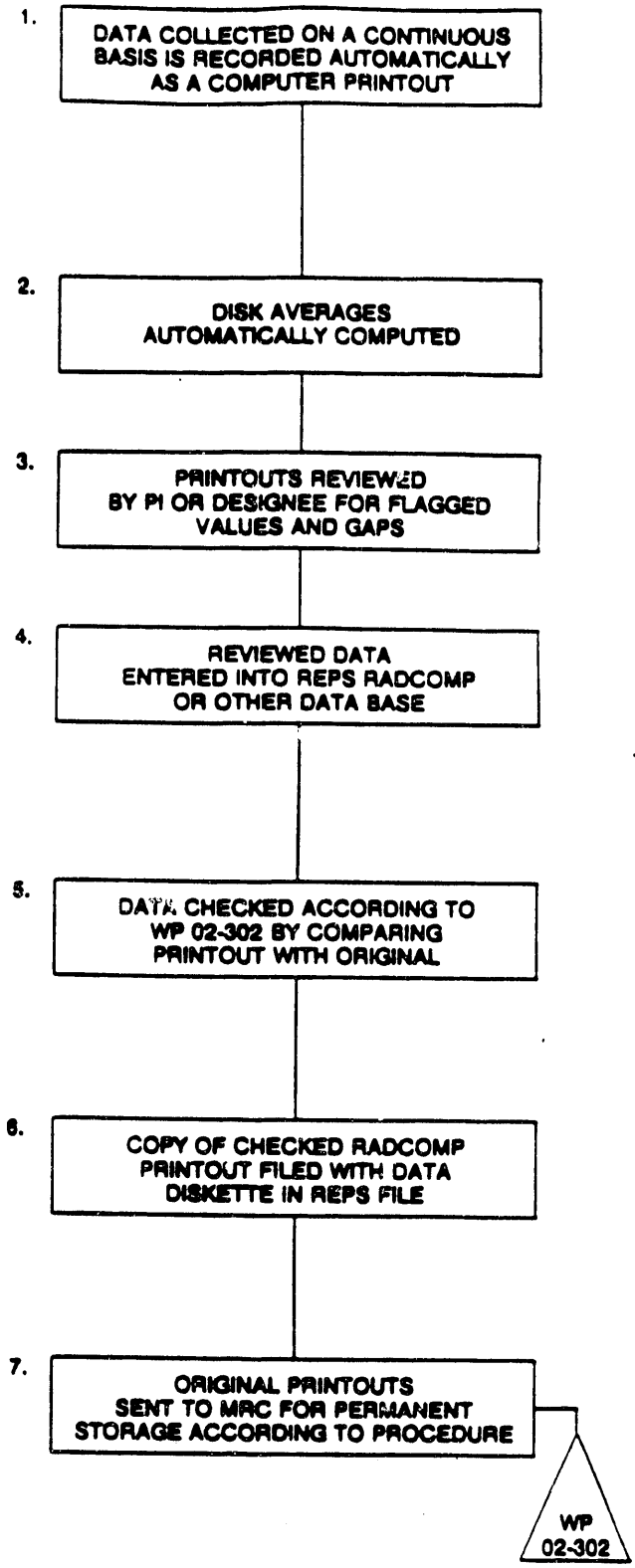
4. Reviewed data is entered to the REPS RADCOMP or other computer data base as directed by PI.

5. The data shall be checked according to procedure in WP 02-302 by comparing the printout of the data with the original input form to ensure accuracy.

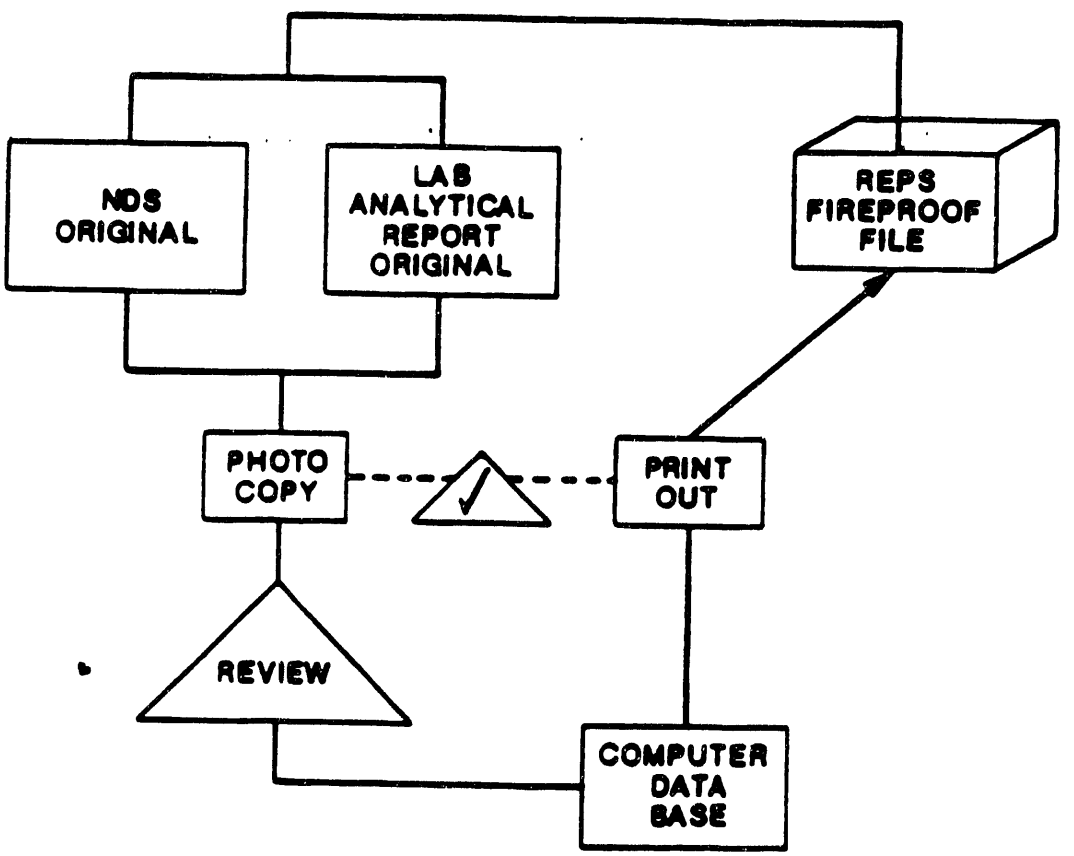
6. A copy of the checked RADCOMP printout is filed with the data diskette in the appropriate section of the REPS file.

7. Original printouts are sent to the Master Records Center (MRC) for permanent storage in accordance with WP 02-302.

172s



RES DATA MANAGEMENT FLOW CHART



LIST OF REVIEWERS

Procedure Number: WP 02-305

Revision Number: 0

Procedure Title: RES DATA MANAGEMENT PROCEDURE

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-306 REV. 1 ISSUE DATE: 02/15/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES/RES EQUIPMENT MAINTENANCE AND CONTROL PROCEDURE*

1.0 SCOPE

This document provides procedures for operability checks and maintenance of equipment used by the Radiological and Environmental Programs Section (REPS). These activities are conducted in addition to the prescribed calibration activities of the WIPP Calibration Laboratory as detailed in WP 10-003, "Instrument Control and Calibration" to assure proper equipment function.

2.0 DEFINITIONS

Refer to Glossary of Terms (Attachment 1).

3.0 REFERENCES

WP 02-304, NES/RES Sample Tracking Procedure
WP 02-313, Environmental Radiation Monitoring Procedure
WP 02-341, NES Ambient Air Quality Monitoring Procedure
Also, refer to References and Standards (Attachment 2).

4.0 GENERAL

The REPS maintains adequate documentation to ensure traceability of equipment calibration, operability checks, and maintenance of quality affecting equipment used for collecting and processing of environmental media.

An Equipment Inventory and Operability Status (EIOS) Log nor a form is maintained for REPS equipment. An example of the EIOS is represented by Attachment 3 of this document.

Maintenance, calibration, and operability test intervals specified in the EIOS are established on the basis of manufacturers' recommendation.

The EIOS shall be updated quarterly by a designated REPS staff member. Equipment scheduled for calibration is sent to the WIPP Calibration Laboratory or is calibrated in place consistent with the requirements of the Calibration Laboratory (CL) and WP 10-003.

REPS maintenance records are maintained for equipment used for collection and processing of samples. Each item of equipment is identified by a unique alphanumeric code issued by the WIPP Calibration Laboratory per WP 10-003. The maintenance records maintained by REPS should include operational checks and maintenance activity for appropriate equipment, including such items as:

- o Operability Test Item Sheets (OTIS) used to provide documentation of the date and results of each operability test. See Attachment 4.
- o Maintenance Log Sheets (MLS) used to describe corrective actions necessary to bring an equipment item into tolerance with operability check requirements. See Attachment 5.
- o Copies of calibration reports from the WIPP Calibration Laboratory or outside Calibration Lab.

Semi-annual reviews of maintenance, operability checks, and calibration activities shall be conducted by the Principal Investigator (PI) to ensure that equipment is functioning within tolerance limits and is being maintained adequately. Variance reports and corrective action items shall be initiated, as appropriate, for unusual or out-of-tolerance conditions.

If an item of equipment fails an operability check and cannot be brought into tolerance with appropriate corrective action, the item is tagged according to its status and the CL notified to initiate calibration by the CL or maintenance and calibration by an appropriate vendor. A yellow "HOLD," "DUE FOR MAINTENANCE," or "SPECIAL INSTRUCTION" tag is used to identify the status (tag-out) of the item in question. This tagged item may or may not be moved to a special holding area, but will be yellow-tagged at all times, until corrective actions rectify the tagging condition. A yellow-tagged item will not be used for routine sample collection or processing without prior written authorization by the REPS manager or designee.

The REPS Department then initiates corrective action either by standard maintenance practices or a calibration of the item in question. If a calibration is performed, REPS will supply within 5 working days, the updated calibration records to the Calibration Laboratory.

If the item in question is not serviced by the REPS Department, the Calibration Laboratory and/or Maintenance Department will be notified.

Prior to making one or a series of pH measurements, the Model 810 must be standardized to compensate for the differences in the zero potential of the electrode systems, according to the instruction manual (Instruction Manual: Fisher Accumet, Model 810, pH Meter, Catalog Nos. 13-636-810 and 811, Allied Fisher Scientific). The meter is tested before use and may be tested between samples if necessary.

NOTE: The unit shall be calibrated annually by a calibration lab.

Proper electrode care is fundamental to obtaining reliable pH measurements. Therefore, the electrode system should be conditioned and used according to the manufacturer's instructions.

The following REPS operability check activities are discussed in this document:

5.1 Low-Volume Continuous Air Sampler
5.2 High-Volume Intermittent Air Sampler
5.3 Environmental Radiation Monitor
5.4 Weathertronics Weather Station
5.5 Sierra Misco Weather Station
5.6 Mettler Balance
5.7 Fisher Accumet pH Meter, Model 810
5.8 Orion Research Conductivity Meter, Model 101
5.9 Densitometer
5.10 Drying Oven
5.11 Environmental Monitoring Trailer

*It should be noted that this procedure was issued previously as an instruction. WP 02-306 has undergone such extensive revision that changes will not be indicated singly.

5.0 PROCEDURE

5.1 Low-Volume Continuous Air Sampler

The CMP-14 samplers have a constant flow valve for regulation of air flow. Annually, a five-point calibration of the regulator function through representative operational conditions for pump head and filter head pressures (ΔP) is conducted by the CL or designated calibration facility.

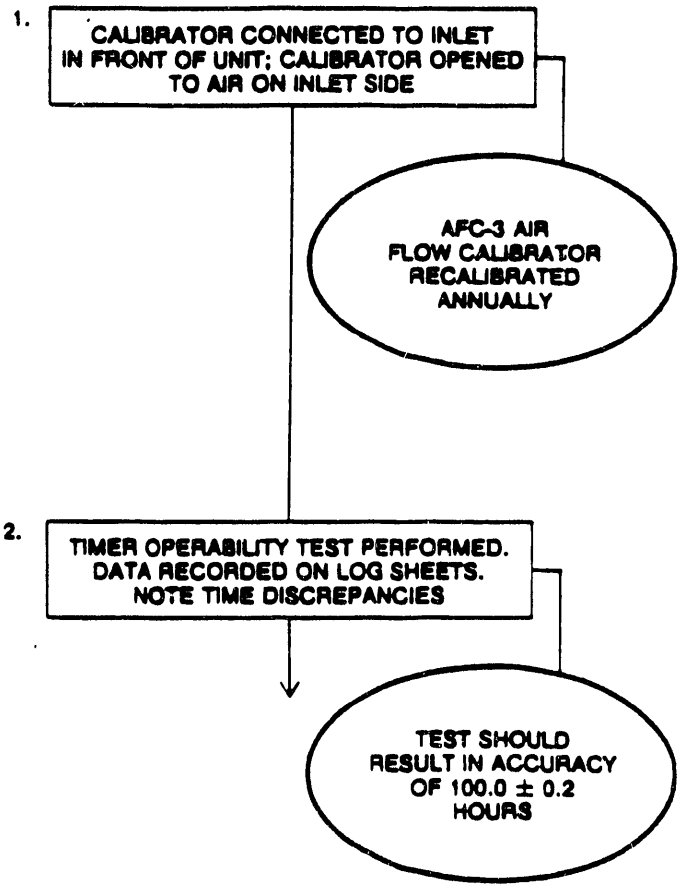
NOTE: The calibration status of test equipment must be verified before performing the operability test. Flow rate operability checks are performed using a calibrated AFC-3 Air Flow Calibrator.

1. The calibrator is connected to the inlet in front of the unit, and the calibrator is opened to the air on the inlet side.

   NOTE: The AFC-3 Air Flow Calibrator is returned to the Calibration Laboratory for recalibration annually (365 days ± 30 days).

2. A timer operability test is performed. Record on data sample log sheets (see WP 02-304) for the sampler. Note consistent discrepancies between the "Elapsed Time" and the "Machine Elapsed Time."

   NOTE: The timer operability test should result in an indicated accuracy relative to 100.0 ± 0.2 hours.



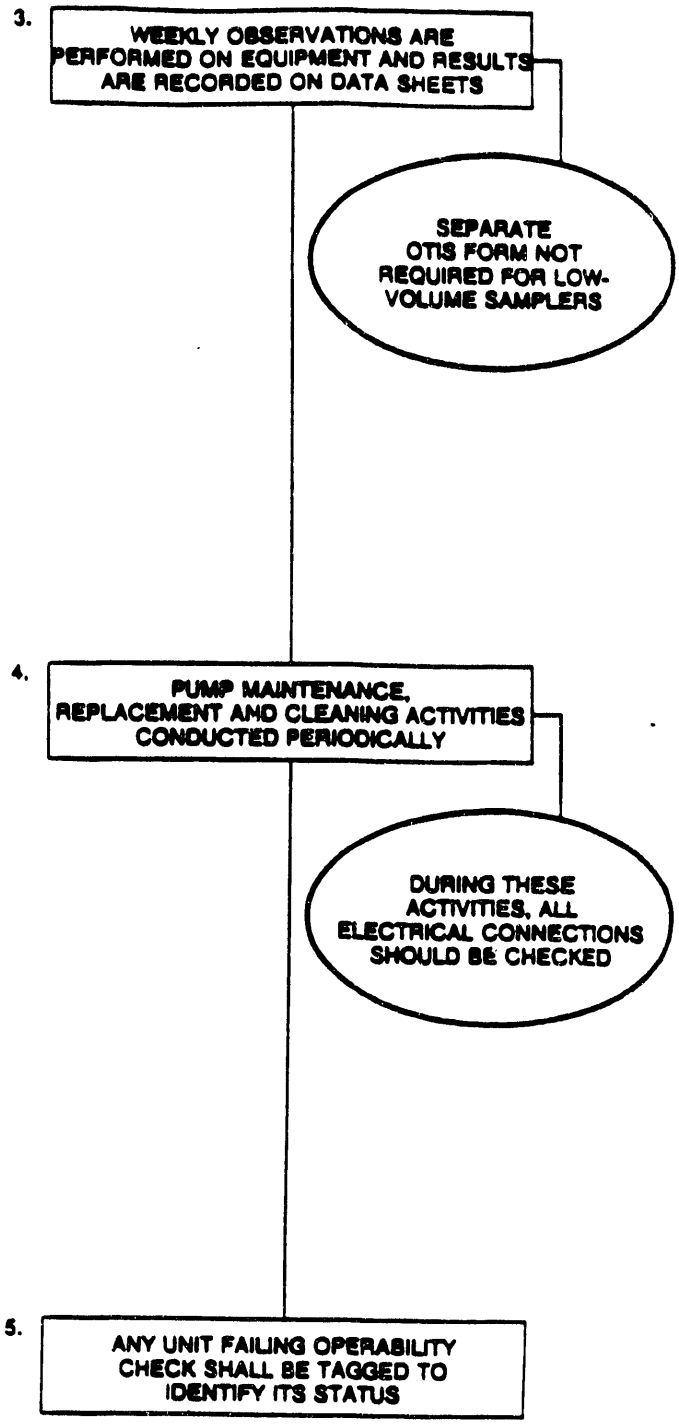
3. Weekly field observations of pump head ΔP, filter head ΔP, indicated CFM, and condition of exhaust filter will be made and any observation of a condition indicating existing or pending malfunction will be recorded on the data sheet.

NOTE: For low-volume air samplers, the weekly data sheet will serve as the separate OTIS. A separate OTIS form is not required.

4. Pump maintenance, replacement, and cleaning activities are conducted periodically, as recommended in the CMP-14 CV instruction manual and the manufacturer's instructions.

NOTE: During replacement or repair of the pump, all electrical connections should be checked for indications of poor contact or loose connection. Also, the hoses and connections are checked for signs of wear or leakage.

5. Any unit which fails an operability check shall be "tagged" to identify its status until corrective actions bring the unit into conformance.



5.2 High-Volume Intermittent Air Sampler

Each Accu-vol sampler has a Kurz 310 Constant Flow Controller which maintains the flow rate under varying conditions of temperature, humidity, and other environmental parameters.

NOTE: Verify the calibration status of all calibration test equipment before performing field test.

1. The air sampler flow rate is tested using the GMW-25A calibration kit.

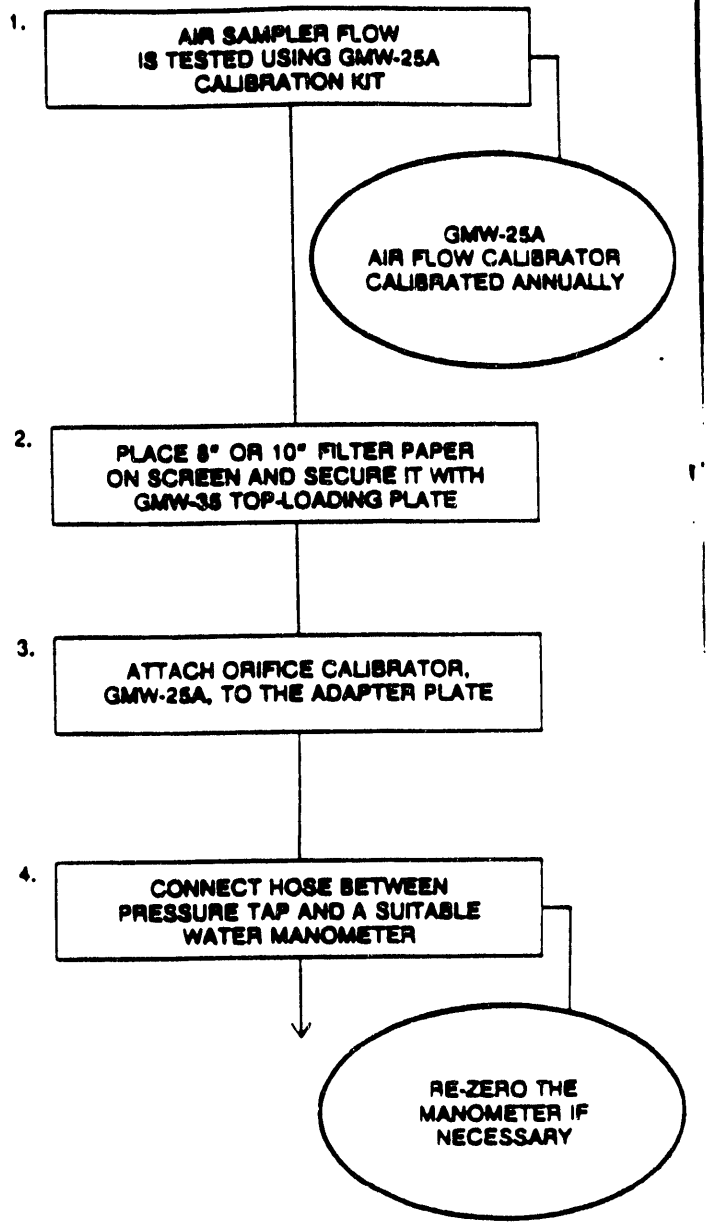
   NOTE: The GMW-25A air flow calibrator is returned to the Calibration Laboratory annually for calibration.

2. Place a standard 8" or 10" filter paper on the inlet screen and secure it with the GMW-35 top-loading adapter plate.

3. Attach the orifice calibrator, GMW-25A, to the adapter plate.

4. Connect a hose between the pressure tap on the calibrating orifice and a water manometer.

   NOTE: Check the zero level of the manometer before use and re-zero, if necessary.



5. Activate the air sampler and allow system to warm up for approximately three minutes.

6. Record temperature and barometric pressure on the High-Volume Air Sampler Calibration Worksheet (Attachment 6) for these environmental factors.

7. Open the access door to the Kurz 310 and locate the control potentiometer.

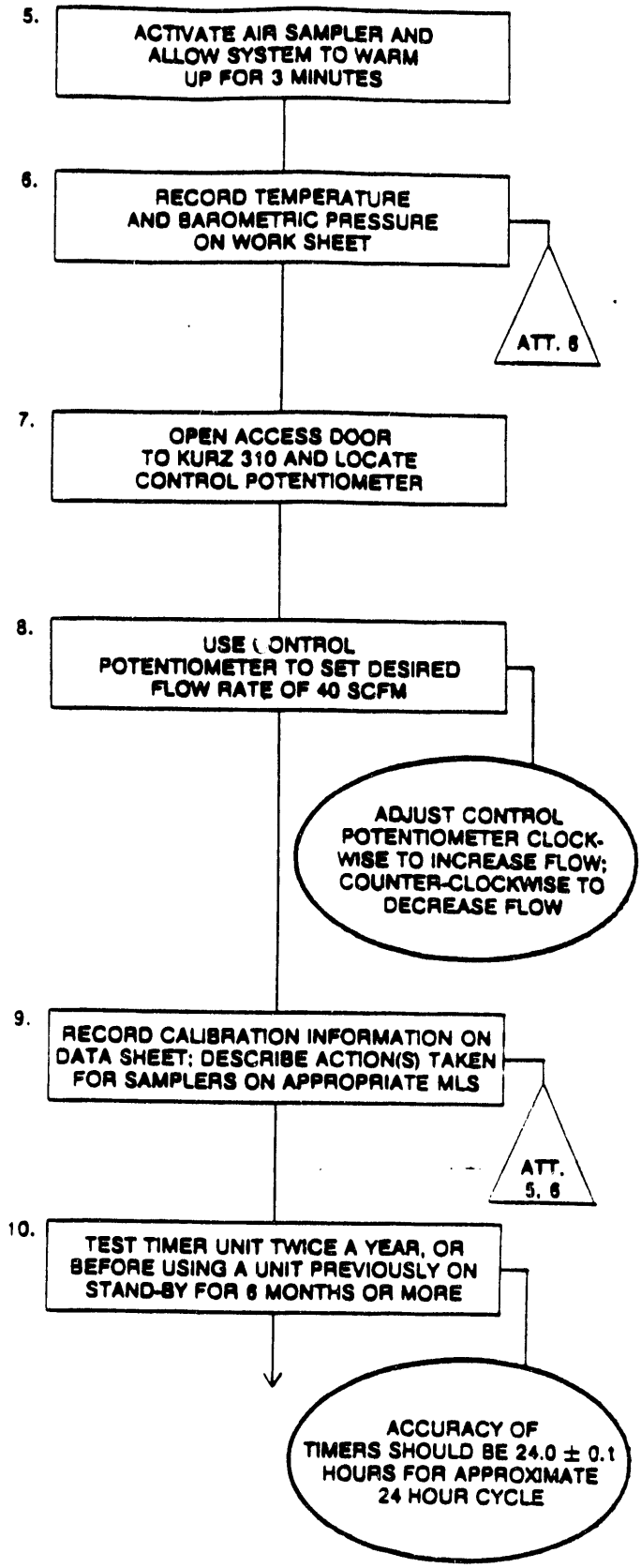
8. Use the control potentiometer to set the desired flow rate of 40 SCFM.

NOTE: Adjust the control potentiometer clockwise to increase flow and counter-clockwise to decrease flow.

9. Record the calibration information on the data sheet (Attachment 6); describe any corrective action taken for a specific sampler on the appropriate MLS (Attachment 5).

10. Test the timer unit against a calibrated timing device twice a year or prior to putting a unit in service that has been in stand-by status for approximately six months (180 days ± 30 days) or more.

NOTE: Accuracy of timers should be 24.0 ± 0.1 hours for an operational cycle of approximately 24 hours.



11. Any unit failing an operability check shall be "tagged," noting its out-of-tolerance status. This unit will remain tagged until corrective action returns the unit to operational status.

11. ANY UNIT FAILING CHECK IS TAGGED TO INDICATE OUT-OF-TOLERANCE STATUS

5.3 Environmental Radiation Monitor, RSS-1012

Refer to WP 02-313 for conduct of daily and weekly RSS-1012 activities.

1. Semi-annual radiation source checks involve the following actions and activities:

   - o Both the Ra-226 (≈10 uCi) and Co-60 (≈100 uCi) sources are used
   - o With one radiation source properly shielded, or at a remote location, personnel place the other in contact with the ion chamber housing
   - o Personnel mark the strip chart and printout noting the test status of the system
   - o Personnel record the appropriate operability check data on an OTIS
   - o Personnel exchange positions of the radiation sources, appropriately marking the strip chart and printout and recording OTIS information for the second source
   - o System status reports are delivered to the PI for determination of out-of-tolerance condition

1. SEMI-ANNUAL RADIATION CHECKS INVOLVE ALL APPROPRIATE ACTIONS AND ACTIVITIES

- o If an out-of-tolerance condition exists, "tag" system noting status of unit until corrective actions are completed

- o Initiate corrective action for out-of-tolerance condition.

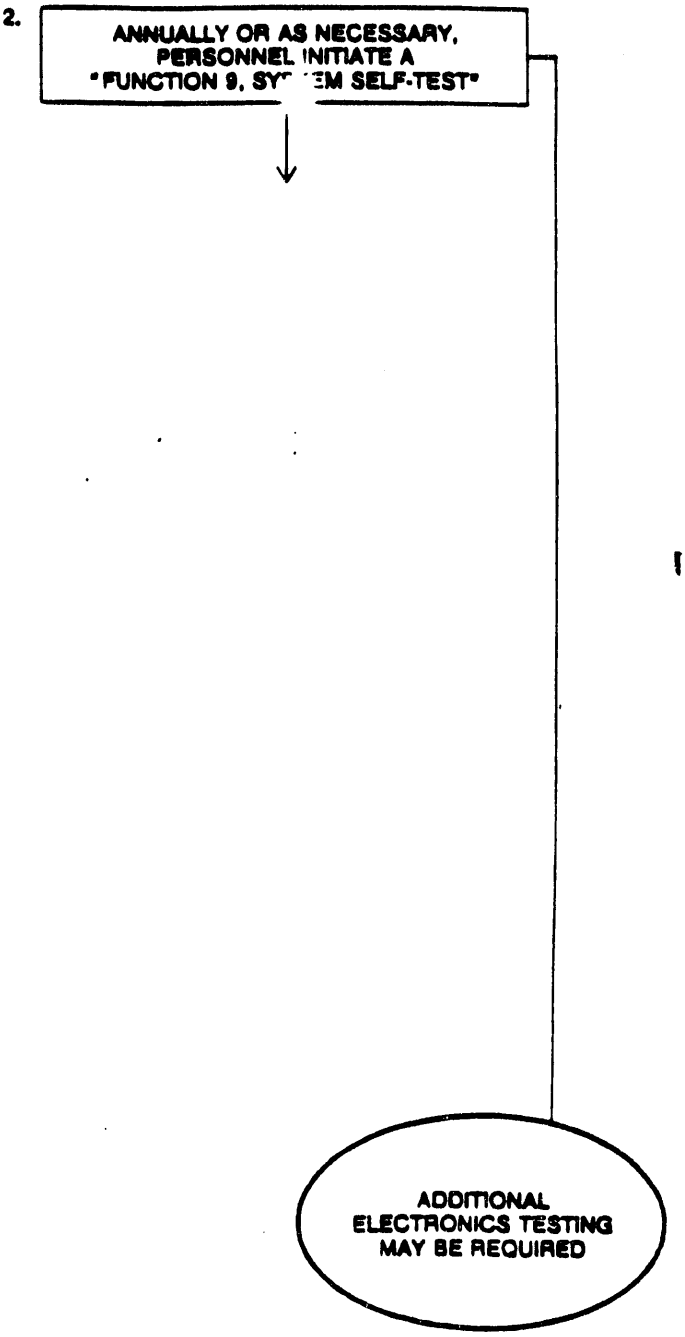
2. Annually, or upon indication of an off-normal or out-of-tolerance condition in the RSS-1012 system status, personnel initiate a "Function 9, System Self-Test," according to Section 2.2.10, pages 11 through 17 of the RSS-1012 Operations Maintenance (OM).

   - o Document the results of the self-test function on an OTIS

   - o If the self-test results indicate equipment malfunction, the RSS-1012 shall be tagged to indicate out-of-service condition and the data printouts will be marked to indicate equipment failure.

   - o The PI shall be notified of the out-of-service condition and corrective action initiated

   NOTE: Additional electronics testing may be required. The CL should be contacted for any additional electronic testing needs.



- o A two-source radiation check (Number 1 above) shall be performed on the system prior to returning the RSS-1012 to unrestricted operational status after corrective actions have been completed

NOTE: Radiation sources are secured in a controlled area, according to Health Physics Program procedures. Contact the HP office to obtain radiation check sources for use in checking the RSS-1012 system's operability.

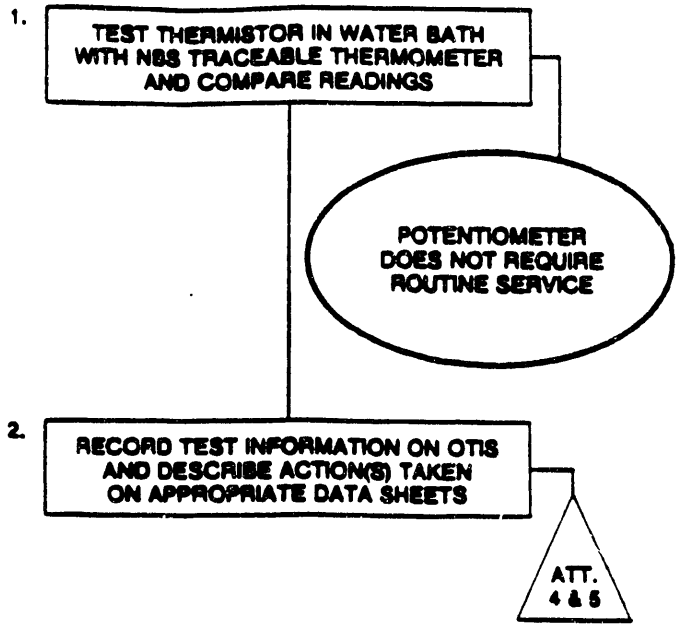
CONTACT HP OFFICE TO OBTAIN RADIATION CHECK SOURCES FOR CHECKING RSS-1012 SYSTEM'S OPERABILITY

5.4 Weathertronics Weather Station

1. To test the thermistor, submerge sensor in a water bath with an NBS traceable thermometer, and compare readings.

   NOTE: The potentiometer does not require routine service.

2. Record the operability test information on the OTIS (Attachment 4) and describe any corrective action taken on the item MLS (Attachment 5).



5.5 Sierra Misco Weather Station

1. To check the temperature and humidity elements, remove the protective shield by releasing the clamps.

   NOTE: This should be done when the elements are in the shade.

2. Immerse the temperature element in a water bath with an NBS traceable thermometer.

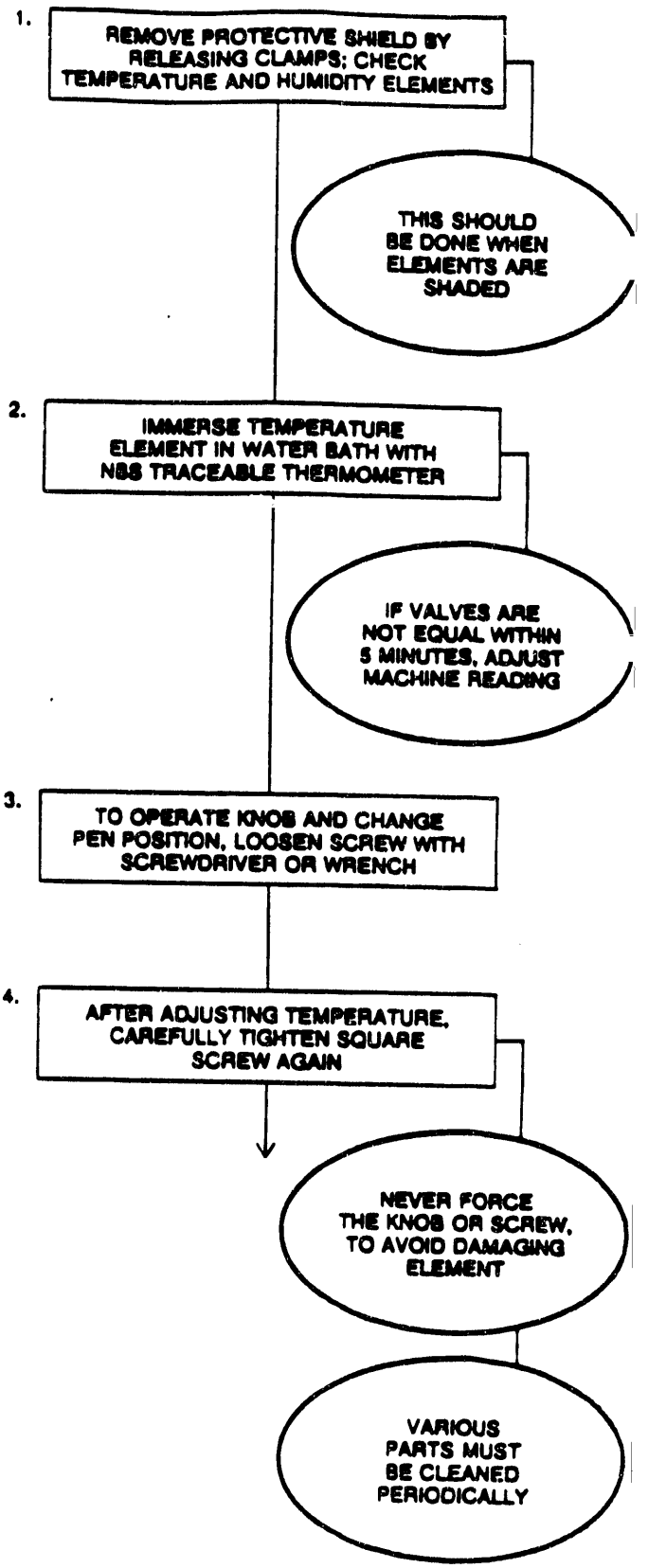
   NOTE: If the values are not equal after five minutes, adjust the temperature reading of the machine by turning the knob on the free end of the element.

3. To operate the knob and change the pen position on the chart, first loosen the screw with a screwdriver, or with the small tube wrench.

4. After adjusting the temperature reading, carefully tighten the square screw again.

   NOTE: Never force the knob or the screw as this could cause permanent damage to the element.

   NOTE: Clean the various parts periodically with a soft brush.



5. To test the humidity unit, wet a piece of gauze, wring it thoroughly, and wrap it around the cage which holds the hair-bundle and wait for 30 minutes.

NOTE: Humidity reading should be 95 to 96%.

6. Adjust the value by unscrewing (to lower) or screwing in (to increase) the square regulating screw at the fixed end of the hair-bundle, to correct for readings beyond the 95 to 96% range.

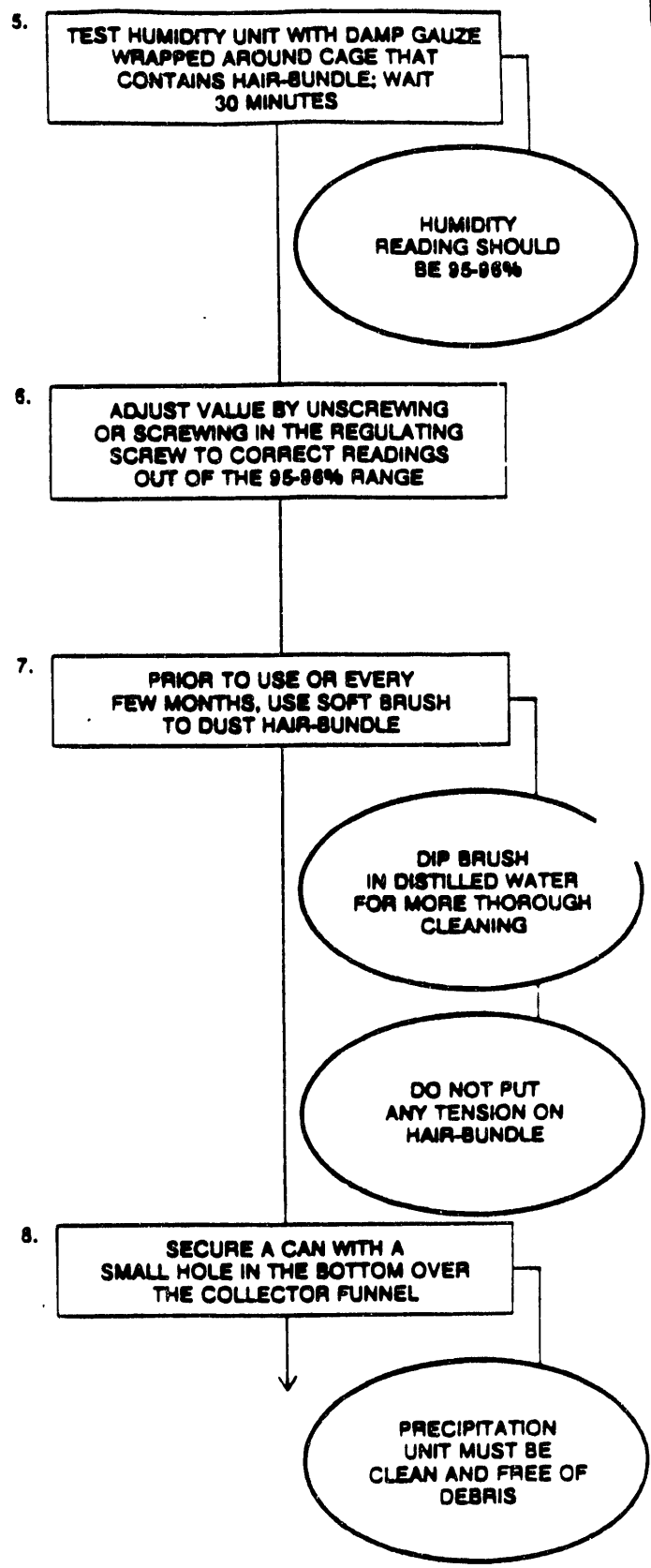
7. Prior to use or every few months, use a soft brush to gently dust the hair-bundle.

NOTE: The brush can be dipped in distilled water which allows for thorough cleaning.

NOTE: Do not put any tension on the hair-bundle.

8. To check the precipitation unit prior to use, secure a can with a small (≈1mm) hole in the bottom over the collector funnel.

NOTE: The precipitation unit must be kept clean and free of debris.



9. Allow 500 ml of water to drip into the funnel (about 30 minutes).

NOTE: The chart should register 25 "steps" or increments in that time, corresponding to 25 mm of rainfall.

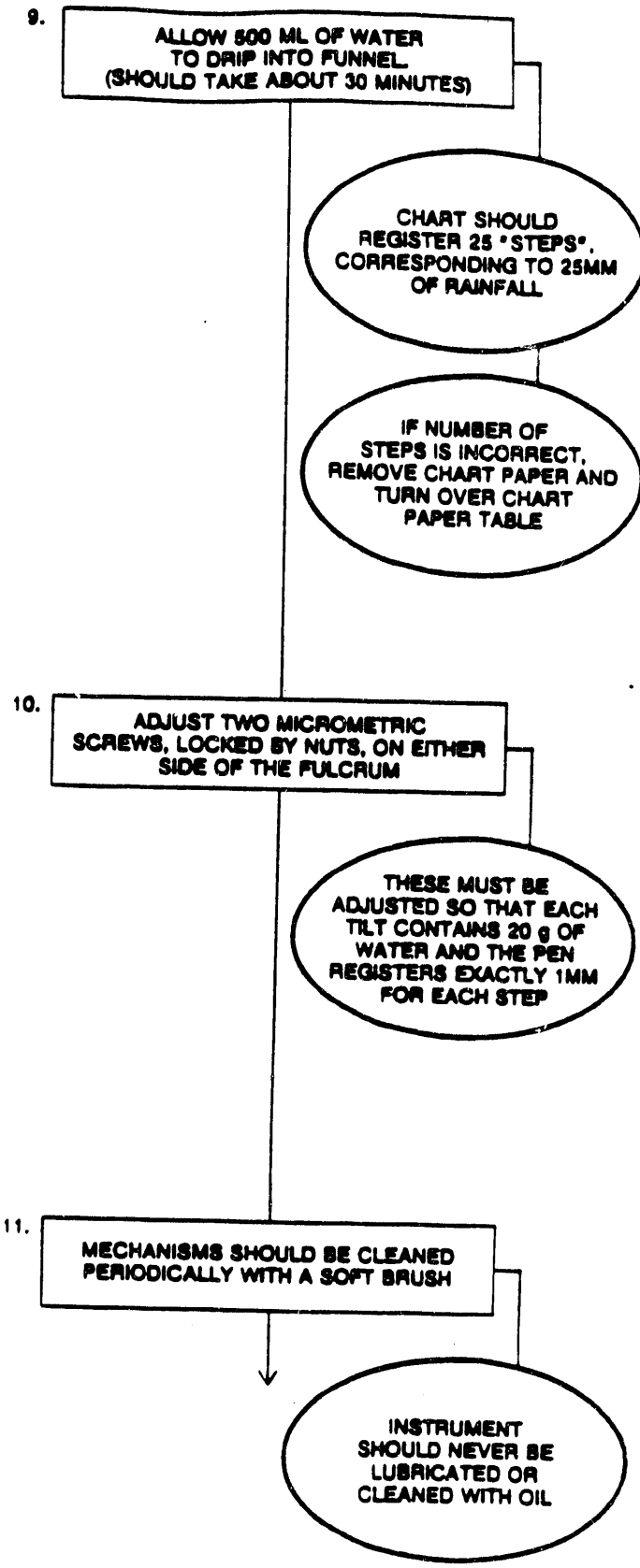
NOTE: If the number of steps on the chart does not correspond to the amounts of water poured into the funnel, remove the chart paper from the clockwork, and turn over the chart paper table.

10. Adjust the two micrometric screws, locked by nuts, on either side of the fulcrum under the yoke of the tilting-bucket.

NOTE: These regulate the inclination of the tilting bucket mechanism, and must be adjusted so each tilt contains 20 g of water and the pen registers exactly 1 mm of rainfall for each step.

11. The mechanisms should be cleaned periodically with a soft brush.

NOTE: The instrument should never be lubricated or cleaned with oil.



12. Record operability test results on the appropriate OTIS (Attachment 4) and describe corrective actions taken on the item MLS (Attachment 5).

12. RECORD TEST RESULTS ON APPROPRIATE OTIS; DESCRIBE ACTION(S) TAKEN ON ITEM MLS

ATT. 4, 5

5.6 Mettler Balance

The Mettler Balance contains a built-in "calibration" mechanism which shall be used in accordance with the manufacturer's instructions to adjust the accuracy of the balance. This shall be performed monthly if the balance is used frequently or prior to use if the balance is used less than once a month.

NOTE: The unit will have a calibration performed annually.

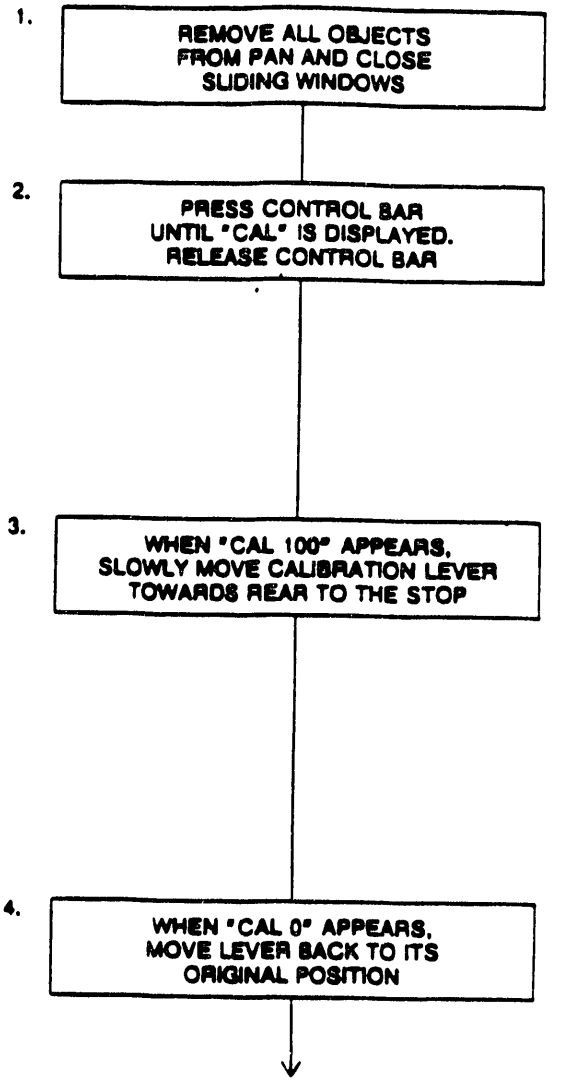
NOTE: This procedure shall be used to check the operability of the Sartorious top-loading balance.

1. Remove all objects from the pan and close the sliding windows.

2. Set the balance to the calibration mode by pressing the control bar until "CAL" is displayed. Release the control bar. "CAL - - - -" will appear in the display.

3. The (internal) calibration weight is placed in position by means of the calibration lever on the right side of the machine. When the "CAL 100" appears (the 100 blinks), slowly move the calibration lever towards the rear all the way to the stop.

4. First "Cal ---" appears, then "100.0000." When "Cal 0" appears (0 blinks), move the lever back to its original position and wait. Display "----" followed by "0.0000" appears. The balance is now calibrated in both weighing ranges.



5. Record the results of the operability test on the OTIS (Attachment 4) and describe any corrective action taken on the item MLS (Attachment 5).

5. RECORD APPROPRIATE INFORMATION ON OTIS FORM: DESCRIBE ACTION(S) TAKEN ON ITEM MLS

ATT. 4, 5

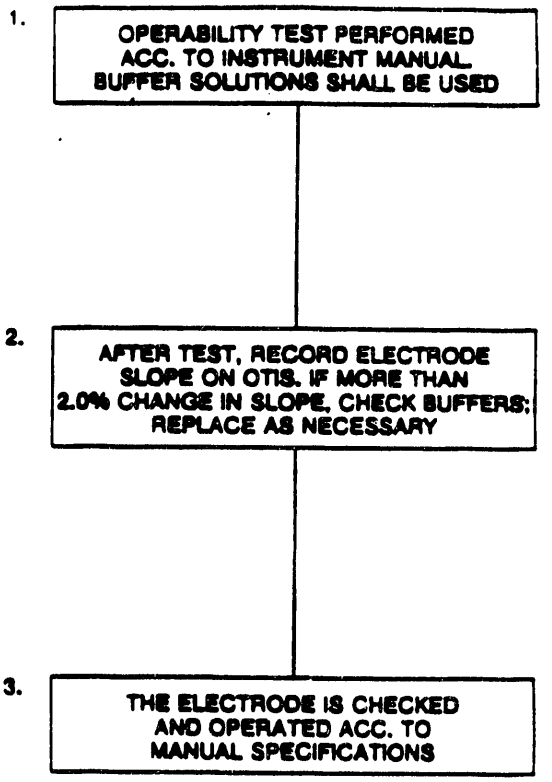
5.7 Fisher Accumet pH Meter, Model 810

The combination pH electrode and the dual pH/mV meter are tested using two temperature equilibrated bracketing buffer solutions, as per the instrument manual. The meter is tested immediately prior to use, and may be testing between samples if necessary. The temperature of the two buffer solutions used in the calibration should be within 1 to 2°C of the material being sampled (i.e., for a water sample, the two standard pH buffers should bracket the expected pH of the water sample) and should be approximately the same temperature.

1. An operability test (calibration) of the pH electrode is performed in accordance with the instrument manual. NBS buffer solutions shall be used.

2. Once the instrument is tested, record the electrode slope on OTIS. If the slope has changed by more than 2.0% from the last calibration, check the integrity of the buffers; replace as necessary.

3. The electrode is checked and operated in accordance with the manual specifications.



5.8 Orion Research Conductivity Meter, Model 101

The Orion Research Conductivity Meter, Model 101, is checked and standardized by measuring the conductance of a known solution.

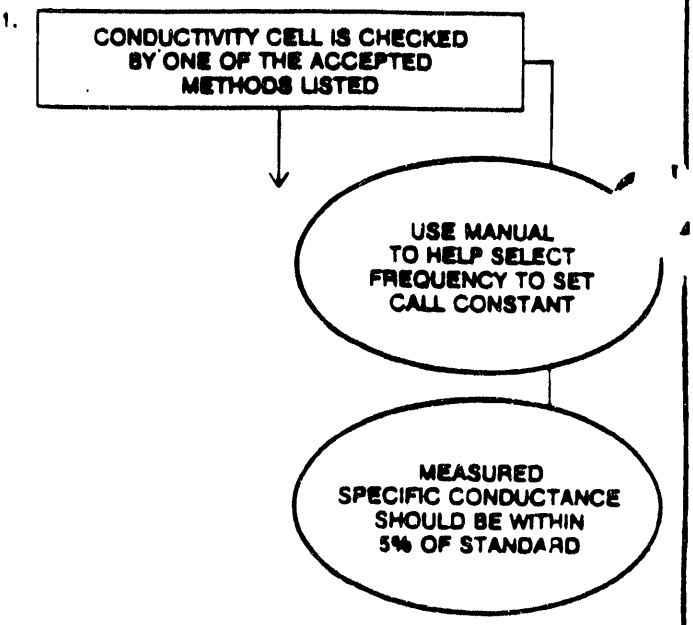
The Orion Conductivity Meter constant is determined by two methods:

- o Preparation of a standard solution described in "The Handbook of Physics and Chemistry" or "Standard Methods."
- o Comparison of two cells of a known constant.

1. The conductivity cell is checked by one of the above methods prior to daily use.

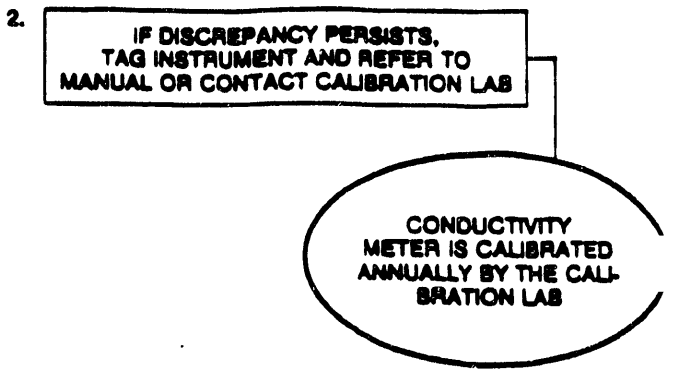
NOTE: Refer to the instruction manual (Instruction Manual: Model 101, Conductivity Meter, Orion Research, Inc.) for selection of a frequency to set the call constant for the Model 101 conductivity meter.

NOTE: The measured specific conductance should be within 5% of the standard solution.



2. If a discrepancy persists, tag instrument, refer to the instrument manual for additional troubleshooting or contact the Calibration Lab.

NOTE: The conductivity meter is calibrated annually by the Calibration Lab.

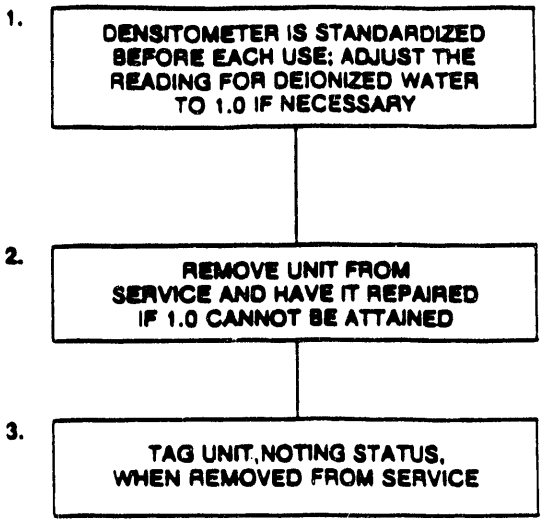


5.9 Standardization of Densitometer

1. The densitometer is standardized before each use by measuring the density of deionized water and adjusting the reading, if necessary, to 1.0.

2. Remove unit from service and have it repaired if a reading of 1.0 cannot be attained.

3. "Tag" unit, noting status, when removed from service.



5.10 Sartorious Balance

Refer to Section 5.6 and follow procedures for the Mettler Balance.

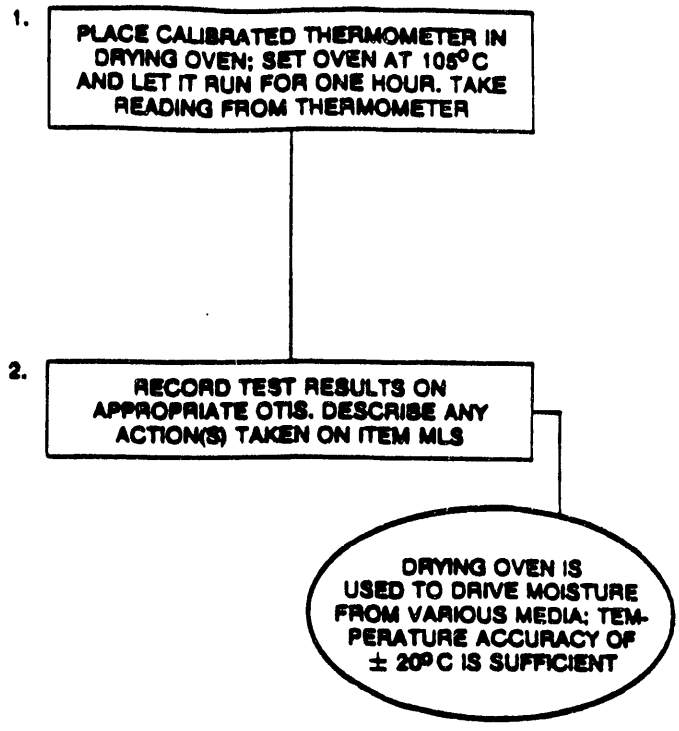
5.11 Drying Oven

1. Place a calibrated thermometer into the drying oven and set the oven at 105°C. Turn the oven on and let it run for approximately one hour. Take a temperature reading from the thermometer.

2. Record the operability test results on the appropriate OTIS (Attachment 4). The operability of the item will be evaluated according to the accuracy requirements of the desired use. Describe any corrective action taken on the item MLS (Attachment 5).

NOTE: The drying oven currently is used to drive moisture from various media. A high degree of accuracy is not required for this task. Therefore, an accuracy of ± 20°C will be sufficient for most drying operations.

An operability test shall be conducted prior to use if a need for greater accuracy in temperature control is required.



5.12 Environmental Monitoring Trailer

NOTE: The Environmental Monitoring Trailer contains an integrated set of ambient air quality monitoring equipment which continuously processes and stores data from several monitoring devices and produces a daily computer printout of data. This integrated system permits daily self-audits which are described in WP 02-341.

244s

GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation - The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample - A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source - A standard radiation source that is used for calibration of a measurement system.

Check Source - A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway - The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector - A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent - The liquid or gaseous waste streams released to the environment.

Emission - Any airborne radioactive material released to the environment.

Environmental Medium - A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs - The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule - A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample - A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber - An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Particle - An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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Radiological Environmental Surveillance

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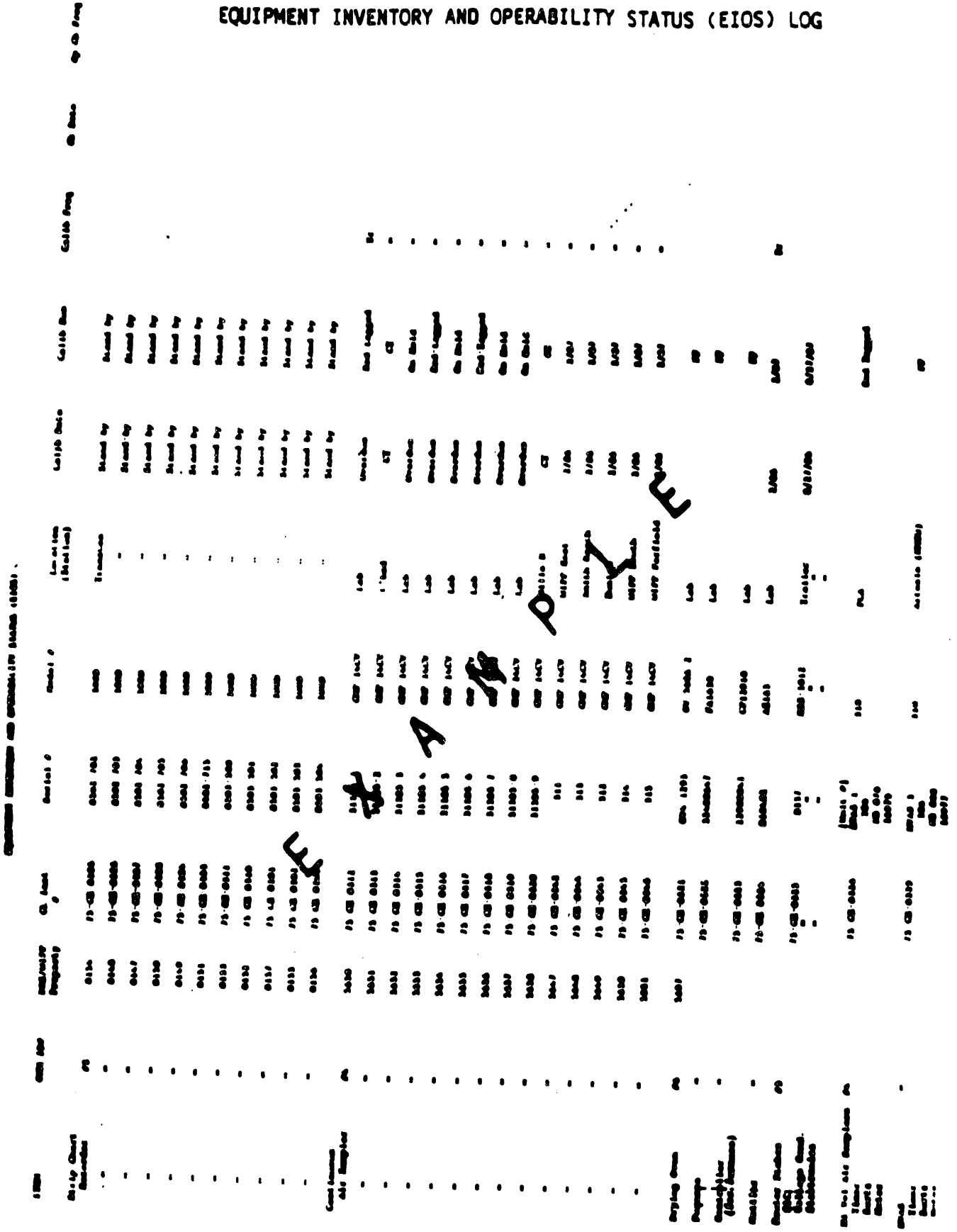
EQUIPMENT INVENTORY AND OPERABILITY STATUS (EIOS) LOG

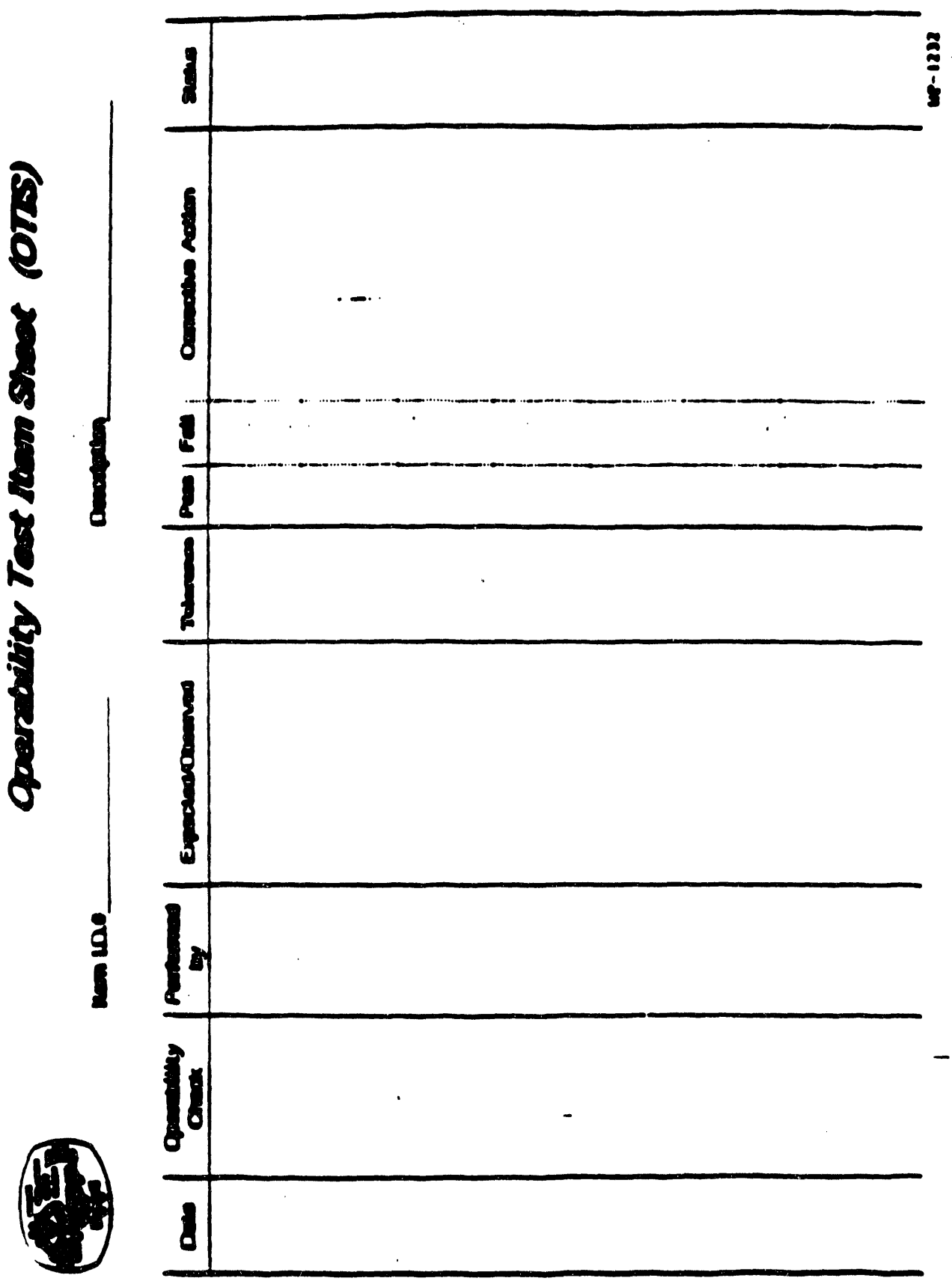


EQUIPMENT INVENTORY AND OPERABILITY STATUS (EIOS) LOG

The following describes the information maintained on the REPS EIOS. The EIOS is a PC Lotus 1-2-3 based spreadsheet containing the following:

Column	Description
Item	A brief name for the specific piece of equipment for which the information in the other columns across the spreadsheet are applicable.
ONM ID#	Refers to the operating and maintenance (ONM) manual (notebook) identification number. A copy of each ONM is kept in the REPS fireproof file.
DOE/WIPP Property	Refers to the WIPP or DOE property tag number assigned to the item. Not all items have WIPP or DOE property tag numbers.
CL Inst #	Refers to the identification number assigned to the item by the Calibration Laboratory. Not all items have CL ID numbers.
Serial #	This column contains the manufacturer's serial number for the item, if available.
Model #	This column contains the manufacturer's model number for the item, if available.
Location (Station)	This column provides a brief descriptor about the present location of the item.
Calib Date	This column identifies the most recent CL calibration date or other descriptor pertinent to the calibration status of the item (i.e., CT refers to an item identified as in Continuous Test (CT) per WP 10-003).
Calib Due	This column identifies the date for which the CL has tagged the item for being due for recalibration.
Calib Freq	This column identifies the period established by CL for calibration recall.
Ck Date	This column identifies the most recent date, at which time the REPS performed a specified operability or field test on the item to verify its functional status.
Op Ck Fre	This column identifies the established frequency for which REPS operability/field tests are conducted On the item.

OPERABILITY TEST ITEM SHEET (OTIS)



MAINTENANCE LOG SHEET (MLS)

EQUIPMENT ID

Date	Time	Span Check/ Flow Check/ Calibration	Notes

HIGH VOLUME AIR SAMPLER CALIBRATION WORKSHEET

DATA SHEET No. _____

DATE _____

SAMPLER No. _____

CALIBRATED BY _____

BAROMETIC PRESSURE ABSOLUTE (in. Hg) _____

SOURCE OF B. P. DATA _____

AIR TEMPERATURE _____

CALIBRATOR SERIAL No. (Check One) C256 ☐ 3241 ☐ C166 ☐

CALCULATIONS:

$$C = \sqrt{\frac{T + 273}{P}} \times 0.3168 \times Q$$

WHERE:

- C = CORRECTED ORIFICE STATIC PRESSURE (in. H_2O)
- Q = ORIGINAL ORIFICE STATIC PRESSURE (in. H_2O)
- P = BAROMETRIC PRESSURE ABSOLUTE (in. Hg)
- T = TEMPERATURE (°C)

NOTE ORIGINAL ORIFICE STATIC PRESSURE OBTAINED FROM SAMPLER CERTIFICATE OF CALIBRATION

RECORDED BY _____

CHECKED BY _____ DATE _____

HIGH VOLUME AIRBORNE PARTICULATE SAMPLING DATA SHEET

RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

UNIQUE IDENTITY CODE _____ UNIT No. _____

PREPARATION:

DATE _____ BLANK FILTER Wt. _____ g RECORDED BY _____

INSTALLATION:

DATE _____ TIME _____ RECORDED BY _____ CLOCK SET AT CURRENT TIME ☐

ADVANCED TIMER SET. START _____ STOP _____ ON _____ DATE _____

FLOW RATE CALIBRATED AT _____ cfm NO CALIBRATION PERFORMED ON THIS DAY ☐

FOR NON-RESETTABLE TIMER: REMOVAL TIME _____ – INSTALL TIME _____ =

TOTAL ELAPSED TIME _____ ÷ 60 = _____ hours

REMOVAL:

DATE _____ TIME _____

TOTAL ELAPSED TIME _____ RECORDED BY _____

SAMPLE STATUS. ☐ O.K. ☐ QUALIFIED/FLAWED ☐ ABORTED ☐ P.I. NOTIFIED

FIELD CHECKS

	YES	NO
POWER OUTAGE LIGHT OFF.	___	___
UNIT APPEARS TO HAVE COMPLETED A NORMAL CYCLE.	___	___

NOTE: IF RESPONSE IS NO, ACTION IS REQUIRED. PLEASE NOTE ACTION TAKEN: _____

ACTIONS RECORDED IN MAINTENANCE LOG ☐

POST EXCHANGE ACTIVITIES:

Wt. AFTER 12 HRS. IN DESICCATOR _____ g

Wt OF PARTICULATES: _____ g _____ mg

CALCULATED VOL OF AIR SAMPLED _____ m^3

Wt. OF PARTICULATES PER UNIT OF AIR SAMPLED _____ mg/m^3

RECORDED BY _____ DATE _____

CHECKED BY _____ DATE _____

LIST OF REVIEWERS

Procedure Number: WP 02-306

Revision Number: 1

Procedure Title: NES/RES Equipment Maintenance and Control Procedure

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-307 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: RES SOIL SAMPLING PROCEDURES

1.0 SCOPE

This document provides procedures, data sheets, and checklists for collecting soil samples for the Radiological Environmental Surveillance (RES) Program conducted by the Radiological and Environmental Programs Section (REPS). Soil sampling and soil handling shall be conducted in the manner described in this document.

2.0 DEFINITIONS

Refer to Attachment 1.

3.0 REFERENCES

Refer to Attachment 2.

4.0 GENERAL

All activities associated with the collection, handling, data review, and management of soil samples shall be described in the Environmental Procedure Manual (WP 02-3).

Soil samples collected for the RES Program will be collected on a schedule developed according to the procedures detailed in WP 02-303. Data sheets and sample containers are prepared prior to sampling activities according to the procedures listed in WP 02-303.

The tasks defined by these procedures are to be implemented only by qualified personnel as described in Section 5.2 of WP 02-301.

Activities are recorded on a Soil Sampling Data Sheet (Form WP-1221). An example of a completed Soil Sampling Data Sheet is provided as Attachment 3.

Non-routine deep soil samples may be required at the discretion of the Principal Investigator (PI). Sampling methods consistent with appropriate sections of WP 02-336 will be utilized for deep soil samples.

The following RES Soil Sampling procedures are discussed in this document:

5.1 Preparation for Field Sampling
5.2 Sample Collection
5.3 Post-Sampling Activities

5.0 PROCEDURE

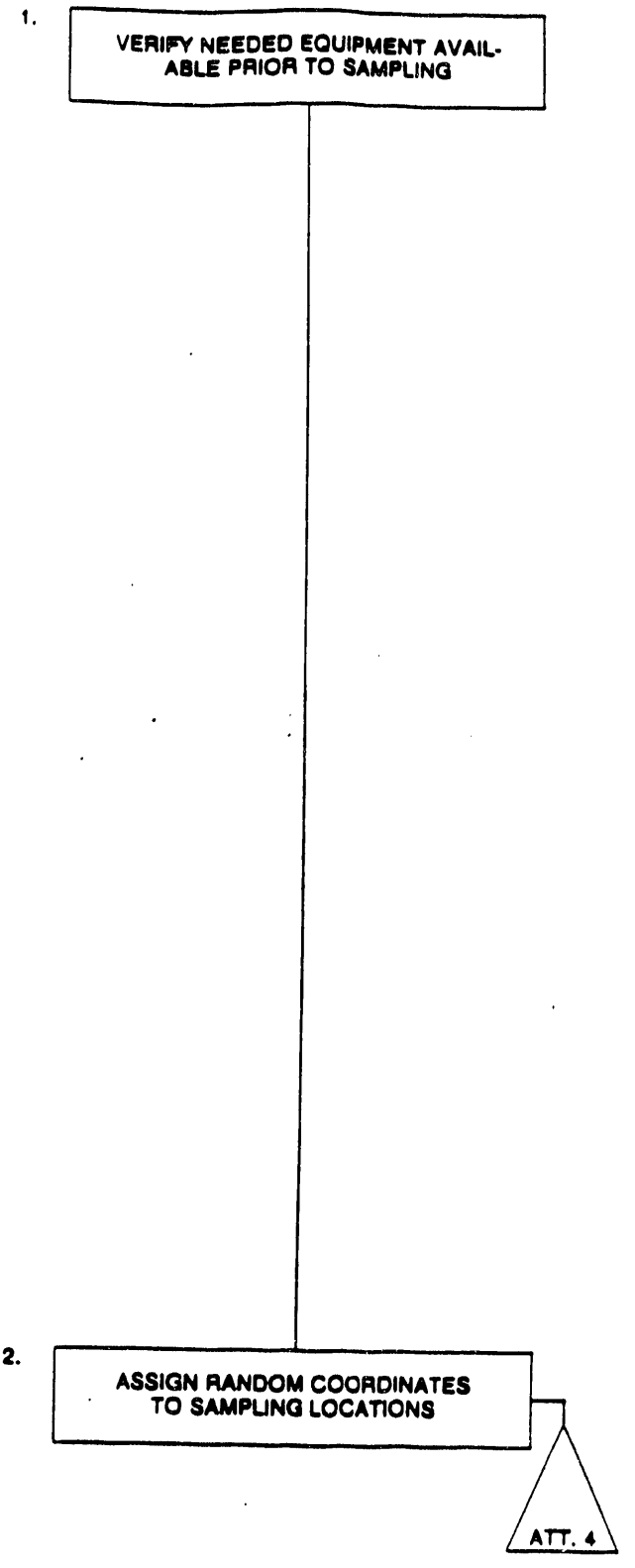
Preparation for Field Sampling

1. Prior to field sampling, the following equipment or equivalent and supplies shall be available:

   - o Appropriately labeled Soil Sampling Data Sheets/Procedure Completion Checklists
   - o Stainless steel soil sampling template (10 cm x 10 cm x 10 cm)

     Template shouid be marked at 1 cm intervals on internal faces
   - o Flat piece of wood, approximately 10 cm x 10 cm. (optional)
   - o Spatula or equivalent implement
   - o Three buckets with plastic liners, at least two gallons in volume, labeled for appropriate depth intervals
   - o Paper towels or Kimwipes
   - o Sample splitter
   - o Labeled sample bags
   - o Pens, markers
   - o Compass (optional)

2. Assign random coordinates as described in Attachment 4, Selecting Random Locations.



5.2 Sample Collection

The following will be performed at each sampling location.

1. At the specified sampling station, locate the starting point marker.

2. Fill in the location, date, time, and field personnel information on the Soil Sampling Data Sheet (Attachment 3) for that location.

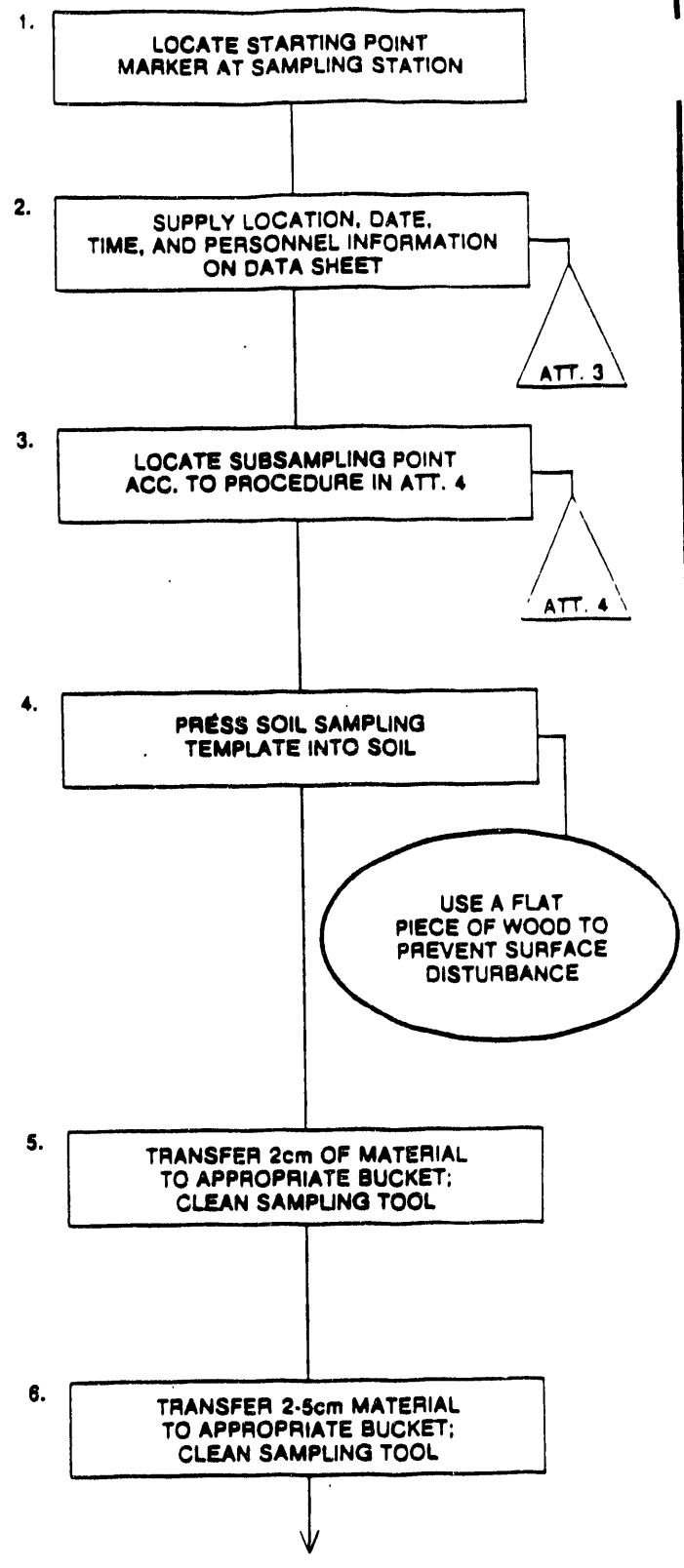
3. Locate a subsampling point following the procedure described in Attachment 4.

4. Press the soil sampling template into the soil with the marked centimeter rule facing up.

   NOTE: A flat piece of wood may be placed over the top of the template to prevent undue disturbance of the surface soil layers.

5. Using a clean spatula or equivalent implement, transfer the first 2 cm of material inside the template into a plastic-lined bucket labeled for that depth interval; wipe the sampling tool.

6. Transfer the material from 2 to 5 cm inside the template to the bucket labeled for that depth interval; wipe the sampling tool.



7. Transfer the material from 5 to 10 cm inside the template to the bucket labeled for that depth interval. Wipe the sampling tool, extract the template and wipe.

8. Repeat steps 3 through 10 for each remaining subsampling location.

NOTE: All 10 subsamples for each depth interval are placed in the same bucket.

9. Return buckets containing the samples from each depth to the field vehicle.

10. Pour a sample through the sample splitter.

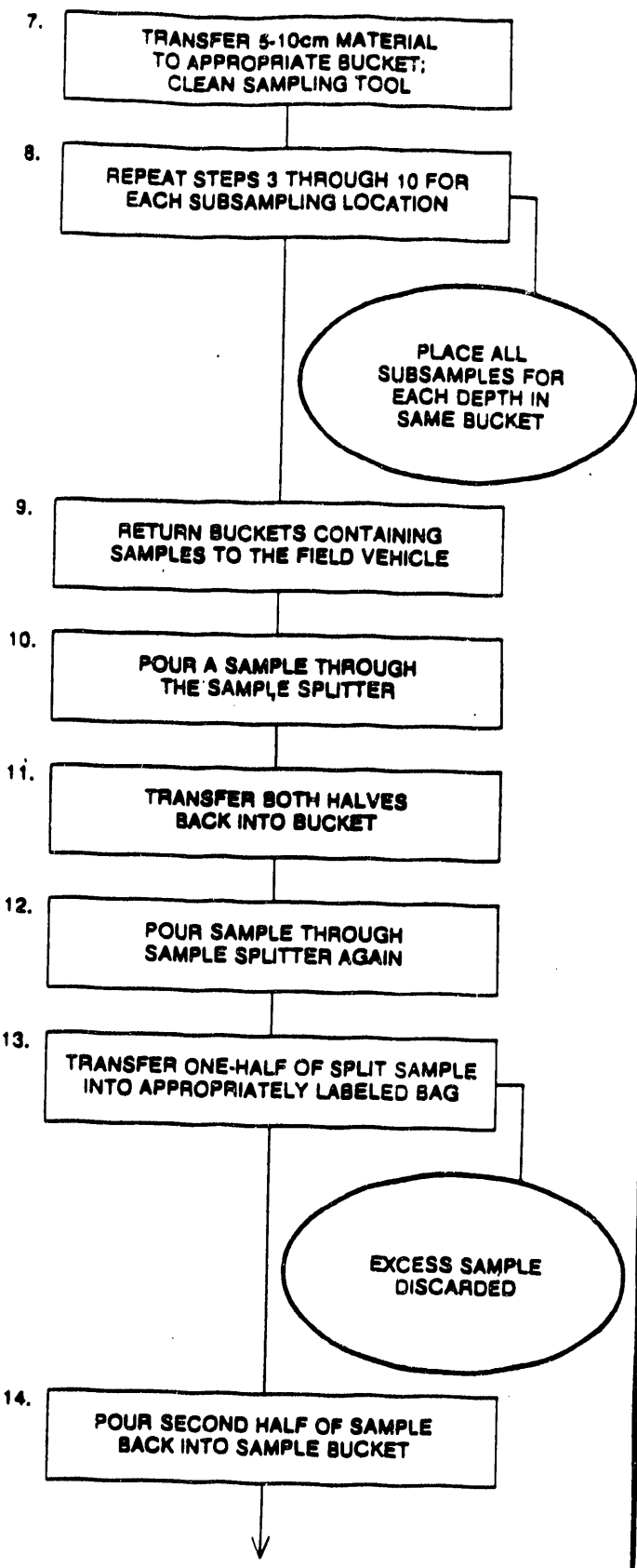
11. Transfer both halves of the split sample back into the bucket.

12. Pour the sample through the sample splitter again.

13. Transfer one-half of the split sample into a sample bag labeled with the specification code 1.3 for that depth interval.

NOTE: Excess sample material can be discarded.

14. Pour the second half of the split sample back into the bucket.



15. Pour the contents of the bucket through the sample splitter.

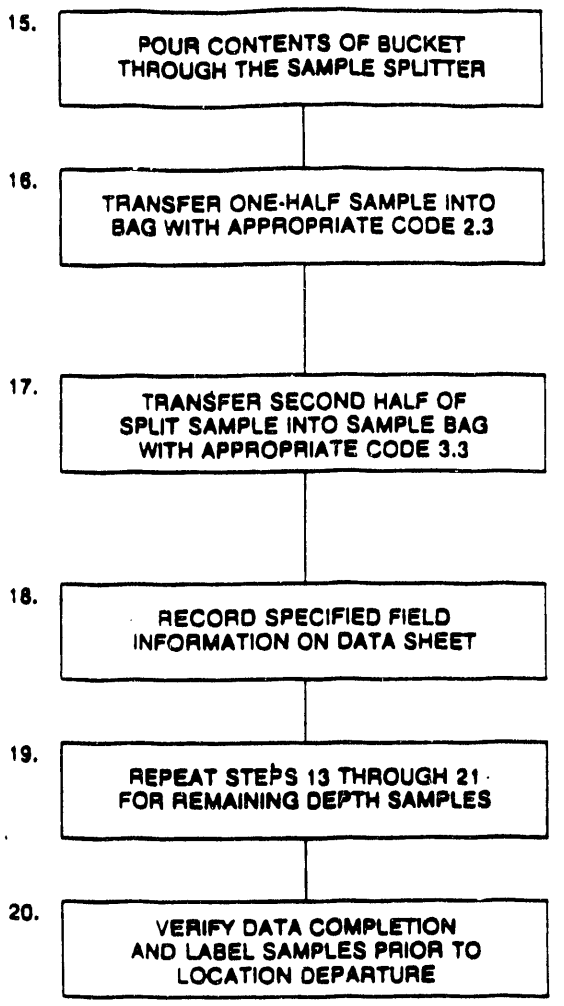
16. Transfer one-half of the split sample into a sample bag labeled with the specification code 2.3 for that depth interval.

17. Transfer the second half of the split sample into a sample bag labeled with the specification code 3.3 for that depth interval.

18. Record specified field information on the data sheet.

19. Repeat steps 13 through 21 for the remaining two depth samples.

20. Verify completion of data sheet and labeling of all samples prior to leaving each sampling station.

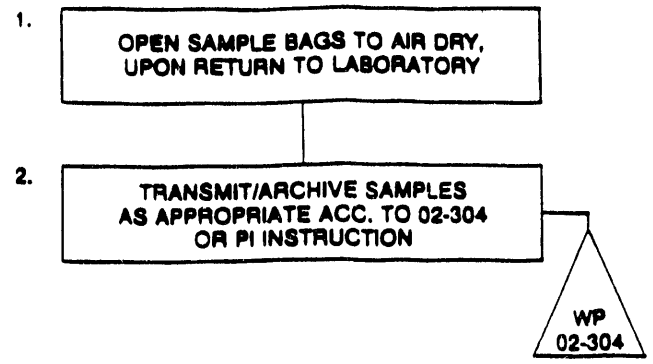


5.3 Post-Sampling Activities

1. Upon return to the sample preparation laboratory, open sample bags for air drying inside the lab.

2. Transmit or archive samples, as appropriate, according to WP 02-304 or as indicated by the PI.

169s



GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation - The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample - A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source - A standard radiation source that is used for calibration of a measurement system.

Check Source - A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway - The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector - A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent - The liquid or gaseous waste streams released to the environment.

Emission - Any airborne radioactive material released to the environment.

Environmental Medium - A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs - The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule - A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample - A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber - An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Particle - An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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DIRECTIONS FOR COMPLETING SOIL SAMPLING DATA SHEET

The following information applies to the completion of Soil Sampling Data Sheets (Form WP-1221) as specified in the RES Soil Sampling Procedures. An example of a completed Soil Sampling Data Sheet/Procedure Completion Checklist is shown on pages 3 and 4 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to WP 02-303.
Location	Accepted name of the site from which sample is collected.
Date	Date samples are collected (month, day, year).
Time	Approximate time samples are collected (in 24-hour time).
Field Personnel	Name(s) of personnel actively collecting samples.
Sample Codes of Splits	Unique identity code (UIC) for each of the three sample splits obtained from the composite sample as per WP 02-307. Preprinted adhesive labels should be used when available.
Specification/Comments	The destination of each split sample (analysis, archive, or transmittal). Also, any noteworthy observations about the split.
Status	A change in sample status (from normal or "OK") for any of the splits as determined by the PI.
Random Locations	See Attachment 2 for instructions on obtaining random directions and coordinates for each of the random sampling locations.
Comments	Any specific information/comments relevant to sampling location, i.e., "near caliche," "heavy rainfall prior to collection."

Checked By	Signature of personnel responsible for checking the accuracy and completeness of the data sheet.
Date	Date on which data sheet is checked.

SOIL SAMPLING DATA SHEET

Radiological Environmental Surveillance

Location: OSR-90 Date: 10-31-86 Time: 1330

Field Personnel: Joe Checker, John Sampler

Surface Sample (Subprogram TS) 0-2 cm

Sample Codes of Splits (Use Labels when Available)		Specification/Comments	Status*
	TS-R05-19861031-1.3	Analysis	
	TS-R05-19861031-2.3	to EEG	
	TS-R05-19861031-3.3	Archive	

Intermediate Sample (Subprogram TI) 2-5 cm

Sample Codes of Splits (Use Labels when Available)		Specification/Comments	Status*
	TI-R05-19861031-1.3	Analysis	
	TI-R05-19861031-2.3	to EEG	
	TS-R05-19861031-3.3	Archive	

Deep Sample (Subprogram TD) 5-10 cm

Sample Codes of Splits (Use Labels when Available)		Specification/Comments	Status*
	TD-R05-19861031-1.3	Analysis	
	TD-R05-19861031-2.3	to EEG	
	TD-R05-19861031-3.3	Archive	

*Status: Blank=OK Q=Qualified F=Flawed A=Aborted

Random Locations:

	Direction	# of Paces (0-40)	# of Paces (0-40)
1	E	10	39
2	N	16	30
3	W	25	4
4	S	5	40
5	E	39	16
6	S	27	17
7	N	2	12
8	W	35	25
9	W	15	10
10	S	22	30

Comments: Heavy Rainfall prior to collection

Checked by: Jane Doe Date: 11/11/86

WP 1221

SELECTING RANDOM LOCATIONS

1.0 SCOPE

This attachment describes the steps required to randomly locate sampling stations or points in the RES Program at the WIPP facility. These steps shall be followed to select a random location for collecting soil samples, or other sampling activities where random locations within a rectangular area are required.

2.0 LOCATING A RANDOM SAMPLING STATION OR POINT

(1) A starting point shall be defined at each sampling station for which these steps are used.

(2) Draw a random number to represent one of the four major compass headings (N=1, S=2, E=3, and W=4) using a random number generator or a random number table. This will be the starting direction.

(3) Draw a random integer between 0 and 40 to represent the number of paces to proceed in the starting direction (see step 1).

(4) Draw a second random integer between 0 and 40 to represent the number of paces to proceed in the second direction.

(5) Enter these numbers in the appropriate blanks on the data sheet for each sample.

3.0 IDENTIFICATION OF SAMPLING LOCATION IN THE FIELD

At the sampling station:

(1) Proceed to the permanent marker or starting point.

(2) Using a compass or the directional markers in place at the plots, find the starting direction indicated on the data sheet for the current sample or subsample.

(3) Proceed in that direction for the number of paces determined by the first random number listed on the data sheet. Turn left 90 degrees and proceed in the second direction for the number of paces determined by the second random number listed on the data sheet.

(4) If the selected location is inaccessible or inappropriate (e.g., man-made barrier), draw a new starting direction and proceed to the random location using the previously selected coordinates.

LIST OF REVIEWERS

Procedure Number: WP 02-307

Revision Number: 0

Procedure Title: RFS SOIL SAMPLING PROCEDURES

	Reviewer's Name	Department
	J. Cockman	REPS
B.	B. Kehrman	REPS
	T. Fischer	REPS
	A. Rodriguez	REPS
	R. Youngman	QA

NO: 02-308 REV. 1 ISSUE DATE: 03/03/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: THERMOLUMINESCENT DOSIMETER (TLD) HANDLING PROCEDURES*

1.0 SCOPE

This document provides procedures, data sheets, and checklists for the use of thermoluminescent dosimeters (TLDs) in conducting the Radiological Environmental Surveillance (RES) Program of the Radiological and Environmental Programs Section (REPS). The TLDs are used to measure penetrating ambient radiation at WIPP and the surrounding environment.

2.0 DEFINITIONS

Refer to Attachment 1.

3.0 REFERENCES

WP 02-301, Radiological Environmental Surveillance (RES) Implementation
WP 02-302, RES Quality Assurance/Quality Control Implementation
WP 02-303, RES Scheduling, Documentation, and Field Preparation
WP 02-304, RES Sample Tracking
WP 02-305, RES Data Management
Refer to Attachment 2.

4.0 GENERAL

All activities associated with the storage, handling, transport, and exchange of TLDs shall be as described in the Environmental Procedure Manual (WIPP 02-3).

The tasks defined by this procedure are to be implemented only by qualified personnel as described in Section 5.2 of WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS Section Manager as specified in WP 02-302.

Activities are recorded on a TLD Field Exchange Data Sheet (Form WP-1222) and/or Dosimeter Placement Sheet (Form WP-1223) at the time such activities are conducted. After each procedure is completed, the appropriate area on the Procedure Completion Checklist (back of data sheets) is to be marked. Any uncompleted procedure must be explained. Examples of a completed TLD Field Exchange Data Sheet/Procedure Completion Checklist and a Dosimeter Placement Sheet/Procedure Completion Checklist are provided as Attachments 3 and 4.

Dosimeters will be placed and exchanged on a schedule developed according to the procedure detailed in WP 02-303. Additional field cycle periods may be designated by the Principal Investigator (PI) for special or nonroutine evaluations.

The following TLD Handling procedures are discussed in this document:

5.1 Handling of TLDs
5.2 TLD Exchange: Laboratory Preparation
5.3 TLD Exchange: Field Activities
5.4 New Station Installation
5.5 Discontinuation Of A TLD Station

*It should be noted that this procedure was issued previously as an instruction. WP 02-308 has undergone such extensive revision that changes will not be indicated singly.

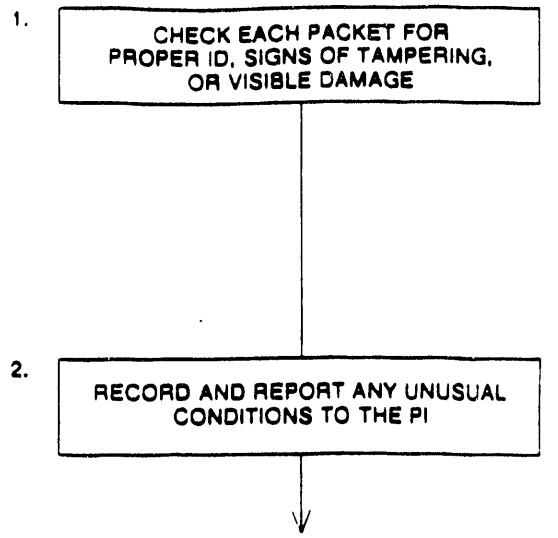
5.0 PROCEDURES

Handling of TLDs

This section applies to the storage, handling, and transport of TLDs during monitoring activities.

1. Upon receipt of TLD packets from the analytical laboratory, carefully check each packet for proper identification, signs of tampering, or other visible damage that might have occurred during transit.

2. Record and report any apparent unusual conditions (e.g. signs of tampering or visible damage) to the PI. The PI will determine whether out of tolerance condition constitutes a variance as defined in WP Q2-302.

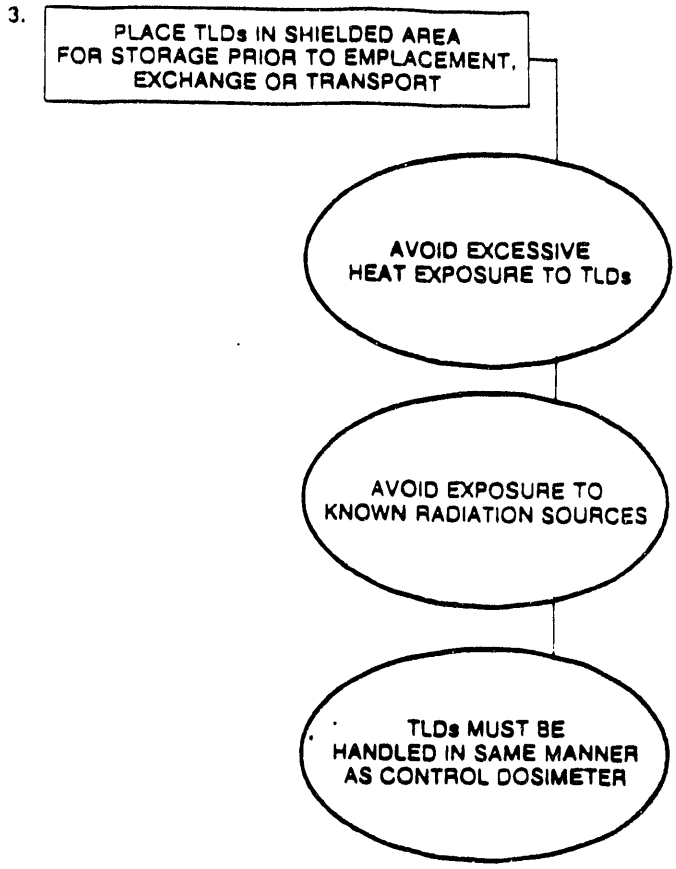


3. Place TLDs in REPS laboratory shielded area for interim storage prior to emplacement, exchange, or transport to the analytical laboratory. Control TLDs will be placed in a shielded area for storage during a monitoring period (field cycle).

NOTE: Avoid exposing the TLDs to excessive heat (direct sun while in the field vehicle; near the furnace or oven in the laboratory area).

NOTE: Avoid intentional exposure to known radiation sources (areas where radiation sources are in use or being stored.

NOTE: Do not handle or transport TLDs without simultaneously handling or transporting the control dosimeter(s) in the same manner.



5.2 TLD Exchange: Laboratory Preparation

1. The following equipment and supplies shall be available:

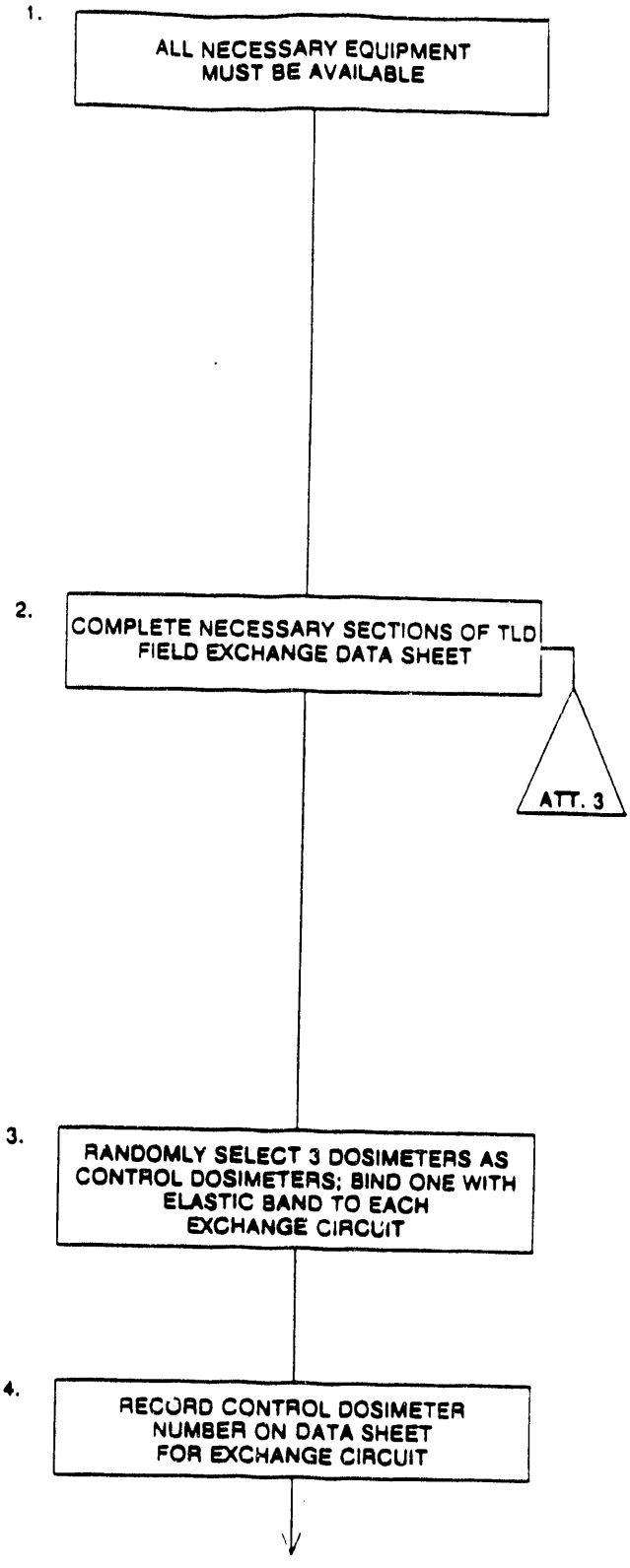
   - o TLD Field Exchange Data Sheets/Instruction Completion Checklists for dosimeters currently in the field
   - o Blank TLD Field Exchange Data Sheets/ Instruction Completion Checklists for dosimeters to be installed
   - o Dosimeters (sufficient number for exchange activities) that have been released by the PI
   - o Elastic bands.

2. For each exchange circuit, complete the following sections on a blank TLD Field Exchange Data Sheet (Attachment 3):

   - o Field cycle
   - o Installation date
   - o Exchange circuit
   - o Locations included in the exchange circuit.

3. Select at random at least three (3) dosimeters to serve as control dosimeters for each exchange circuit, and bind together with an elastic band.

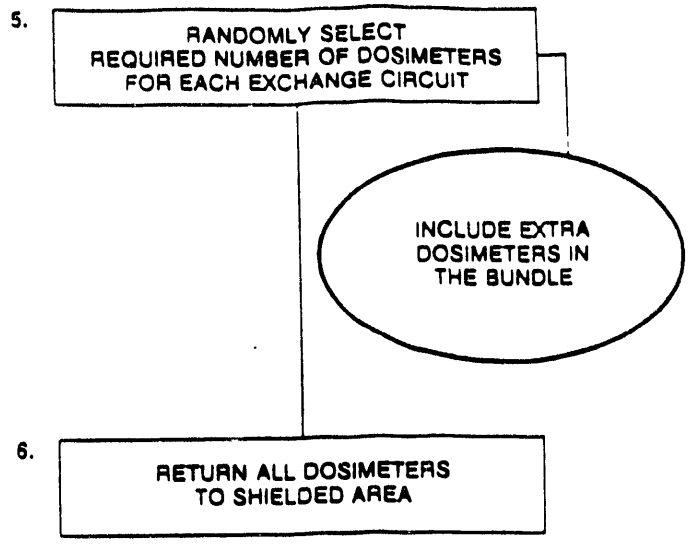
4. Record control dosimeter numbers in the designated spaces on the data sheet for that exchange circuit.



5. Select at random the required number of dosimeters for each exchange circuit, and bind these to a control bundle with an elastic band. Indicate the exchange circuit on the bundle.

   NOTE: Include one or two extra dosimeters in the bundle.

6. Return all dosimeters to shielded area until the time of the field exchange.



5.3 TLD Exchange: Field Activities

The following will be performed for each exchange circuit.

1. Remove the prepared bundle of dosimeters to be installed, the complementary set of control dosimeters and the control dosimeters for the TLDs currently in the field, from the shielded area and place in portable shielded container for transport to field locations.

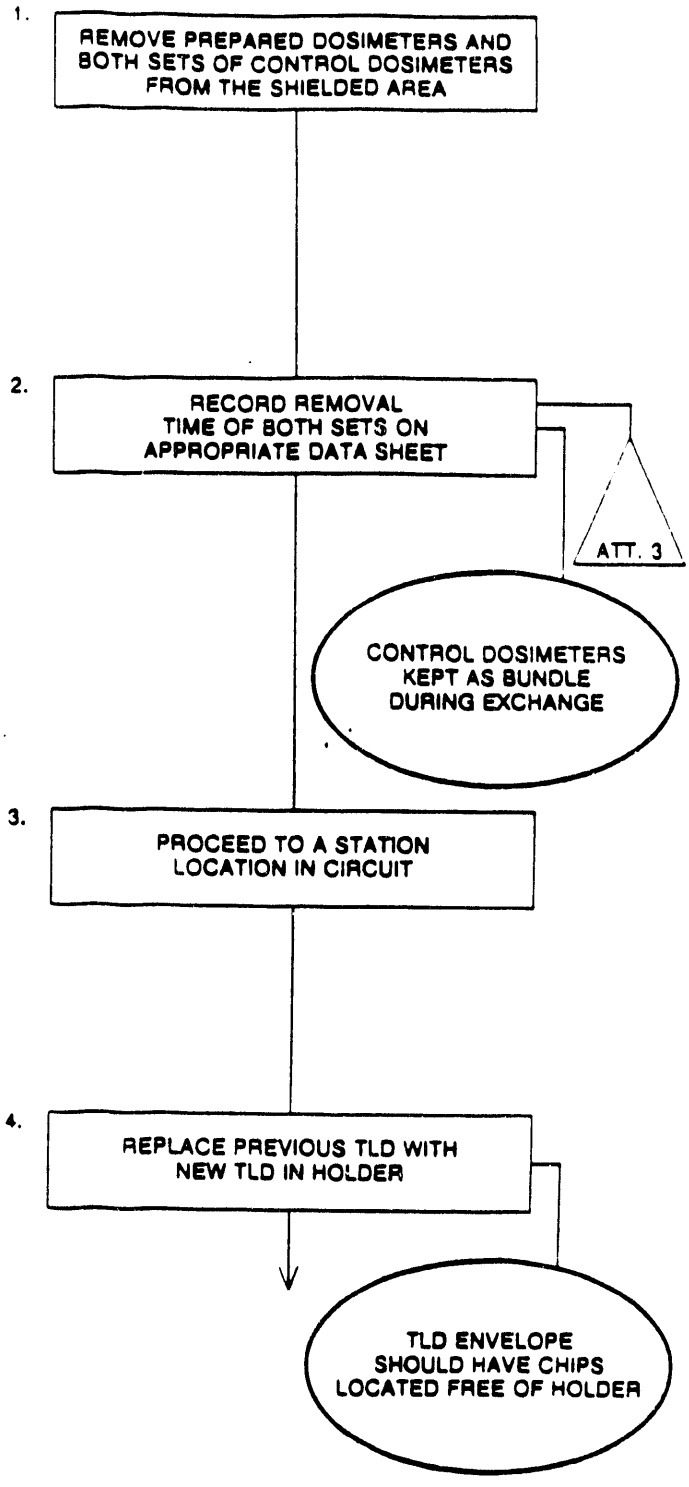
2. Record the removal time of both sets of control dosimeters on the appropriate TLD Field Exchange Data Sheets (Attachment 3).

   NOTE: All control dosimeters should be kept as a bundle throughout the exchange.

3. Using station location maps, if necessary, proceed to a station location in the circuit.

4. Remove the previous field cycle TLD from the holder and securely place the new TLD in the holder.

   NOTE: The portion of the TLD envelope containing the chips should be completely free of the holder.



5. For the TLD which has been removed, record the time of retrieval and initial the appropriate data sheet; bind the TLD to its control dosimeters with an elastic band.

6. For the TLD which has been installed, record the TLD number and time installed, and initial the appropriate data sheet.

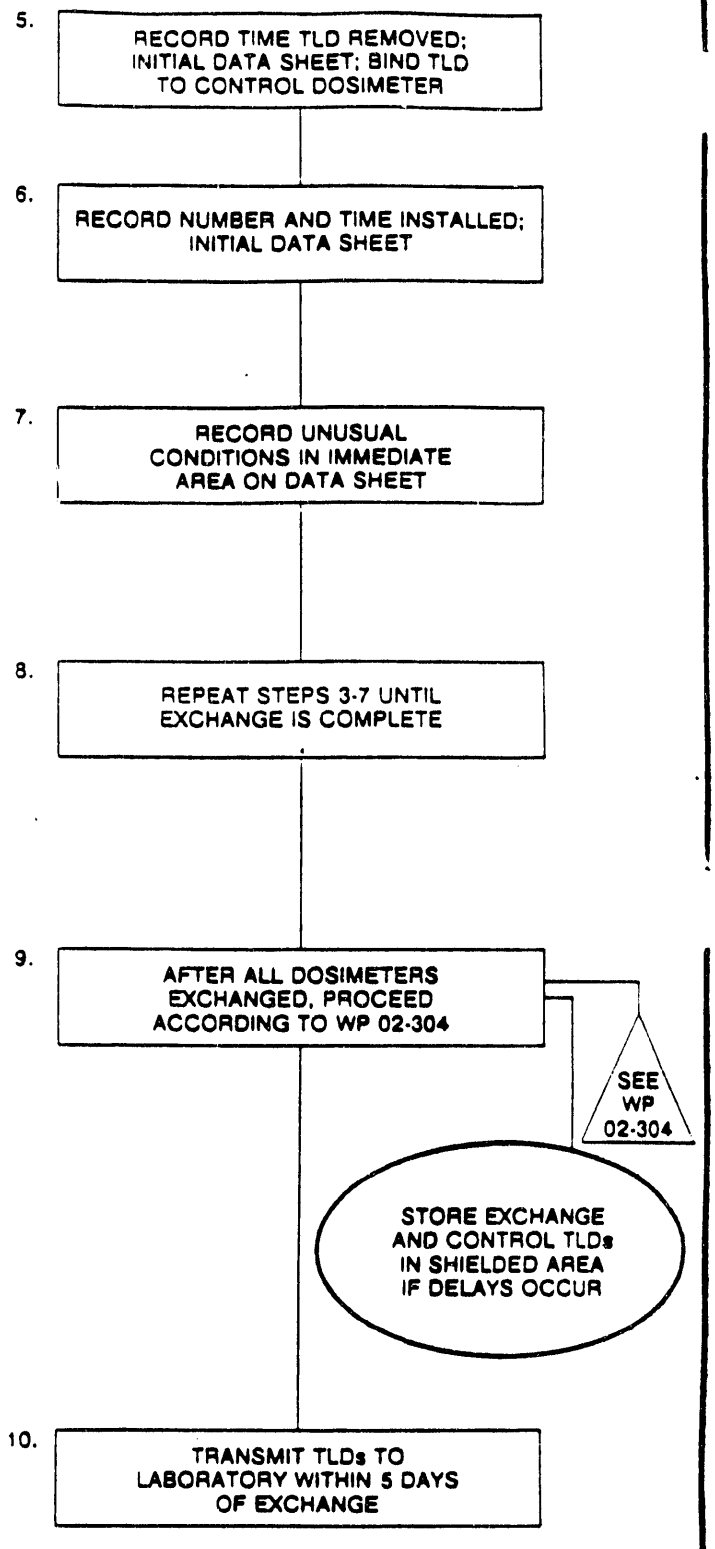
7. Record any unusual conditions in the immediate area, TLD station, or TLDs themselves on the data sheets.

8. At each station, repeat steps 3 through 7 until the exchange is complete for all stations in the circuit. Return all dosimeters to the shielded area promptly after completion of the circuit.

9. Upon completion of all exchange circuits, proceed with post-exchange activities according to WP 02-304, for transmitting TLDs to laboratory.

   NOTE: If there is any delay in initiating post-exchange activities (e.g. overnight), store the exchanged and control dosimeters in a shielded area.

10. Transmit exchanged and control TLDs unshielded to laboratory within five (5) days of exchange using conventional commercial transport.



5.4 New Station Installation

1. When installing a new dosimeter station, a camera and Dosimeter Placement Sheet (Attachment 4) should be available.

2. Identify the location of the station relative to two reference points. These should include map-based coordinates and/or prominent landmarks.

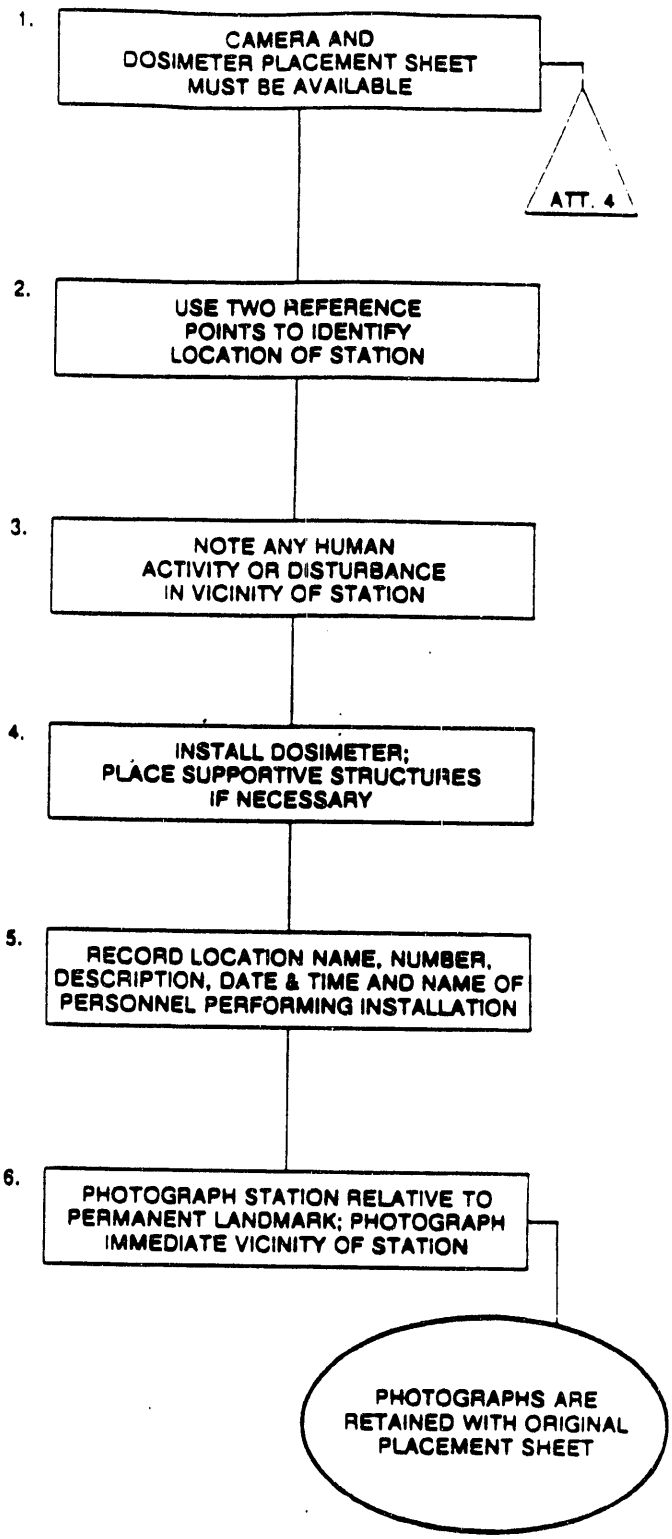
3. Note evidence of human activity or disturbance in the vicinity of the station on the placement sheet.

4. Securely install dosimeter holder and any supportive or protective structures required.

5. Record the location name, number, and description, the date and time of installation, and the individual performing the installation on the placement sheet.

6. Photograph the position of the station relative to a permanent landmark, if possible, and the environment in the immediate vicinity of the station.

NOTE: The photograph(s) will be retained with the original Dosimeter Placement Sheet for that station.



5.5 Discontinuation Of A TLD Station

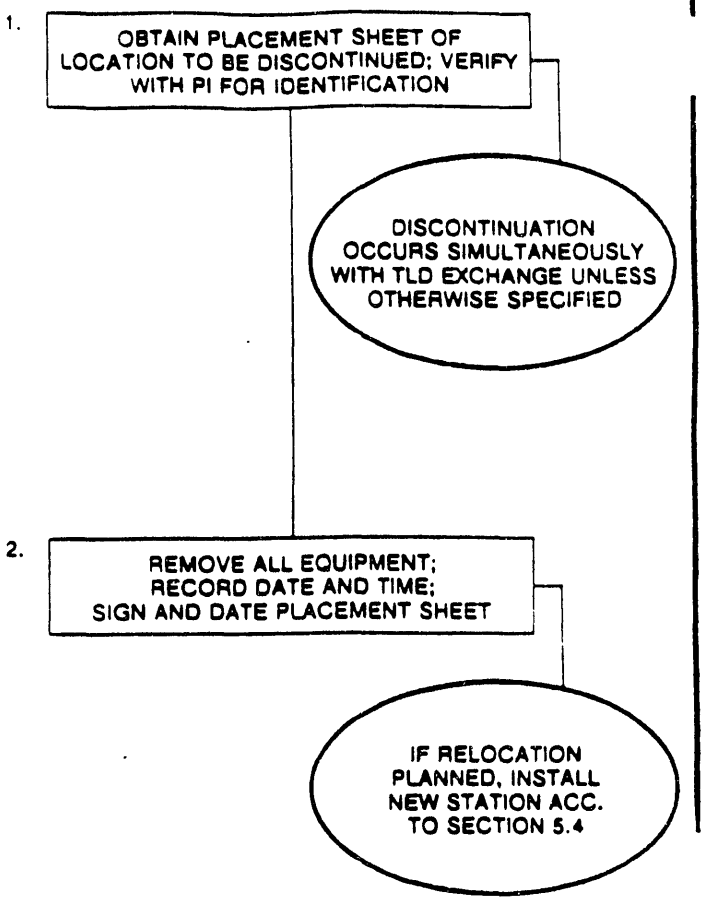
1. Obtain the Dosimeter Placement Sheet for a location to be discontinued and verify with the PI that the correct location has been identified.

   NOTE: Discontinuation of the TLD station occurs simultaneously with a dosimeter exchange or after the last TLD has been removed, unless specific instructions to the contrary are received.

2. Remove the dosimeter, dosimeter holder, and other supportive or protective structures emplaced specifically for the dosimeter; record the date and time of removal on the placement sheet, and sign and date the placement sheet.

   NOTE: If relocation of the station is planned, install the new station prior to dosimeter exchange according to Section 5.4.

168s



GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation - The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample - A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source - A standard radiation source that is used for calibration of a measurement system.

Check Source - A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway - The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector - A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent - The liquid or gaseous waste streams released to the environment.

Emission - Any airborne radioactive material released to the environment.

Environmental Medium - A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs - The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule - A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample - A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber - An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Particle - An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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DIRECTIONS FOR COMPLETING TLD FIELD EXCHANGE DATA SHEET

The following information applies to the completion of TLD Field Exchange Data Sheets (Form WP-1222) as specified in the TLD Handling procedures. An example of a completed TLD Field Exchange Data Sheet/Procedure Completion Checklist is shown on pages 3 and 4 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique identity number assigned to the data sheet and recorded on it according to procedure WP 02-303.
Field Cycle	A number (1, 2, 3, or 4) indicating the quarter being sampled; 1 = January to March, 2 = April to June, 3 = July to September, 4 = October to December.
Installation Date	The date on which the exchange circuit initiating the field cycle is performed.
Retrieval Date	The date on which the exchange circuit concluding the field cycle is performed.
Exchange Circuit	Identifies one of six field circuits.
Controls 1, 2, and 3:	
TLD No.	The identification codes (printed on the TLDs) or the unique portion of the codes, from the three TLDs selected as controls for the circuit.
Installation Circuit:	
Time Out of Shield	The time (24-hour clock) at which the control TLDs are removed from the shielded area to initiate the installation circuit.
Time Returned to Shield	The time (24-hour clock) at which the control TLDs are returned to the shielded area at the conclusion of the installation circuit.
By	The initials of the person returning the control TLDs to the shielded area.

NOTE: The control TLDs should be bound together so that the above information is identical for all three TLDs. When this is the case, vertical lines down the column or ditto marks may be used to indicate repeated data.

Item (Front of Sheet)	Description
Retrieval Circuit:	All items are filled out as per the Installation Circuit.
Location:	The dosimeter station name or its 3-letter identity code for each TLD being installed on the circuit.
TLD No.	The TLD identification code (printed on the TLD), or the unique portion of the code, of the TLD being installed at the corresponding location.
Time Installed	The time (24-hour clock) at which the TLD is installed at the location.
By	The initials of the person performing the installation.
Time Retrieved	The time (24-hour clock) at which the TLD is retrieved.
By	The initials of the person performing the retrieval.
Comments	Any noteworthy observations which may have bearing on the performance of the TLD or the quality of the measurement.
Checked By/Date	Signature of the personnel reviewing the data sheet for completeness and accuracy, and date on which the data sheet is reviewed.

Item (Back of Sheet)	Description
Item No.	The specific step listed in the TLD Handling procedures.
Completed	A check mark indicates that the step has been completed.
Comment	If any step was not performed, explain why it was not performed.

Data Sheet No. 000461
Sample Collected According to

TLD Field Exchange Data Sheet

Radiological Environmental Surveillance

Field Cycle: 3 Installation Date 7-2-86 Retrieval Date 10-1-86

Exchange Circuit: WIPP SAB ☒ WIPP POI E ☐ Sandia Correlation ☐
WIPP OSR ☐ WIPP POI W ☐ Other ☐ _____
(Points of Interest)

		Installation Circuit:			Retrieval Circuit:		
	TLD #	Time out of Shield	Time Returned to Shield	By	Time out of Shield	Time Returned to Shield	By
Control 1	M006	1107	1622	JB	1200	1545	SW
Control 2	M035	"	"	"	"	"	"
Control 3	M014	"	"	"	"	"	"

Location	TLD#	Time Installed	By	Time Retrieved	By	Comments
WNW	M036	1204	JB	1245	SW	
WNE	M018	1237	"	1255	"	
WNE	M009	1237	"	"	"	Replicate for this location
WEE	M010	1245	"	1310	"	
WSW	M015	1255	"	1325	"	TLD found on ground
WSS	M027	1310	"	1410	"	
WSE	M033	1346	"	1420	"	
WWW	M056	1416	"	—	"	TLD missing
WNW	M004	1530	"	1500	"	

Checked by John Chesher Date 10-2-86

WP-1222

DIRECTIONS FOR COMPLETING DOSIMETER PLACEMENT SHEET

The following information applies to the completion of Dosimeter Placement Sheets (Form WP-1223) as specified in the RES TLD Handling procedures. An example of a completed Dosimeter Placement Sheet/Procedure Completion Checklist is shown on pages 3 and 4 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	The unique identification number assigned to the data sheet and recorded according to procedure WP 02-303.
Location Name	The accepted name used to refer to the dosimeter station.
Location Code	The 3-letter unique identity code assigned to the dosimeter station.
Installed By	The signature of the personnel installing the dosimeter station, or the person in charge of the field crew.
Installation Date/Time	The date (month-day-year) and time (24-hour clock) at which the station is installed.
Location:	
Legal Description	The township, range, section, and at least one quarter section locating the dosimeter station.
Verbal Description	A description of the station location with reference to prominent features, such as roads, fences, powerlines, wells, etc.
Reference Points:	
Description	Description of two permanent landmarks within site of the dosimeter station which will act as reference points.
Distance	The distance in meters from the station to the corresponding reference point.
Direction	The compass direction, in degrees, from the station to the corresponding reference point.

Item (Front of Sheet)	Description
Photographs(s)	Photographs (attached to the sheet) of the dosimeter station.
Installation Reviewed and Approved By/Date	Signature of the PI and the date of review of the data sheet.
Removed By	The signature of the person removing the dosimeter station, or the person in charge of the field crew.
Date/Time	Date (month-day-year) and time (24-hour clock) of station removal.
Removal Reviewed/ Approved By/Date	Signature of the PI and the date of review of the data sheet after removal.

Item (Back of Sheet)	Description
Item No.	The specific step listed in the TLD Handling procedures.
Completed	A check mark indicates that the step has been completed.
Comment	If any step was not performed, explain why it was not performed.

Data Sheet No. 000461

Sample Collected According to

Dosimeter Placement Sheet

Radiological Environmental Surveillance

Location Name OFF-SITE RING 185° Location Code R07

Installed by J. Smith Installation Date/Time 12-03-84 / 1400

Location: Legal Description: T 23 S R 32 E Sec 12 SW¼ NW¼

Verbal Description: On fencepost 50 m E of cattle guard on Eddy County Road 326

Reference Points:	Description:	Distance (meters)	Direction (true)
	WINDMILL (unnamed)	700	214°
	CATTLE GUARD	50 m	270°

Photograph(s)

Installation Reviewed and Approved by: Jane Doe Date: 12-04-84

Removed by: S Gomez Date/Time: 03-07-85 / 1330

Removal Reviewed/Approved by: Jane Doe Date: 03-08-85

WP-1223

LIST OF REVIEWERS

Procedure Number: WP 02-308

Revision Number: 0

Procedure Title: THERMOLUMINESCENT DOSIMETER (TLD) HANDLING PROCEDURES

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriquez	REPS
R. Youngman	QA

NO: 02-309 REV. 1 ISSUE DATE: 03/02/88

APPROVAL SIGNATURE: R. D. Boyce for TKC

PROCEDURE AUTHOR: J. Cockman

TITLE: RES SURFACE WATER AND SEDIMENT SAMPLING PROCEDURES*

1.0 SCOPE

This document provides procedures for collecting surface water and sediment samples for chemical and radiological analysis as part of the Radiological Environmental Surveillance (RES) Program conducted by the Radiological and Environmental Programs Section (REPS). Samples will be collected and prepared for storage or analysis as described in this document.

2.0 DEFINITIONS

Refer to WP 02-301

3.0 REFERENCES

WP 02-301, Radiological Environmental Surveillance (RES) Implementation
WP 02-303, RES Scheduling, Documentation, and Field Preparation
WP 02-304, RES/NES Sample Tracking
WP 02-306, RES Equipment Maintenance and Control

4.0 GENERAL

All activities associated with the collection, handling, and transmittal of surface water and sediment samples shall be described in the Environmental Procedure Manual (WP 02-3). Samples will be collected at times and locations developed according to WP 02-303.

The tasks defined by these procedures shall be implemented only by qualified personnel, as described in Section 5.2 of WP 02-301. Activities shall be recorded on a Surface Water and Sediment Sampling Data Sheet (Form WP-1228) Attachment 1.

Data sheets and sample containers shall be prepared prior to sampling activities in accordance with WP 02-303.

*It should be noted that this procedure was issued previously as an instruction. WP 02-309 has undergone such extensive revision that changes will not be indicated singly.

It is recommended that a minimum of two staff members form the water sampling team. The amount of sample collected at each station shall be sufficient to assure that the appropriate number of aliquots is available for independent analysis, duplicate analysis, and to archive. The Principal Investigator (PI) will determine the required sample volumes prior to the sampling trip.

The following activities are described in this procedure:

5.1 Preparation for Field Sampling
5.2 Collection of Single Water Samples
5.3 Collection of a Composite Water Sample
5.4 Collection of a Sediment Sample
5.5 Field Observations
5.6 Post-Collection Activities

5.0 PROCEDURE

5.1 Preparation for Field Sampling

1. Prior to field sampling, the following equipment and supplies should be available:

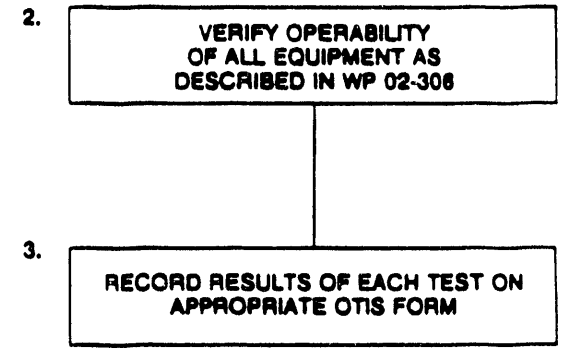
   - o Surface Water and Sediment Sampling Data Sheets (Form WP-1228)
   - o Sample labels
   - o Anemometer
   - o Thermometer (minimum range 0° to 30°C)
   - o Camera and film
   - o Boat, oars, and water safety gear
   - o Rubber boots and/or hip waders
   - o 20 feet of sounding line with terminal plumb
   - o Water sample collector
   - o Sample bottles
   - o Conductivity meter and probe with standard solutions
   - o pH meter with standard solutions
   - o Densitometer or hydrometer
   - o 500-ml deionized water (> 14 megaohm conductivity)
   - o Concentrated nitric acid in plastic bottle

1. ALL NECESSARY EQUIPMENT AND SUPPLIES MUST BE OBTAINED PRIOR TO SAMPLING

- o Pipet
- o Litmus paper with range to at least pH 2.0
- o Large mixing container for compositing (optional)
- o Large graduated cylinder
- o Paper towels
- o Indelible markers and pens
- o Waterproof clear plastic tape and electrician's tape
- o Boxes for transport of samples
- o Clean, sealable, heavy-duty plastic bags (1 qt. or larger)
- o Eckman dredge
- o Shovel

2. Verify the operability of the conductivity meter, pH meter, and densitomer (or hydrometer) by performing an operability test as described in WP 02-306.

3. Record the results of each operability test on the appropriate Operability Test Item Sheet (Form WP-1232), indicating on the data sheets that operability of equipment has been verified.



5.2 Collection of Single Water Samples

The following activities will be performed at stations designated for the collection of a single water sample.

1. On arrival at the sampling station, record date and time on the Surface Water Sampling Data Sheet for that sampling area (Attachment 1).

2. Proceed to the sampling point specified by the PI.

   NOTE: Boat or hip waders may be required.

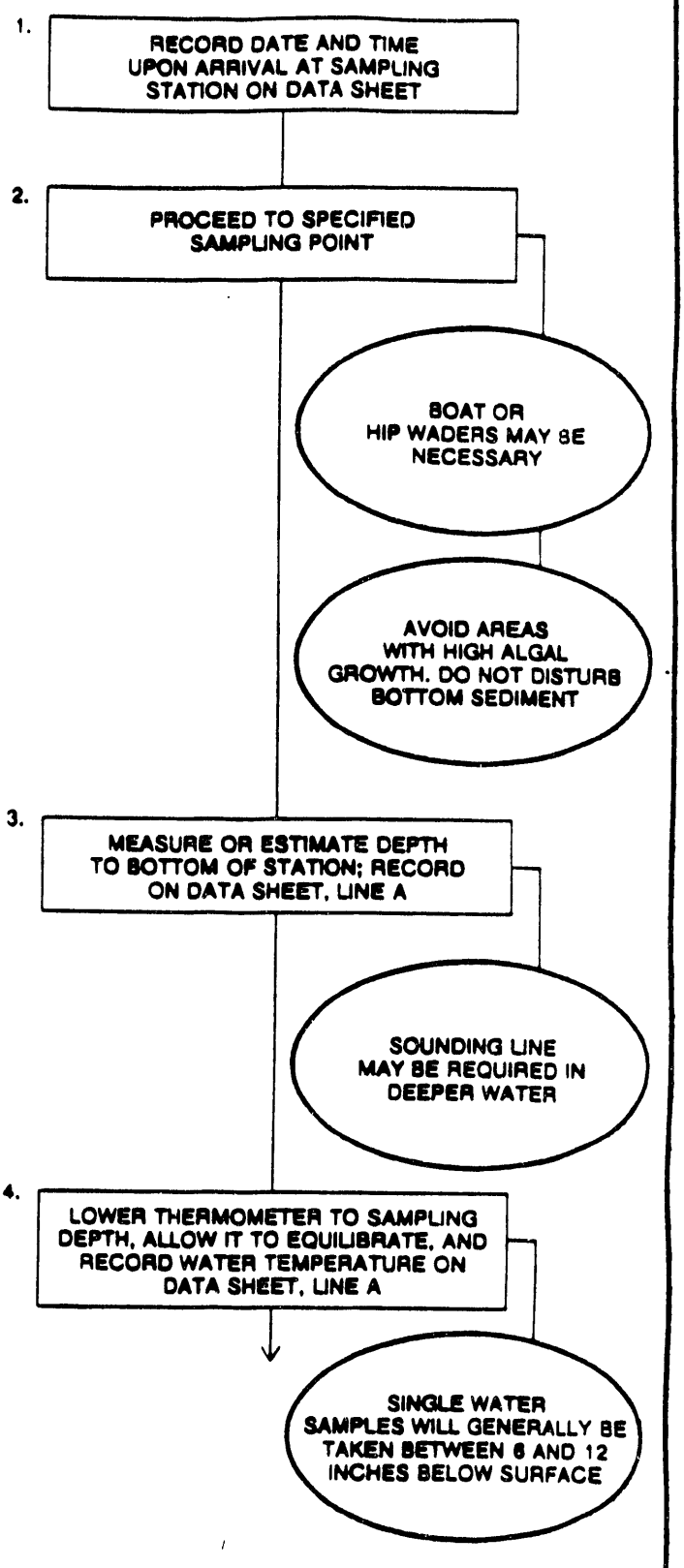
   NOTE: Avoid any areas with high algal growth on the water's surface. Minimize disturbance of bottom sediments with oars, anchor, or boots.

3. Measure or estimate depth to bottom at the sampling station and record on the data sheet on Line A.

   NOTE: The sounding line may be required in deeper water.

4. Lower the thermometer to sampling depth, allow it to equilibrate, and record water temperature on the data sheet on Line A.

   NOTE: For single water samples, the sampling depth will typically be between 6 and 12 inches below the surface.



5. Rinse the collecting bottle at least three times prior to sampling by filling to approximately one-fourth capacity with the water to be sampled, then shaking the water out before re-rinsing.

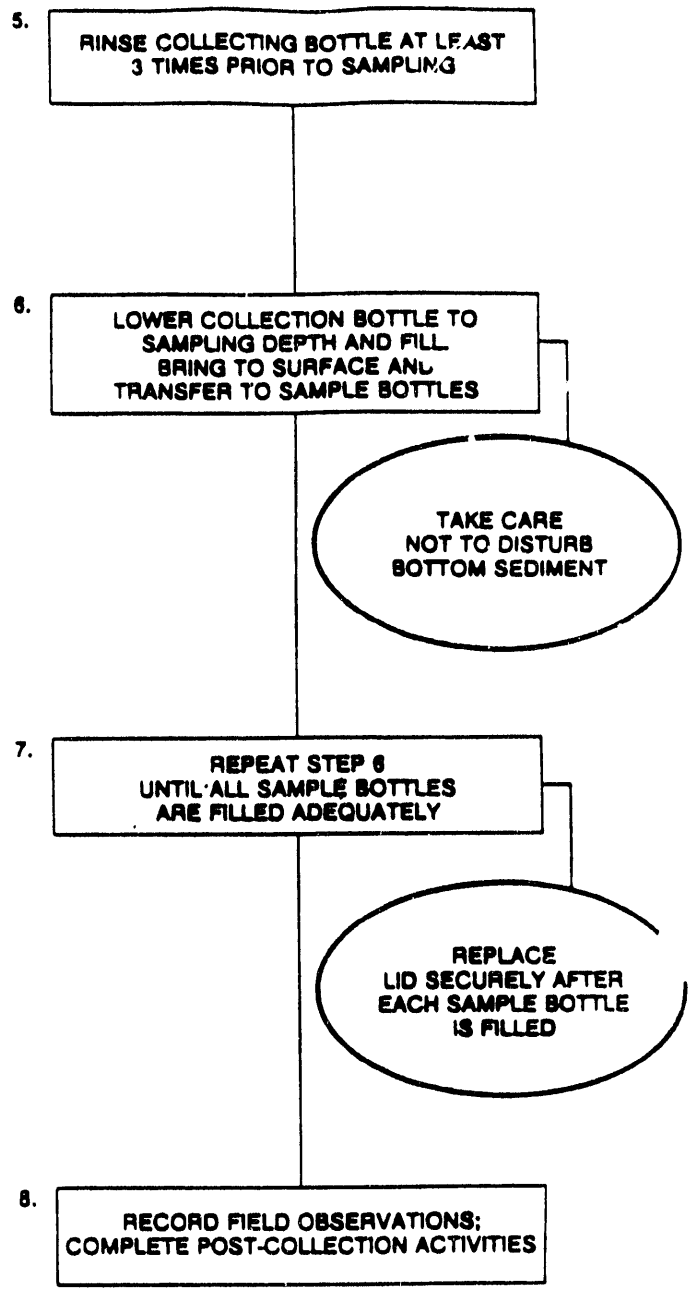
6. Lower the collecting bottle to the sampling depth and fill. Bring it to the surface and transfer the contents to the sample bottles.

   NOTE: Take care not to disturb the bottom by lowering the container too near the bottom.

7. Repeat Step 6 until an adequate sample volume is obtained for all sample bottles specified for that station.

   NOTE: Replace lid securely after each sample bottle is filled.

8. Record field observations as described in Section 5.4. Complete post-collection field activities as described in Section 5.5.



5.3 Collection of a Composite Water Sample

The following activities will be performed at stations designated for the collection of a composite water sample.

1. On arrival at the sampling station, record date and time on the Surface Water Sampling Data Sheet (Attachment 1).

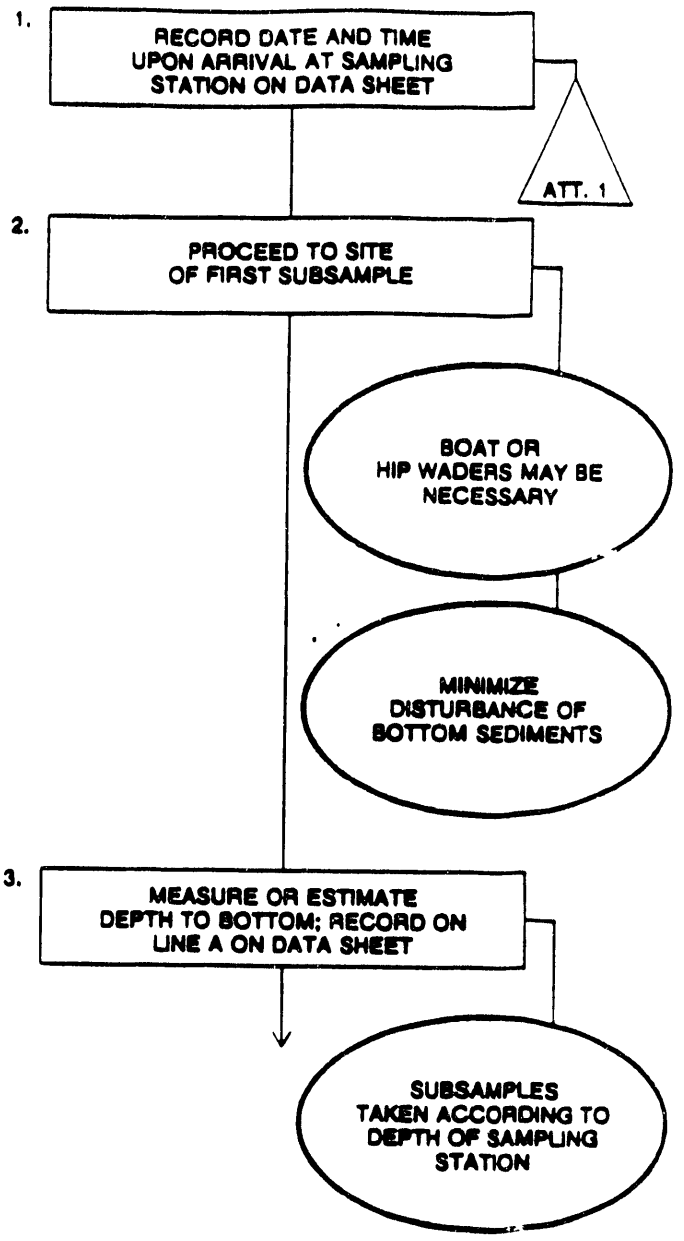
2. Proceed to site of the first subsample.

   NOTE: Boat or hip waders may be necessary.

   NOTE: Minimize disturbance of bottom sediments with oars, anchors, or boots.

3. Measure or estimate depth to bottom at the sampling station and record on the data sheet on Line A. The sounding line may be required in deeper water.

   NOTE: For depths between approximately five and ten feet, half of the subsample should be taken about one foot below the surface and half from about two feet above the bottom. For depths greater than ten feet, a third of the subsample should come from approximately one foot deep, approximately a third from mid-depth, and approximately a third from about two feet above the bottom.



4. Lower the thermometer to sampling depth, allow it to equilibrate, and record the water temperature and depth on Line A of the data sheet.

5. Rinse the collecting bottle at least three times by filling it to approximately one-fourth capacity with the water to be sampled, then shaking the water out before re-rinsing.

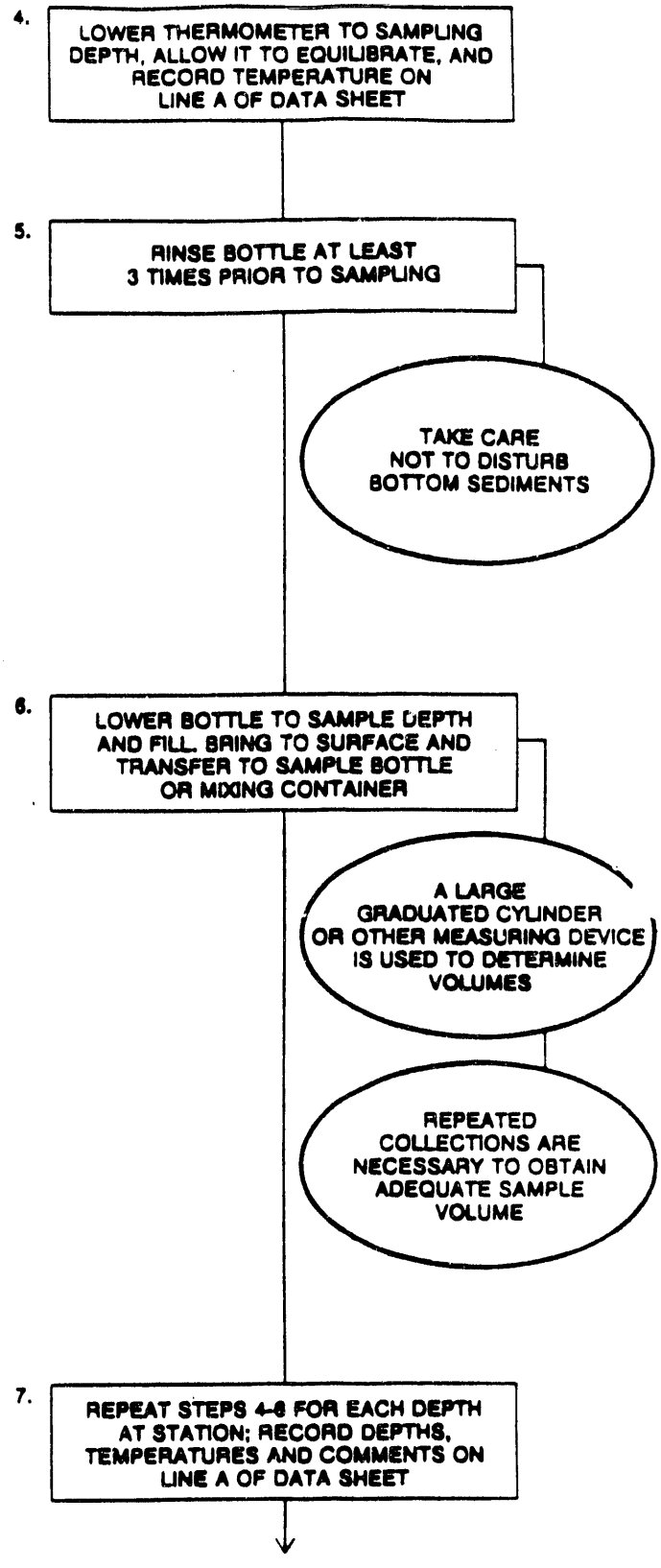
NOTE: Take care not to disturb the bottom by lowering the container too near the bottom.

6. Lower the collecting bottle to sample depth and fill. Bring it to the surface, and transfer appropriate volumes to each sample bottle (determined by dividing the bottle volume by the number of subsamples to be collected) or transfer an appropriate measured volume to a single mixing container.

NOTE: A large graduated cylinder, or equivalent measuring device, should be used in determining volumes.

NOTE: Repeated collection at each substation is necessary to obtain adequate sample volume.

7. Repeat Steps 4 through 6 for each depth required at the station and record depths, temperatures, and comments on Line A of the data sheet.

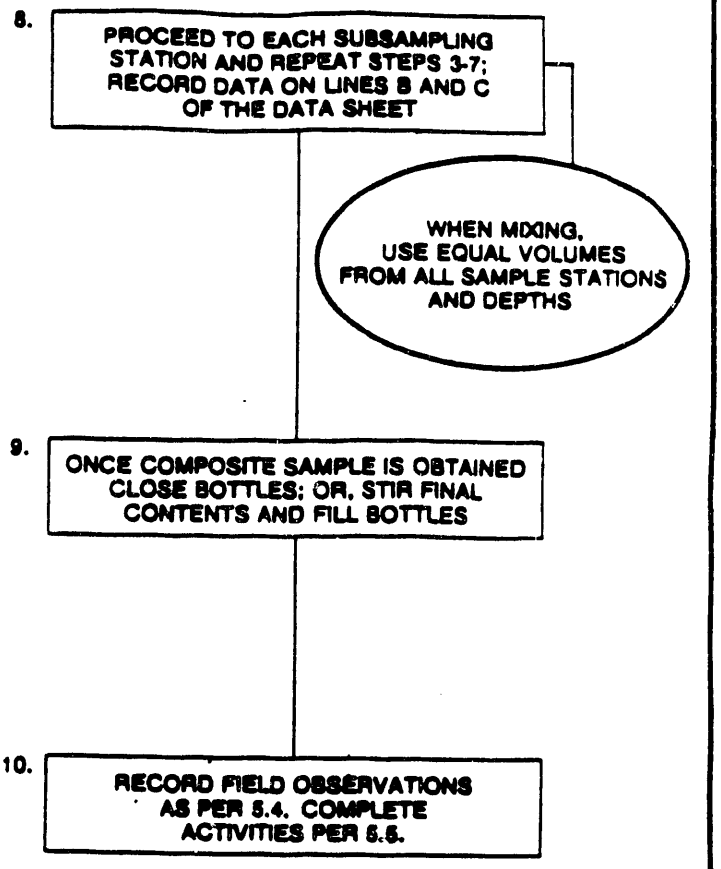


8. As required, proceed to each successive subsampling station and repeat Steps 3 through 7, recording data on Lines B and C of the data sheet.

NOTE: When a mixing container is used, take equal volumes from all sample stations and depths.

9. Once a completed composite sample is obtained, securely close the sample bottles; or, when a mixing container is used, stir final contents with a clean implement and fill each sample bottle from the container.

10. Record field observations as described in Section 5.4. Complete post-collection activities according to Section 5.5.



5.4 Collection of Sediment Sample

1. Field personnel determine whether the sediment sample will be taken by shovel or dredge.

   NOTE: The dredge should be used for water depths greater than 3 feet.

2. If the dredge is used, personnel shall use care to prevent injury from accidental tripping of the jaws.

3. If the shovel is used, the depth of sediments taken should not exceed 6 inches.

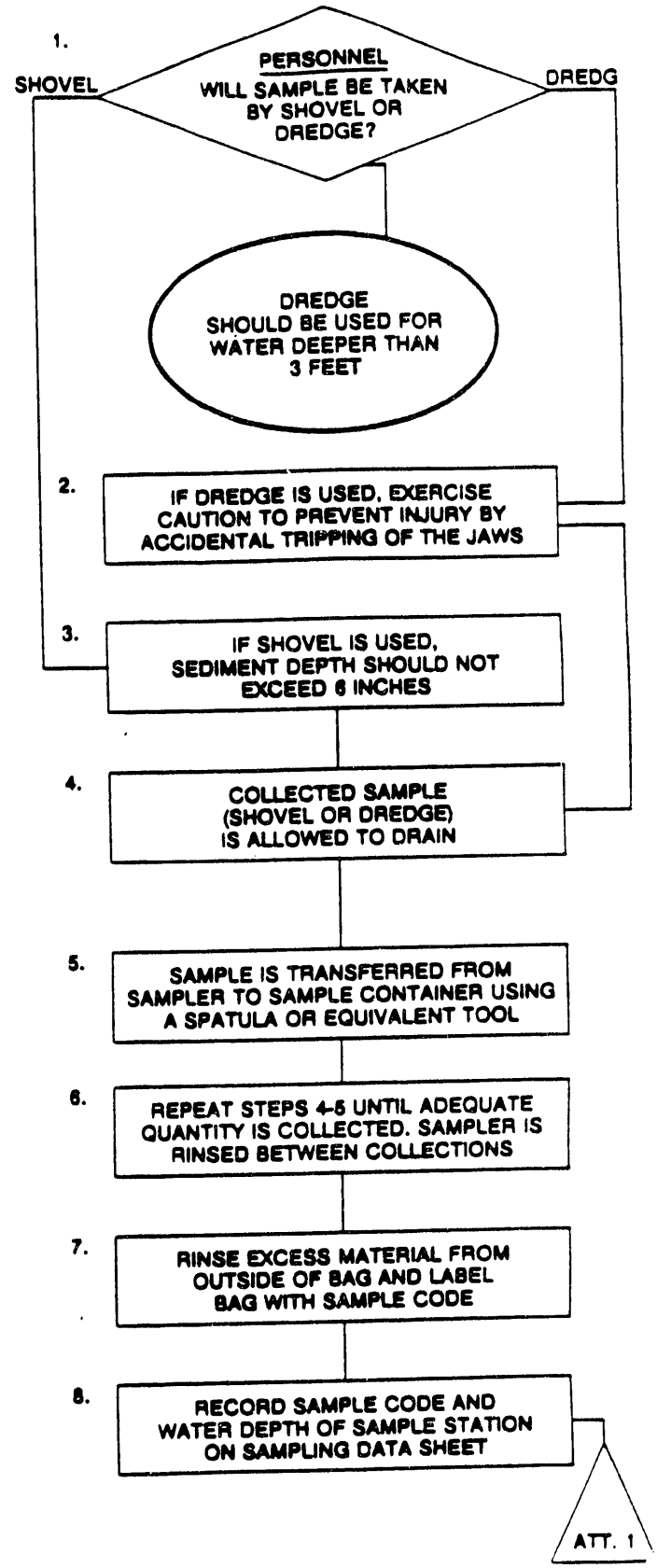
4. Collected sample from either shovel or dredge shall be allowed to drain.

5. The sample is transferred from the sampler (shovel or dredge) to the sample container (plastic bag) using a spatula or equivalent tool.

6. Repeat steps 4 and 5 until an adequate quantity is collected. The sampler shall be rinsed between each collection.

7. Rinse excess material from the outside of the bag and label the bag with the sample code.

8. Record the sample code and depth of the water at the sample station on the Surface Water and Sediment Sampling Data Sheet (Attachment 1).



5.5 Field Observations

The following activities are recommended but not required for this procedure.

1. Prior to leaving the sampling location, observations on the following weather and water quality parameters should be made and recorded on the data sheet (Attachment 1):

    - o Air temperature: measured or estimated
    - o Wind speed: measured or estimated
    - o Water surface condition: smooth or calm, rippled, wavy whitecaps
    - o Clarity: clear, turbid, very turbid (a Secchi disk may be used to quantify clarity)
    - o Relative water level: normal, above normal, below normal
    - o pH: measured with a portable meter or with litmus paper
    - o Conductivity: measured with a portable meter
    - o Temperature: measured on sample used for pH determination
    - o Density: measured with a densitometer or hydrometer

1. BEFORE LEAVING SAMPLING LOCATION, MAKE ALL APPROPRIATE WEATHER AND WATER OBSERVATIONS AND RECORD

ATT. 1

2. It is recommended that photographs be taken to document conditions at the time of sampling. Photographs should be labeled as to location, direction, and date and retained with the data sheets.

2. PHOTOGRAPHS SHOULD BE TAKEN TO DOCUMENT CONDITIONS. PHOTOS SHOULD BE LABELED AS APPROPRIATE

5.6 Post-Collection Activities

This section applies to the preparation of samples for storage or shipment.

1. Begin post-collection activities by checking data sheet (Attachment 1) and sample containers for completeness and accuracy of field information, including identification numbers and field observations.

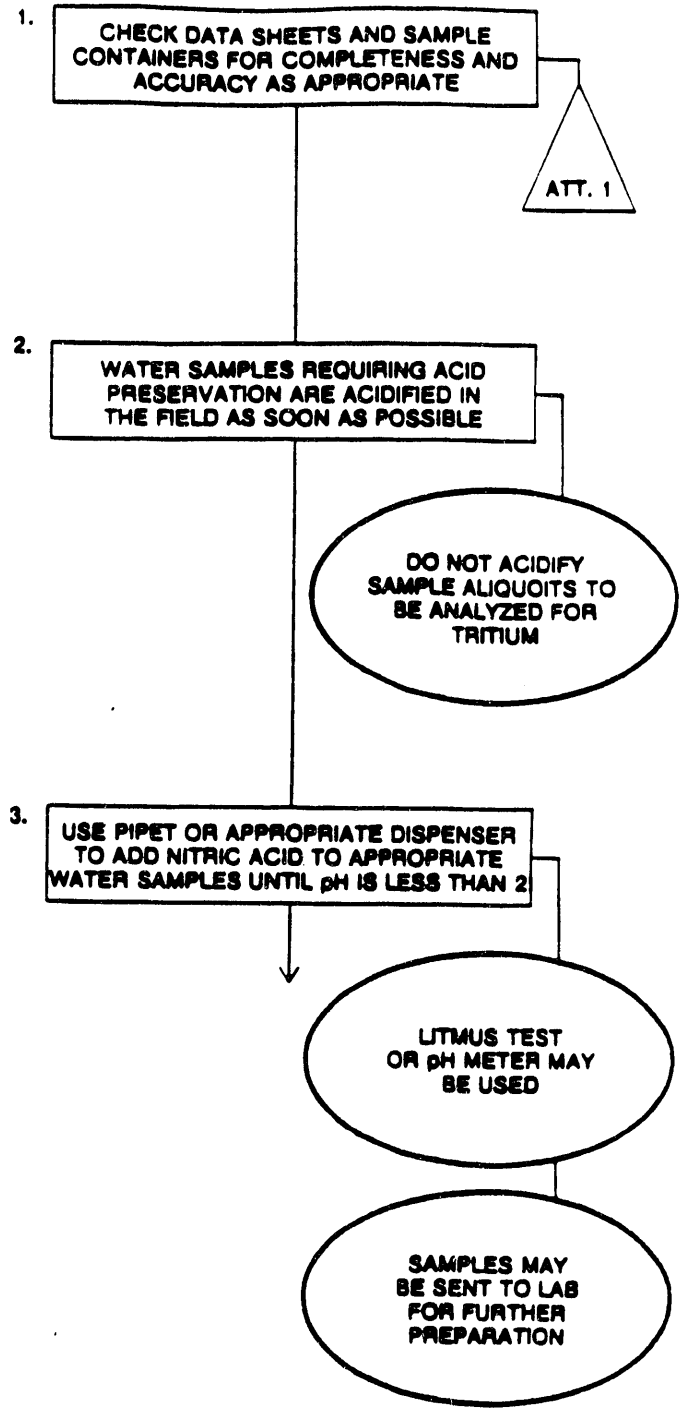
2. Water samples requiring acid preservation shall be acidified in the field as soon as possible after sample collection (or collection of the last subsamples of a composite).

   NOTE: Do not acidify sample aliquots to be analyzed for tritium.

3. Using a pipet or appropriate dispenser, add concentrated nitric acid to the appropriate water samples until the pH is less than 2.

   NOTE: Litmus paper or pH meter may be used.

   NOTE: The remaining steps can be performed at the sample preparation lab.



4. Wipe bottles clean and dry. Seal the sample containers and secure with electrician's tape. If not previously done, attach labels to sample bottles and record specifications on data sheets. Clear plastic tape should be placed over the label for protection.

5. Follow procedures outlined in WP 02-304 for preparing documentation for transmitting or archiving samples.

NOTE: Samples being transmitted should be sent with appropriate forms within 10 working days of sample collection, or as otherwise directed by the PI.

6. The PI or a designee shall review the data sheets and sign.

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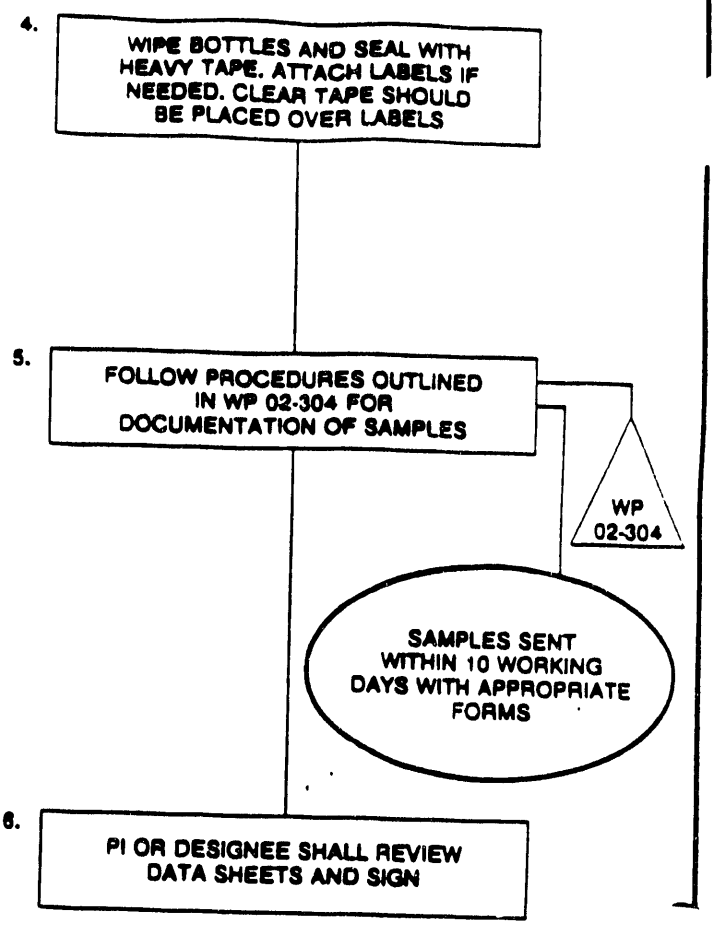


DIRECTIONS FOR COMPLETING SURFACE WATER AND SEDIMENT SAMPLING DATA SHEET

The following information applies to the completion of Surface Water Sampling Data Sheets (Form WP-1228) as specified in the RES Surface Water Sampling Procedures. An example of a completed Surface Water Sampling Data Sheet/Instruction Completion Checklist is provided on pages 4 and 5 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to WP 02-303.
Sampling Station	Accepted name of the location at which the sample is taken.
Equipment Operability Verified	Check the box to indicate operability tests have been performed on instruments being used to measure pH, conductivity, and density.
Unique Identity Code	List of identity codes of all samples being collected at the sampling station, including both RES and NES surface water samples.
Specification/Comments	Description of the type of sample, type of container, type of preservation, and/or type of analysis to be performed on the sample referred to by the corresponding code.
Sample Collection:	
Date/Time	Month/day/year and time (24-hr. clock) that the samples are collected.
Depth to Bottom	Measured or estimated depth of the water at the point of sample collection.
Composite Sample	Check the box if the sample being collected is a composite.
Temp(s)	The water temperatures measured at each sampling depth at each sampling station (A, B, C).
Depth(s)	The depth at which the samples are collected at each sampling station (A, B, C).
Location and Comments	Description of sampling station and any pertinent information about the station.

Item (Front of Sheet)	Description
Field Measurements:	
Air temperature	Measured or estimated air temperature (shade) at the time of sample collection.
Wind speed	Measured or estimated wind speed (or wind speed range if the wind is variable) at the time of sample collection.
Water surface	Observed condition of the water surface (e.g., smooth, rippled, wavy, whitecaps).
Clarity	Observed or measured clarity of the water at the sampling location (e.g., clear, turbid, very turbid).
Relative water level	Observed water level with respect to previous observations (e.g., normal, above normal, below normal).
Sample temp.	Measured temperature of the water sample from which pH, conductivity, and density are measured.
pH	Measured pH of water sample.
Equipment	Equipment used in measuring pH.
Conductivity	
Measured	Measured electrical conductivity of the water sample.
Corrected	Conductivity value corrected for temperature variation from 25°C.
Equipment	Equipment used in measuring electrical conductivity.
Density	Measured density of the water sample.
Equipment	Equipment used to measure sample density.
Samples Acidified	Check the box to indicate that all samples requiring acid preservation have been acidified.
Sampling Completed By	Names or initials of the personnel involved in sample collection.

Item (Front of Sheet)	Description
Checked by/Date	Signature of PI or a designee who has reviewed the data sheet and the date of the review.

Item (Back of Sheet)	Description
Item No.	The specific step listed in the RES Surface Water Sampling Instructions.
Completed	A check mark indicates that the step has been completed.
Comment	If any step was not performed, explain why it was not performed.

Surface water sampling sample bottles, as specified for specific sample type:

- Twelve 50-ml glass bottles (for analysis of tritium)
- Twenty-four 1-gallon polyethylene bottles (for analysis of the remaining radionuclides)
- Twelve 500-ml polyethylene bottles (for measurement of suspended solids concentrations)
- One 100-ml graduated cylinder
- One 1000-ml (1 liter) or 500 ml graduated cylinder
- One conductivity meter
- One pH meter
- A temperature probe or thermometer
- One densitometer
- A graduated line with weight attached
- Distilled water
- Six-foot pole, marked at one-foot intervals
- pH papers (pH scales 1-4 and 10-14)

The numbers of bottles given above assume that one 50-ml glass bottles, two 1-gallon polyethylene bottles, and one 500-ml polyethylene bottles will be needed at each site. The extra bottles on hand will be used for blanks, duplicates, of if bottle breakage or loss occurs. Samples will be collected and split with the Environmental Evaluation Group of the State of New Mexico at its request.

SURFACE WATER AND SEDIMENT SAMPLING DATA

RADIOLOGICAL/NONRADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

SAMPLING STATION: _____

UNIQUE IDENTITY CODE:	SPECIFICATION/COMMENTS
_____	GENERAL ANALYSIS ACIDIFIED ☐
_____	GENERAL ANALYSIS ACIDIFIED ☐
_____	TDS _____
_____	TRITIUM _____
_____	SEDIMENT _____

SAMPLE COLLECTION:

SURFACE WATER ☐ SEDIMENT ☐ SINGLE SAMPLE ☐ COMPOSITE SAMPLE ☐

DATE/TIME: _____ DEPTH TO BOTTOM: _____ m

STATION	DEPTH (m)	TEMP (C)	COMMENTS
A)	_____	_____	_____
B)	_____	_____	_____
C)	_____	_____	_____

FIELD OBSERVATIONS (OPTIONAL)

AIR TEMP: _____ SAMPLE TEMP. (C) _____ WIND SPEED: _____

WATER SURFACE: _____ CLARITY: _____ RELATIVE WATER LEVEL: _____

pH: _____ INSTRUMENT NO. _____

CONDUCTIVITY: (mMHOs/cm) MEASURED _____ INSTRUMENT NO. _____

CORRECTED _____

DENSITY (g/ml) _____ INSTRUMENT NO. _____

FIELD PERSONNEL _____
(List data recorder first)

CHECKED BY _____ DATE _____

LIST OF REVIEWERS

Procedure Number: WP 02-309

Revision Number: 1

Procedure Title: RES Surface Water and Sediment Sampling Procedure

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
R. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-310 REV. 1 ISSUE DATE: 02/15/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: BIOTIC SAMPLING PROCEDURES*

1.0 SCOPE

This procedure provides specific procedures, data sheets, and checklists for the collection of samples used to measure radioactivity levels in biotic tissue, as part of the Radiological Environmental Surveillance (RES) Program conducted by the Radiological and Environmental Programs Section (REPS). Samples of native mammals, native birds, sport fish, locally produced beef, and vegetation will be collected and prepared for analysis as described in this document.

2.0 DEFINITIONS

See attached glossary of terms (Attachment 1).

0 REFERENCES

WP 02-301, Rev. 1, RES Implementation
WP 02-302, RES Quality Assurance/Quality Control Implementation
WP 02-303, RES Scheduling, Documentation, and Field Preparation
WP 02-304, RES Sample Tracking
WP 02-305, RES Data Management
WP 02-306, RES Equipment Maintenance and Control

See attached reference list (Attachment 2).

4.0 GENERAL

All activities associated with collecting, processing, and shipping of biotic tissue samples shall be described in the Environmental Procedure Manual (WP 02-3). The WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS section manager as specified in WP 02-302.

Samples will be collected according to the schedule and sampling locations developed in WP 02-303. Additional samples may be required, as determined by the Principal Investigator (PI).

The tasks defined by this procedure are to be implemented only by qualified personnel, as described in Section 5.2 of WP 02-301. Biotic sampling activities will be performed with all required permits and in accordance with State

of New Mexico regulations. Only qualified personnel with appropriate hunting safety credentials and experience will use firearms to collect samples.

Activities are recorded on a Biotic Tissue Sampling Data Sheet (Form WP-1224) and Biotic Tissue Sampling Worksheet (Form WP-1230). After each procedural activity is completed, the appropriate area on the Procedure Completion Checklist (back of data sheet) is to be marked. Any uncompleted procedures must be explained. Examples of a completed Biotic Tissue Sampling Data Sheet/Procedure Completion Checklist and a Biotic Tissue Sampling Worksheet/Procedure Completion Checklist are provided in Attachments 3 and 4.

The amount of tissue to be collected for each species will be determined by the PI prior to field sampling. Collection of more than one individual animal may be required to obtain adequate tissue quantity for one sample, or one individual may be used in the preparation of two or more samples.

Data sheets and sample containers are prepared prior to field sampling activities according to the procedures listed in WP 02-303.

The following activities are described in this procedure:

5.1 Preparation for Field Sampling

5.2 Collection of Biotic Samples: Cottontail and Quail

5.3 Collection of Biotic Samples: Catfish

5.4 Collection of Biotic Samples: Locally Produced Beef

5.5 Collection of Biotic Samples: Native Vegetation

5.6 Post-Sampling Activities: Cottontail, Quail, Catfish, and Locally Produced Beef

5.7 Post-Sampling Activities: Native Vegetation

*It should be noted that this procedure was issued previously as an instruction. WP 02-310 has undergone such extensive revision that changes will not be indicated singly.

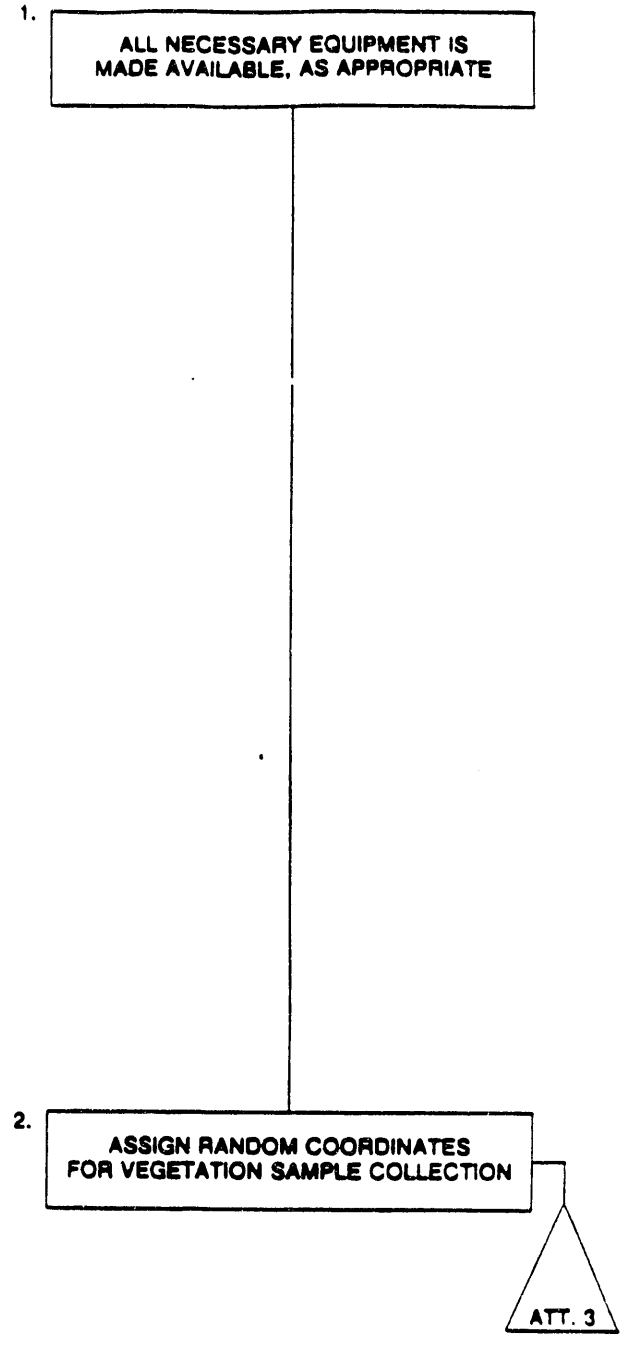
5.0 PROCEDURE

5.1 Preparation for Field Sampling

1. The following materials and equipment, or equivalent, shall be available for sampling activities, as appropriate:

   - o Permits, if applicable, to collect species during designated seasons or collection periods and at the indicated locations by the specified methods
   - o Biotic Tissue Sampling Data Sheets/Instruction Completion Checklists for each sample to be collected
   - o Sample bags
   - o Hunting and fishing equipment
   - o Coolers or ice
   - o Tags
   - o Compass
   - o Quadrat frame, 0.5m x 0.5m
   - o Clippers
   - o Field scale (optional)
   - o Pens and permanent markers

2. If vegetation samples are to be collected, assign random coordinates as described in Attachment 5, Selecting Random Locations.



5.2 Collection of Biotic Samples: Cottontail and Quail

1. The PI will specify sample collection times, quantities desired, and specific methods to be used in collection activities in accordance with program requirements and field conditions.

   NOTE: The PI or designee shall notify Security of the approximate location of sampling activities in accordance with WP 12-101.

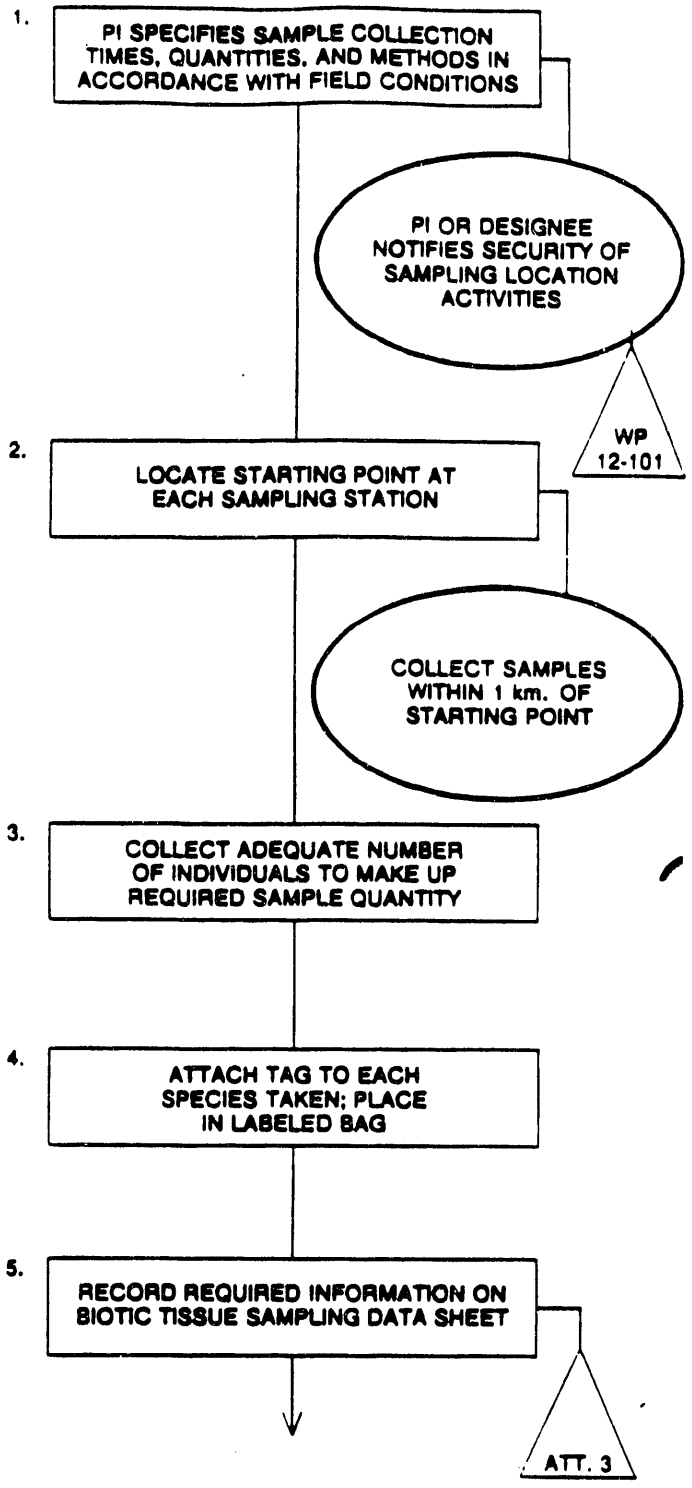
2. At each specified sampling station, locate the permanently designated starting point.

   NOTE: Samples should be collected within approximately 1 km. of the starting point.

3. Collect an adequate number of individuals to make up the required sample quantity.

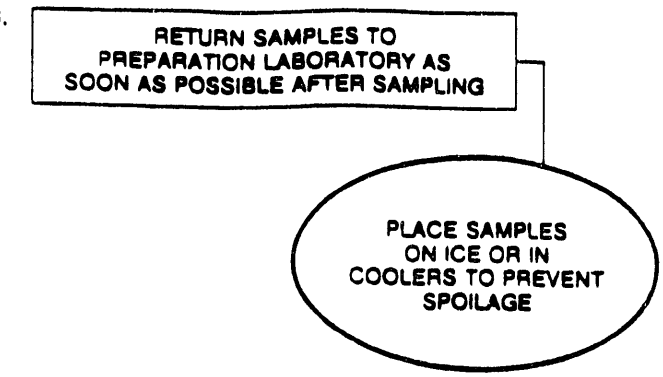
4. Attach a tag to each individual of the species taken, and place it in an appropriately labeled sample bag.

5. Record the required information on the appropriate Biotic Tissue Sampling Data Sheet (WP-1224, Attachment 3).



6. Return samples to the environmental sample preparation laboratory as soon as possible after sampling has been completed.

NOTE: To prevent spoilage, samples should be placed on ice or in coolers.



5.3 Collection of Biotic Samples: Catfish

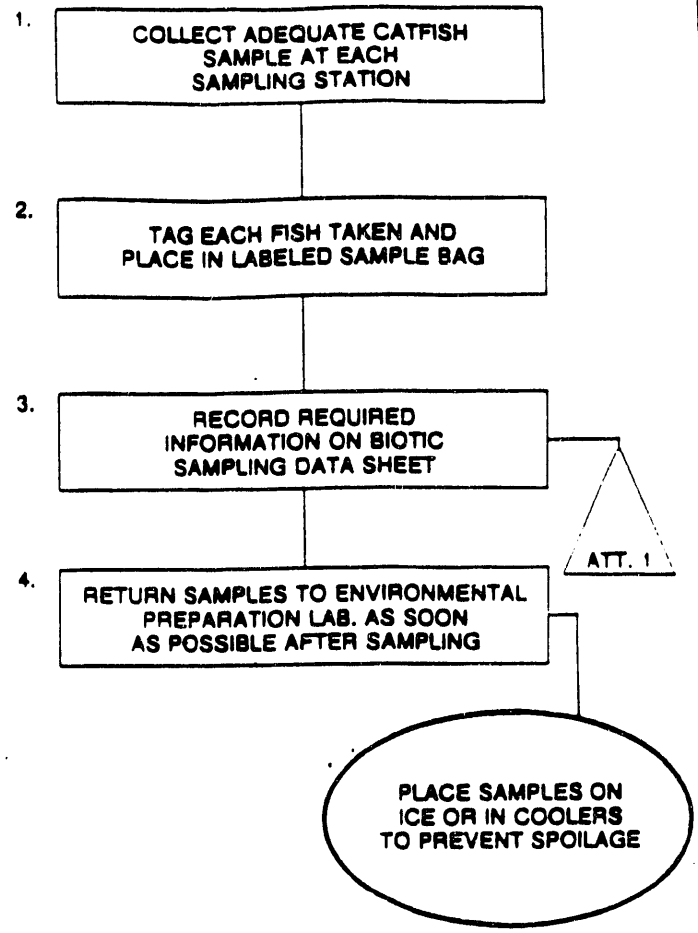
1. Collect an adequate number of catfish to make up the required sample quantity at each predetermined sampling station.

2. Attach a tag to each fish taken, and place it in an appropriately labeled sample bag.

3. Record the required information on the appropriate Biotic Tissue Sampling Data Sheet (Attachment 3).

4. Return samples to the environmental sample preparation laboratory as soon as possible after sampling has been completed.

NOTE: To prevent spoilage, samples should be placed on ice or in coolers.



5.4 Collection of Biotic Samples: Locally Produced Beef

1. The Program Manager will make arrangements in advance with the ranchers operating in the WIPP zone to procure samples of beef.

   NOTE: The animal(s) from which samples are collected should be locally produced beef which have been pastured on range land in the WIPP vicinity over a grazing period typical of local ranch operations.

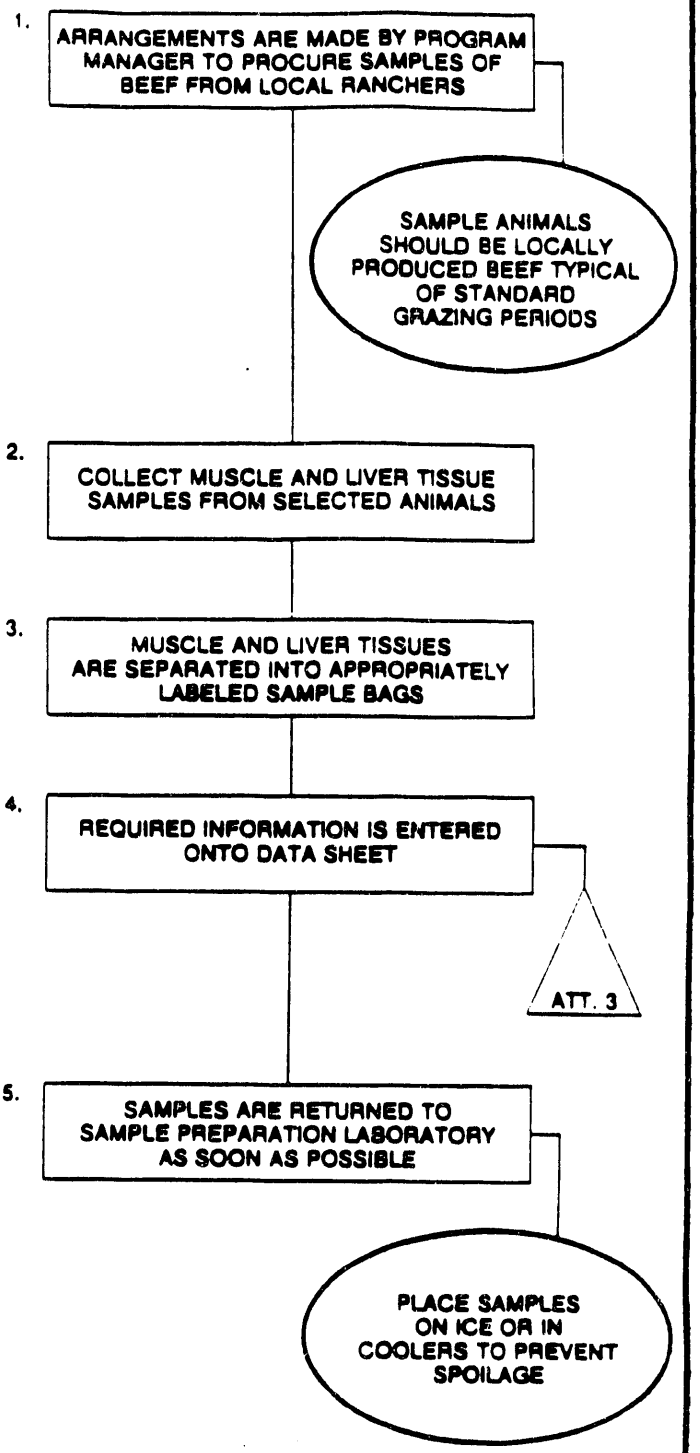
2. Collect samples of muscle and liver tissue from selected animals.

3. Separate muscle and liver tissue into separate, appropriately labeled sample bags for each individual.

4. Enter the following information on the appropriate data sheet: identification number (if available), ranch of origin, age/sex of animal, type of tissue collected, and weight of sample (Attachment 3).

5. Return samples to the environmental sample preparation laboratory as soon as possible after sampling has been completed.

   NOTE: To prevent spoilage, samples should be placed on ice or in coolers.



5.5 Collection of Biotic Samples: Native Vegetation

1. At each designated sampling station specified by the PI, locate the starting point marker.

2. Locate quadrat following the procedure described in Attachment 5; lay the quadrat frame over the vegetation.

3. Using clippers, collect all species in the quadrat. Shake or brush material with hand to remove excess soil from tissue surfaces.

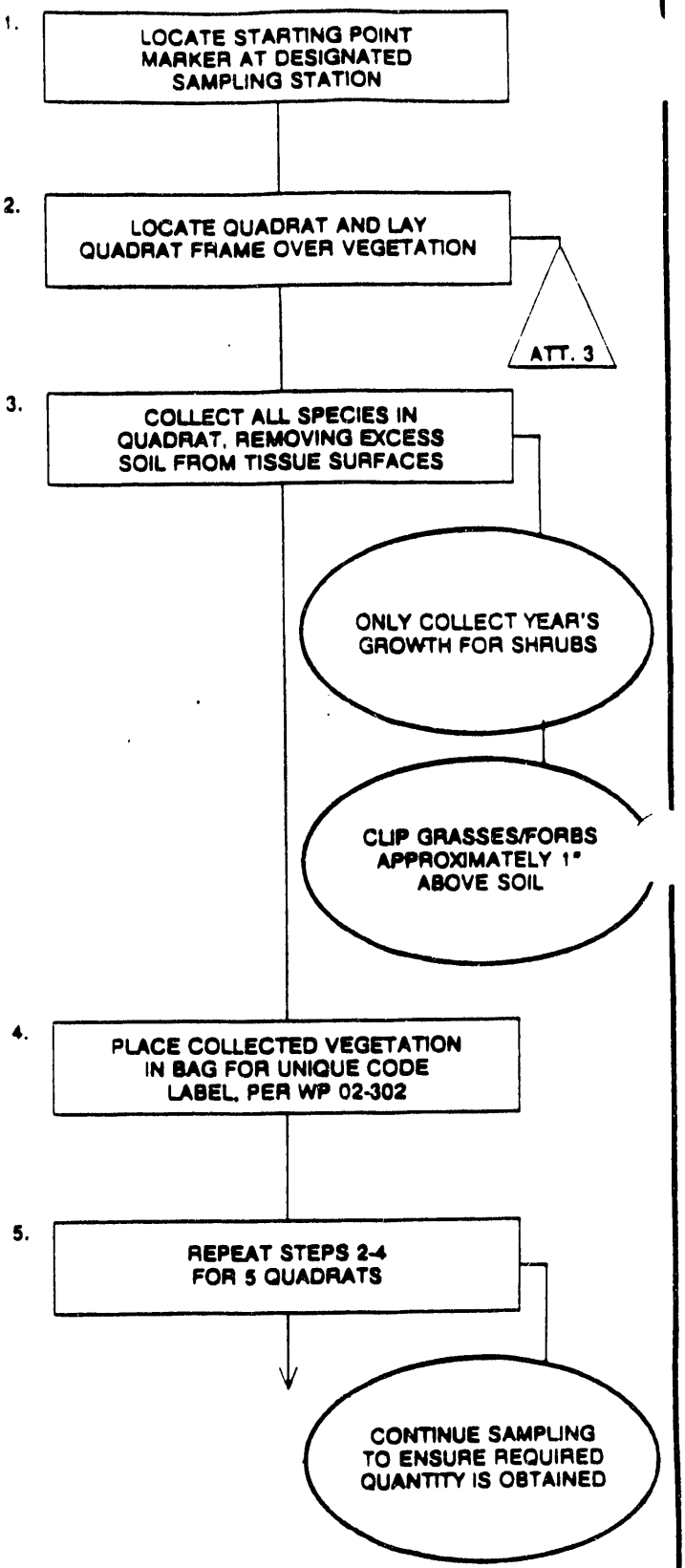
   NOTE: For shrubs, collect only the current year's growth.

   NOTE: Clip grasses and forbs approximately one inch above the soil surface.

4. Place collected vegetation into a large paper bag which, is labeled with the Unique Sample Code per WP 02-302.

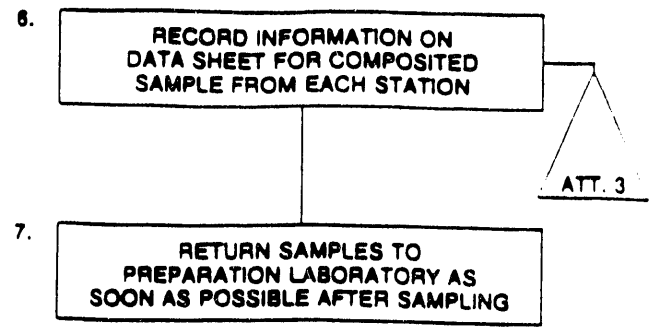
5. Repeat steps 2 through 4 until five quadrats have been sampled.

   NOTE: If an insufficient quantity of tissue has been collected after five quadrats, continue sampling until the required sample quantity is obtained.



6. Record the required information on the data sheet (Attachment 3) for the composited sample from each sampling station.

7. Return samples to the environmental sample preparation laboratory as soon as possible after sampling has been completed.



5.6 Post-Sampling Activities: Cottontail, Quail, Catfish, and Locally Produced Beef

Samples shall be prepared according to guidelines provided by the cognizant personnel at the vendor analytical laboratory.

1. Clean and prepare carcasses as they would be for consumption, using a clean stainless steel scalpel or knife.

   NOTE: Discard damaged tissue (i.e., from shot).

2. Weigh samples to the nearest 0.10 gram to obtain fresh weight; record on data sheet (Attachment 3).

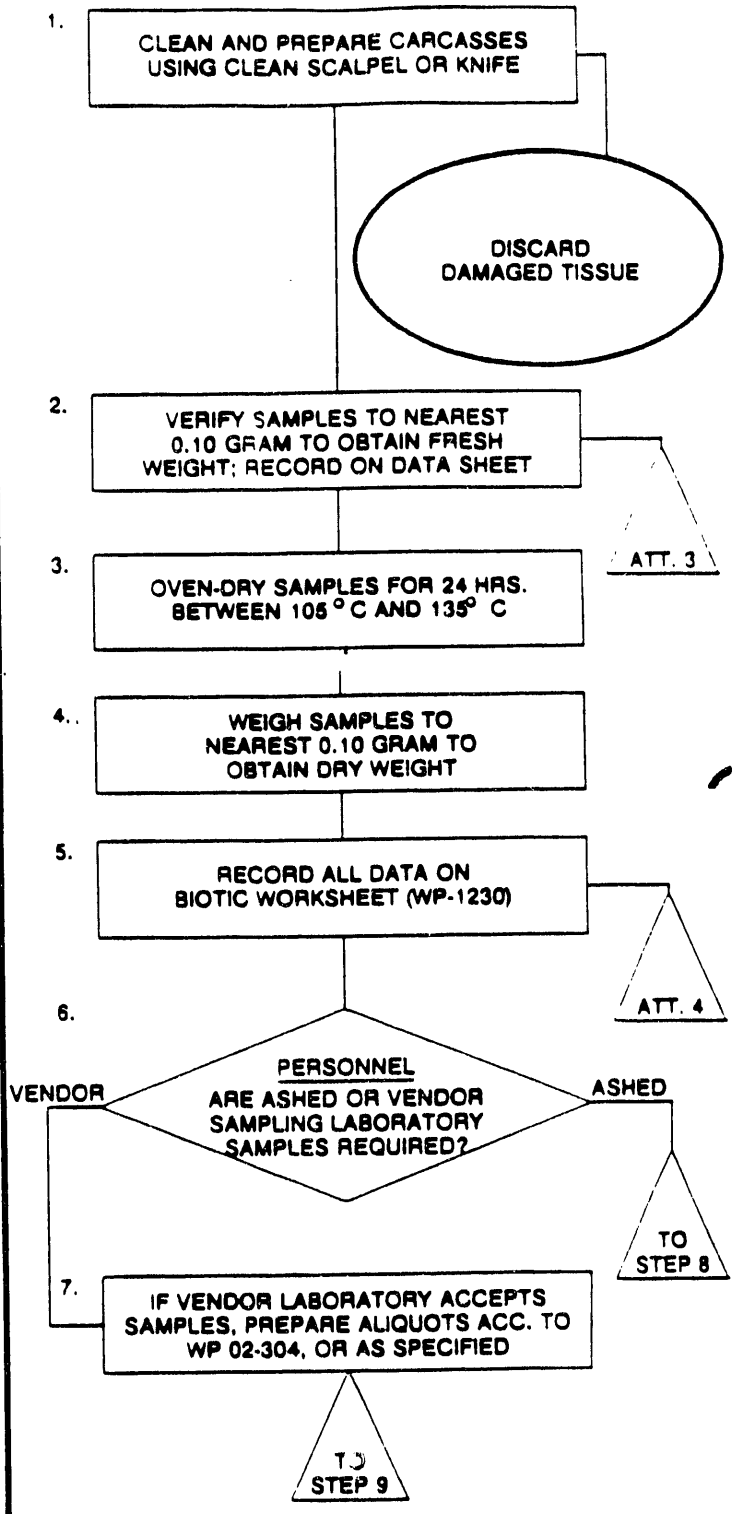
3. Oven-dry samples for at least 24 hours between 105°C and 135°C.

4. Weigh samples to the nearest 0.10 gram to obtain dry weight.

5. Record all appropriate data for each sample on the Biotic Tissue Sampling Worksheet (WP-1230, Attachment 4).

6. Are ashed or vendor sampling laboratory samples required?

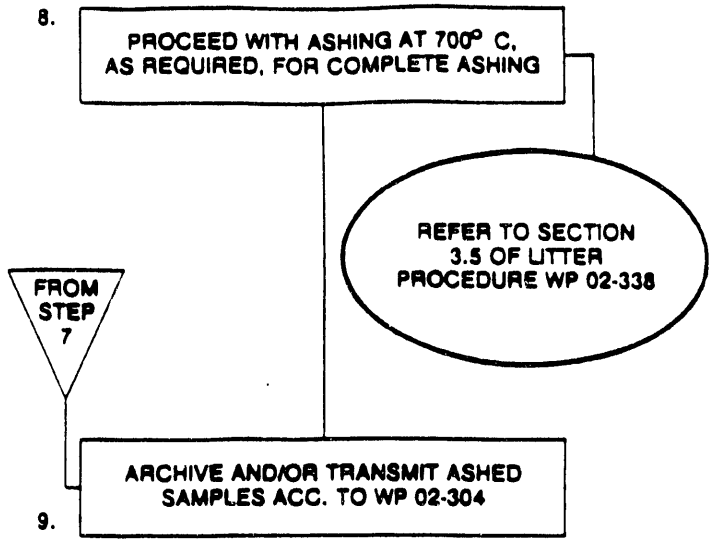
7. If the vendor laboratory has agreed to accept dried tissue samples, then prepare aliquots for transmittal and archival according to WP 02-304, or as specified by the PI.



8. If ashed samples are required, then proceed with ashing at approximately 700°C, until complete ashing is attained.

NOTE: Refer to NES Litter Bag Handling Procedures (WP 02-338, Section 3.5) for ashing procedures.

9. Archive and/or transmit ashed samples according to WP 02-304.



5.7 Post-Sampling Activities: Native Vegetation

1. Weigh samples to nearest 0.10 gram to obtain fresh weight; record on data sheet (Attachment 3).

2. Oven-dry plant material for at least 24 hours between 105°C and 135°C.

3. Weigh samples to nearest 0.10 gram to obtain dry weight; record on data sheet (Attachment 3).

4. Grind the material from each sampling station in a mill; ash material for at least four hours at approximately 700°C.

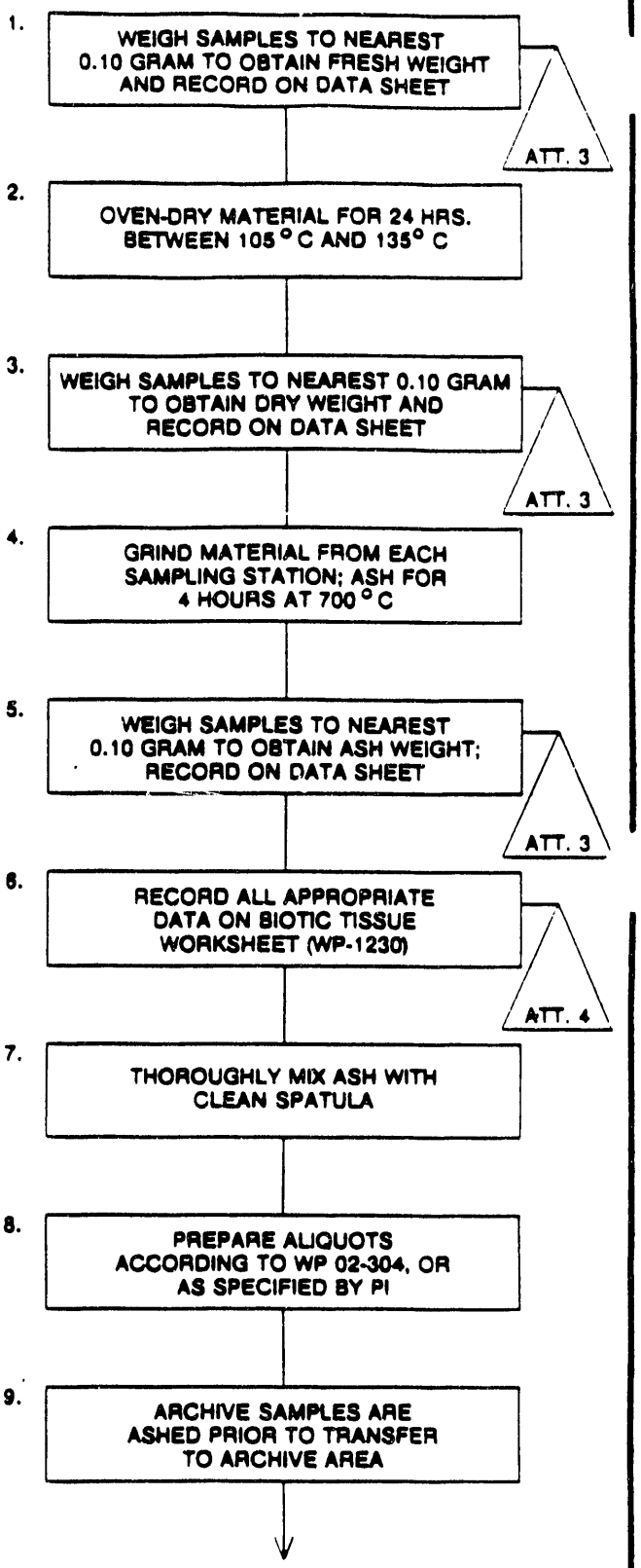
5. Weigh samples to nearest 0.10 gram to obtain ash weight; record on data sheet (Attachment 3).

6. Record all appropriate data for the material from each sampling station on the corresponding Biotic Tissue Sampling Worksheet (WP-1230, Attachment 4).

7. Thoroughly mix the ash with a clean spatula.

8. Prepare aliquots of the sample for transmittal and archival according to WP 02-304, or as specified by the PI.

9. Archive samples should be ashed prior to transfer to archive storage area.



10. Record weight of archive samples on appropriate worksheet.

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10. RECORD WEIGHT OF ARCHIVE SAMPLES ON APPROPRIATE WORKSHEET

GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy: A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample: A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation: The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample: A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration: The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source: A standard radiation source that is used for calibration of a measurement system.

Check Source: A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling: Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway: The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector: A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent: The liquid or gaseous waste streams released to the environment.

Emission: Any airborne radioactive material released to the environment.

Environmental Medium: A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs: The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule: A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample: A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics: The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber: An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring: The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite: Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite: Location within a facility that is controlled with respect to access by the general public.

Particle: An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision: A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance: All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control: Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout: The device that conveys information regarding the measurement to the user.

Reference Test Material: A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample: A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity: The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample: A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample: A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter: A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC): A specific alphanumeric number used to individually identify each sample.

Variability: A general term for the dispersion of values in a data set.

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DIRECTIONS FOR COMPLETING BIOTIC TISSUE SAMPLING DATA SHEET

The following information applies to the completion of Biotic Tissue Sampling Data Sheets (Form WP-1224) as specified in the RES Biotic Sampling Procedures. An example of a completed Biotic Tissue Sampling Data Sheet is shown on page 3 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to Instruction WP 02-303.
Sample Code	Unique sample identity code assigned according to Instruction WP 02-303. Use a preprinted adhesive label when available.
Tissue Type	Check one of the five boxes to indicate the type of tissue collected.
Collected By	The name of the person collecting the sample, or the leader of the field team.
Date/Time	Month/day/year that the sample is collected; time (24-hour clock) that sample collection is initiated.
Location:	
General	Accepted name or legal description of the location at which the sample is collected.
Description	Specific information describing the location of sample collection, such as travel routes, trap locations, starting point locations, etc.
Animal Tissue:	This section is only to be used for rabbit, quail, catfish, and beef samples.
No. of Individuals	The number of individual animals collected to fulfill the sample requirement.
Other Information	Any additional information about the sample which is pertinent to its analysis, e.g., age, sex, condition of individuals sampled, organs taken, methods and equipment used in collection, etc.

Item (Front of Sheet)	Description
Plant Tissue Composite:	This section will only be used for vegetation samples. It is filled out as an example only.
Direction:	
Paces (1st Dir.), and Paces (2nd Dir.)	Random coordinates (10 sets) derived as per this instruction, Attachment 3.
Species	A list of the plants included in the subsample to the nearest known taxon. Species may be identified by the standard 4-letter abbreviation (first two letters of the genus and first two letters of the specific epithet), by scientific name, or by an accepted common name.
Checked By	Name of the person who checked the data sheet for completeness and accuracy (the PI or a designated individual).

Item (Back of Sheet)	Description
Item No.	The specific step listed in the RES Biotic Sampling Instructions.
Completed	Indicates that the step is completed.
Comment	If any step was not performed, explain why it was not performed.

Biotic Tissue Sampling Data Sheet

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BQ-SMR-19861012-1.2
Sample Code
(Use Label When Available)

Tissue Type: ☐ Rabbit ☒ Quail ☐ Catfish ☐ Beef ☐ Vegetation

Collected by BIRDIE HUNTER Date 10-13-86 Time 1430

Location: General SMITH RANCH
Location Description: WALKED 2 MILES NORTH FROM WINDMILL (0.5 MILE NE OF RANCH), THEN EAST 1 MILE, THEN RETURNED TO TRUCK AT WINDMILL

Animal Tissue: # of Individuals 5

Other Information USED 12-GUAGE SHOTGUN W/ STEEL SHOT
2 ♂, 1 ♀, 2 JUVENILES COLLECTED ALL ARE SCALED QUAIL

Plant Tissue Composite: (FILLED OUT AS A SEPARATE EXAMPLE FROM ABOVE)

Subsamples (0.5m x 0.5m quadrats)

	Direction	Paces (1st Dir.)	Paces (2nd Dir.)	Species
1	N	10	30	QUHA, YUCA, ARFI
2	S	19	76	QUHA, ARFL, EUMI
3	W	19	19	QUHA, 3-AWN, SANDSAGE
4	N	21	02	SHIN OAK, TRISTLOA SP., UNK. FORB
5	E	27	00	BARE
6	S	86	66	
7	E	15	36	
8	E	54	41	
9	S	16	57	
10	N	12	12	

Checked by John Chesher

WP-1224

DIRECTIONS FOR COMPLETING BIOTIC TISSUE SAMPLING WORKSHEET

The following information applies to the completion of Biotic Tissue Sampling Worksheets (Form WP-1230) as specified in the RES Biotic Sampling Procedures. An example of a completed Biotic Tissue Sampling Worksheet is shown on page 3 of this attachment.

Item (Front of Sheet)	Description
Attachment to Data Sheet No.	Data sheet number to which this attachment corresponds.
Specimen No.	Identifying number assigned to each specimen collected. A specimen may be an individual animal (rabbit, quail, fish), a specimen of tissue from an individual animal (beef), or a composite sample (vegetation)
Specimen Wt.	Weight of each individual animal used in grams (not applicable to vegetation).
Specimen Sex	Sex of each individual animal used (not applicable to vegetation).
Specimen Age	Approximate age of individual animals used (not applicable to vegetation).
Tissue(s) Included	Specimen tissues which will be included in the sample.
Fresh Wt. of Tissue	Specimen tissue weight, in grams, before drying.
Dry Wt. of Tissue	Specimen tissue weight, in grams, after drying.
Crucible No. and Wt.	Crucible identification number and weight, in grams. (Crucibles are pre-marked with numbers.)
Crucible + Dry Wt.	Weight of crucible and dry tissue contained in the crucible, in grams.
Sample Wt.	Difference between the Crucible + Dry Wt. and the crucible weight.
Crucible + Ash	
Ash	

Item (Back of Sheet)	Description
Item No.	The specific step listed in the RES Biotic Sampling Instructions.
Completed	A checkmark indicates that the step has been completed.
Comment	If any step was not performed, explain why it was not performed.

Attachment to Data Sheet No. 463
464
465

Biotic Tissue Sampling Worksheet

Radiological Environmental Surveillance

If Determinable

Specimen #	Specimen Wt. (g)	Specimen Sex	Specimen Age	Tissue(s) Included	Fresh Wt. of Tissue (g)	Dry Wt. of Tissue (g)	Crucible # & Wt. (g)	Crucible + Dry Wt. (g)	Sample Wt. (g)	Crucible + Ash (g)	Ash (g)
1	28.0	F	?	muscle/ bone	20.0	15.0	2 20.0	35.0	15.0	21.5	1.5
2	36.0	M	JUV.	"	26.0	17.0	8 20.0	37.0	17.0	22.7	2.7
3	38.0	?	ADULT	"	30.0	20.0	5 25.0	45.0	20.0	27.0	2.0
4	~150 lb	steer	2yr.	Liver	6000g	959.4g	2 20.8	270.5	250.8	107.3	86.5
"	"	"	"	"	"	"	5 21.0	265.3	244.3	96.5	75.5
"	"	"	"	"	"	"	4 20.6	260.4	239.8	108.4	87.8
"	"	"	"	"	"	"	6 20.7	225.2	204.5	90.3	69.6
2	5.0	—	—	All	5.0	1.0	1 20.0	24.5	4.5	21.0	1.0
3	8.0	—	—	All	8.0	2.0					
4	6.0	—	—	All	6.0	1.5					

ATTACHMENT 4
WP 02-310, Rev. 1
Page 3 of 3

SELECTING RANDOM LOCATIONS

1. SCOPE

This attachment describes the steps required to randomly locate sampling stations or points in the RES Program at the WIPP facility. These steps shall be followed to select a random location for collecting biotic samples, or other sampling activities where random locations within a rectangular area are required.

2. LOCATING A RANDOM SAMPLING STATION OR POINT

a. A starting point shall be defined at each sampling station for which these steps are used.

b. Draw a random number to represent one of the four major compass headings (N=1, S=2, E=3, and W=4) using a random number generator or a random number table. This will be the starting direction.

c. Draw a random integer between 0 and 100 to represent the number of paces to proceed in the starting direction (see Step 1).

d. Draw a second random integer between 0 and 100 to represent the number of paces to proceed in the second direction.

e. Enter these numbers in the appropriate blanks on the Sample Data Sheet for each sample.

3. IDENTIFICATION OF SAMPLING LOCATION IN THE FIELD

At the sampling station:

a. Proceed to the permanent marker or starting point.

b. Using a compass or the directional markers in place at the plots, find the starting direction indicated on the data sheet for the current sample or subsample.

c. Proceed in that direction for the number of paces determined by the first random number listed on the data sheet. Turn left 90 degrees and proceed in the second direction for the number of paces determined by the second random number listed on the data sheet.

d. If the selected location is inaccessible or inappropriate (e.g. man-made barrier), draw a new starting direction and proceed to the random location using the previously selected coordinates.

LIST OF REVIEWERS

Procedure Number: WP 02-310

Revision Number: 1

Procedure Title: Biotic Sampling Procedures

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-311 REV. 1 ISSUE DATE: 03/02/88

APPROVAL SIGNATURE: R.D Bergen for TKC

PROCEDURE AUTHOR: J. Cockman

TITLE: HIGH VOLUME AIRBORNE PARTICULATE SAMPLING PROCEDURES*

1.0 SCOPE

This document provides specific procedures, data sheets, and checklists for intermittent airborne particulate sampling, using the high volume intermittent flow sampler. Intermittent sampling of airborne particulates is conducted as part of the Radiological Environmental Surveillance (RES) Program conducted by the Radiological and Environmental Programs Section (REPS). The preparation and handling of filters and the operation of high volume samplers will be conducted as described in this procedure.

2.0 DEFINITIONS

See Attachment 1.

3.0 REFERENCES

WP 02-301, RES Implementation
WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures
WP 02-303, RES Scheduling, Documentation, and Field Preparation Procedures
WP 02-304, RES Sample Tracking Procedures
WP 02-305, RES Data Management Procedures

See Attachment 2.

4.0 GENERAL

All activities associated with sampling, handling, and documentation of high volume intermittent airborne particulate monitoring units shall be described in the Environmental Procedure Manual (WP 02-3).

Airborne particulate samples will be collected at times and locations developed according to the procedures in WP 02-303. Data sheets and plastic filter holders are prepared prior to sampling activities according to WP 02-303.

Qualified personnel shall perform the tasks of this procedure, as described in WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS section manager, as specified in WP 02-302.

Activities are recorded on a High Volume Airborne Particulate Sampling Data Sheet/High Volume Air Sampler Calibration Worksheet (WP-1226). Examples of a completed High Volume Airborne Particulate Sampling Data Sheet and a High Volume Air Sampler Calibration Worksheet are provided as Attachment 3.

The following activities are described in this procedure:

5.1 Preparation for Sampling
5.2 Installing a Filter
5.3 Removing a Filter
5.4 Post-Exchange Activities

*It should be noted that this procedure was issued previously as an instruction. WP 02-311 has undergone such extensive revision that changes will not be indicated singly.

5.0 PROCEDURE

5.1 Preparation for Sampling

1. Select one unused high volume sampling filter for each station where exchange is to be performed.

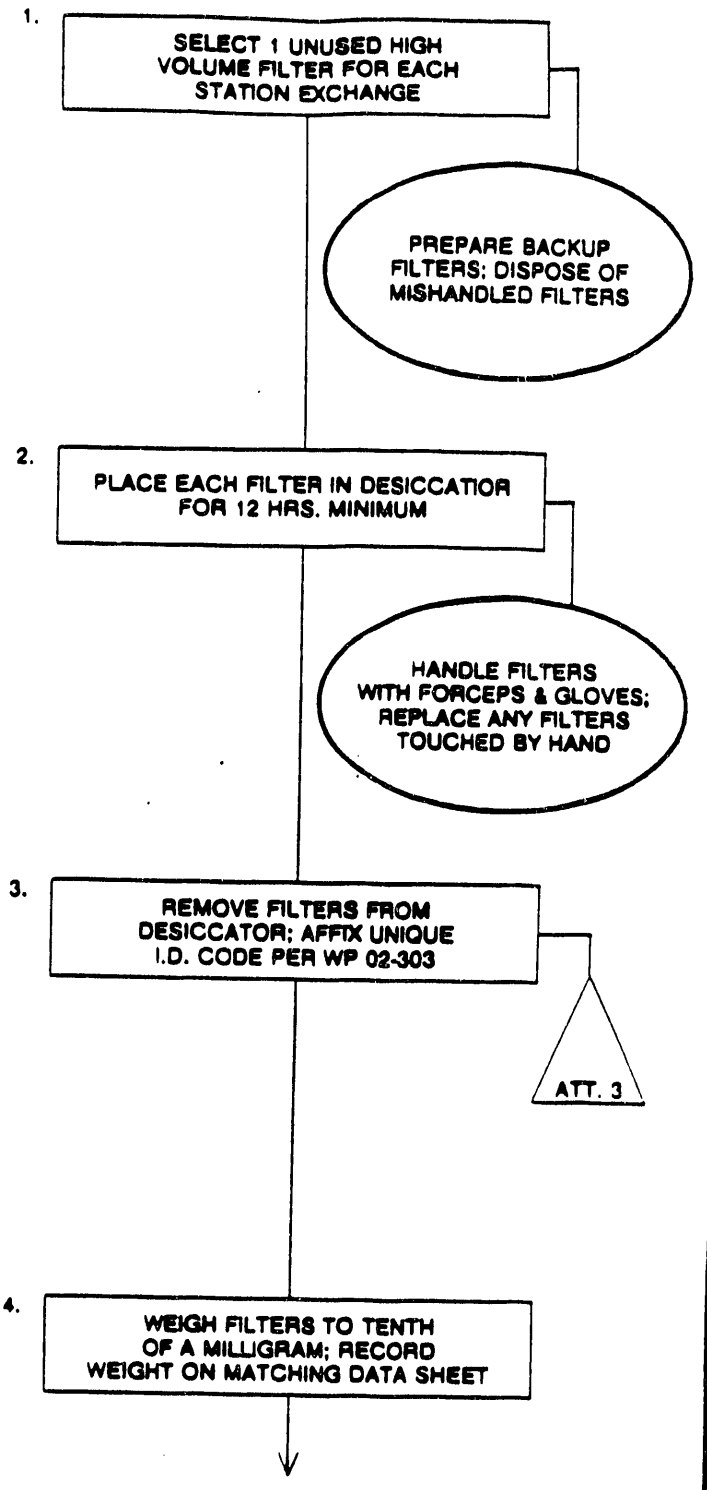
   NOTE: Prepare at least one extra filter in case a filter is mishandled or lost. Dispose of mishandled filters as necessary.

2. Place each filter in the desiccator for at least 12 hours.

   NOTE: Use forceps/gloves to handle filters. Do not touch the impaction face (rougher surface) of the filters. If touched, then replace with clean filter.

3. Remove each filter from the desiccator and affix a unique identity code (UIC) label (per WP 02-303) on the plastic filter holder. This UIC will match the label on the High Volume Airborne Particulate Sampling Data Sheet (WP-1226) (Attachment 3).

4. Weigh each filter to the nearest tenth of a milligram; record the weight of the filter on the matching data sheet (WP-1226).



5. Place each weighed filter in an aluminum filter holder for transport to the high volume sampling unit.

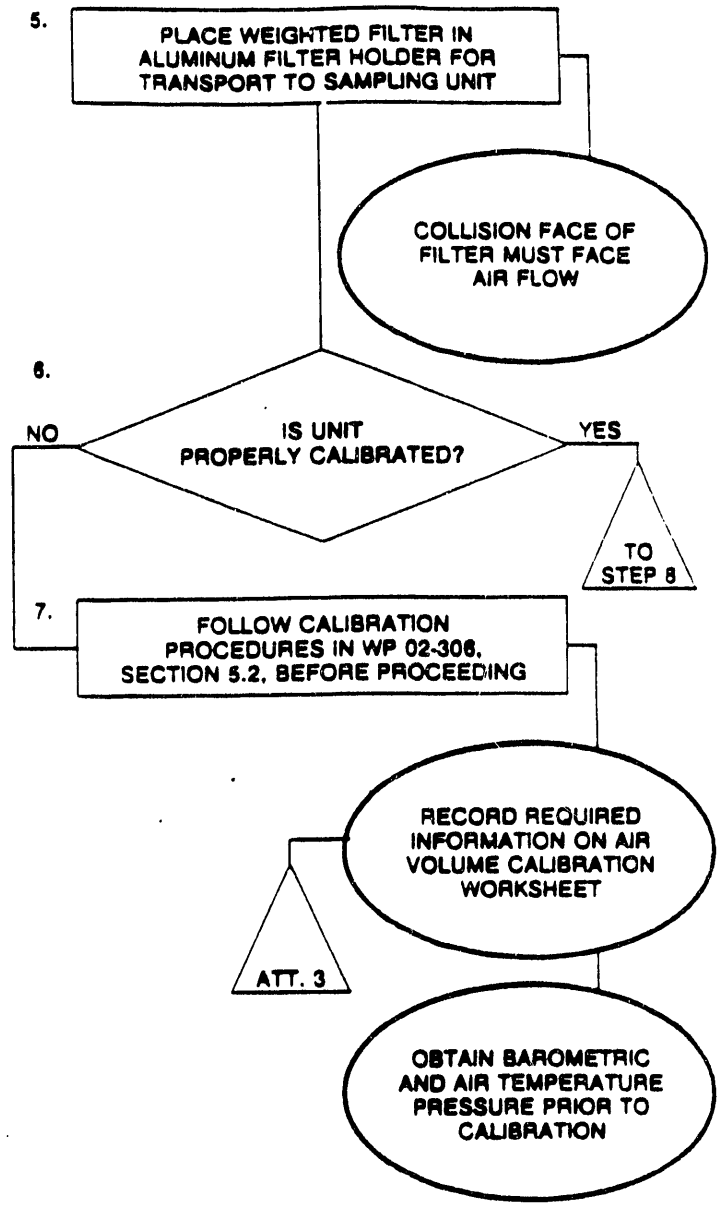
NOTE: The collision face (rougher surface) of the filter must face into the air flow (i.e, up).

6. Verify the calibration status of the high volume sampling unit, recording the expiration date on the data sheet (WP-1226).

7. If the unit is not in calibration, refer to calibration procedures contained in WP 02-306, section 5.2, before proceeding.

NOTE: Record required information on air volume calibration worksheet (Attachment 3: WP-1226).

NOTE: Barometric pressure and air temperature should be obtained prior to calibration, with source noted on calibration worksheet.

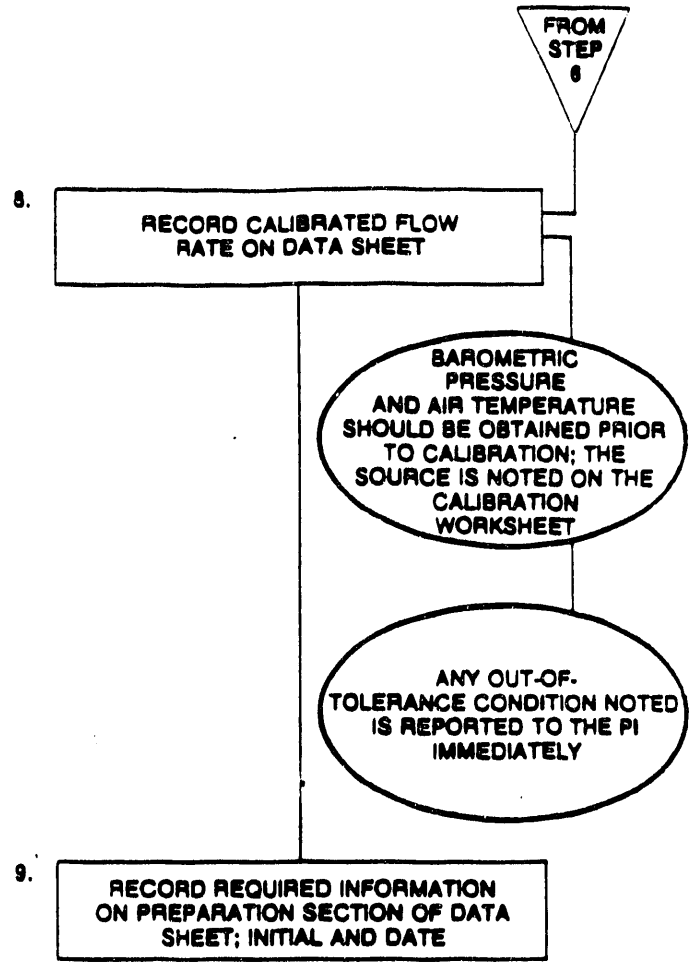


8. If the unit is properly calibrated, record the calibrated flow rate on the data sheet.

NOTE: Barometric pressure and air temperature should be obtained prior to calibration and the source noted on the calibration worksheet.

NOTE: Any out-of-tolerance condition noted should be reported to the Principal Investigator (PI) as soon as possible.

9. Record the required information on the preparation section of the data sheet; initial and date the data sheet.



5.2 Installing a Filter

1. Connect the high volume sampler to the power source, if not already energized.

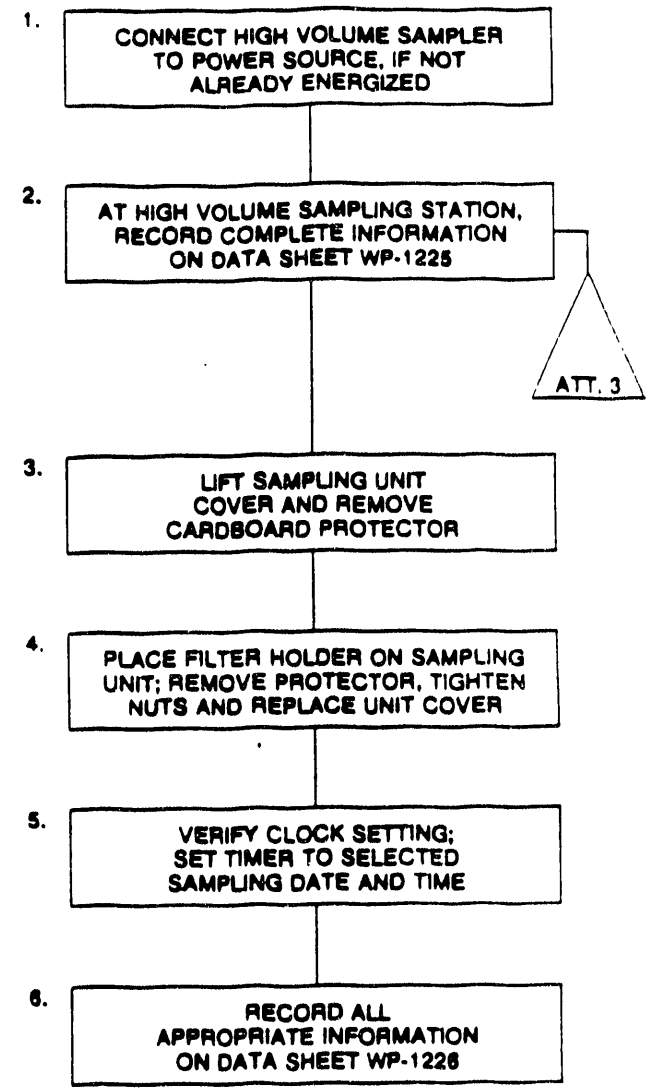
2. At the high volume sampling station, record the installation date and time; identify the sampling station and sampler number (Attachment 3: data sheet WP-1226).

3. Lift the sampling unit cover and remove the cardboard protector left in place on the sampling unit.

4. Place the filter holder on the sampling unit; remove the clip-on protector; tighten the four wing nuts. Replace the sampling unit cover.

5. Verify that the clock is set at the current time. Set the advance timer to the selected sampling date and time.

6. Record all appropriate information on the data sheet (WP-1226).



5.3 Removing a Filter

1. At the end of the sampling period, read the elapsed time on the timing meter; record date, time, and elapsed time on the data sheet (WP-1226) and initial.

2. Examine the sampling unit and record the required information on the Field Check section of the data sheet (WP-1226).

3. Disconnect the high volume sampler from the power source if a new filter is not being installed.

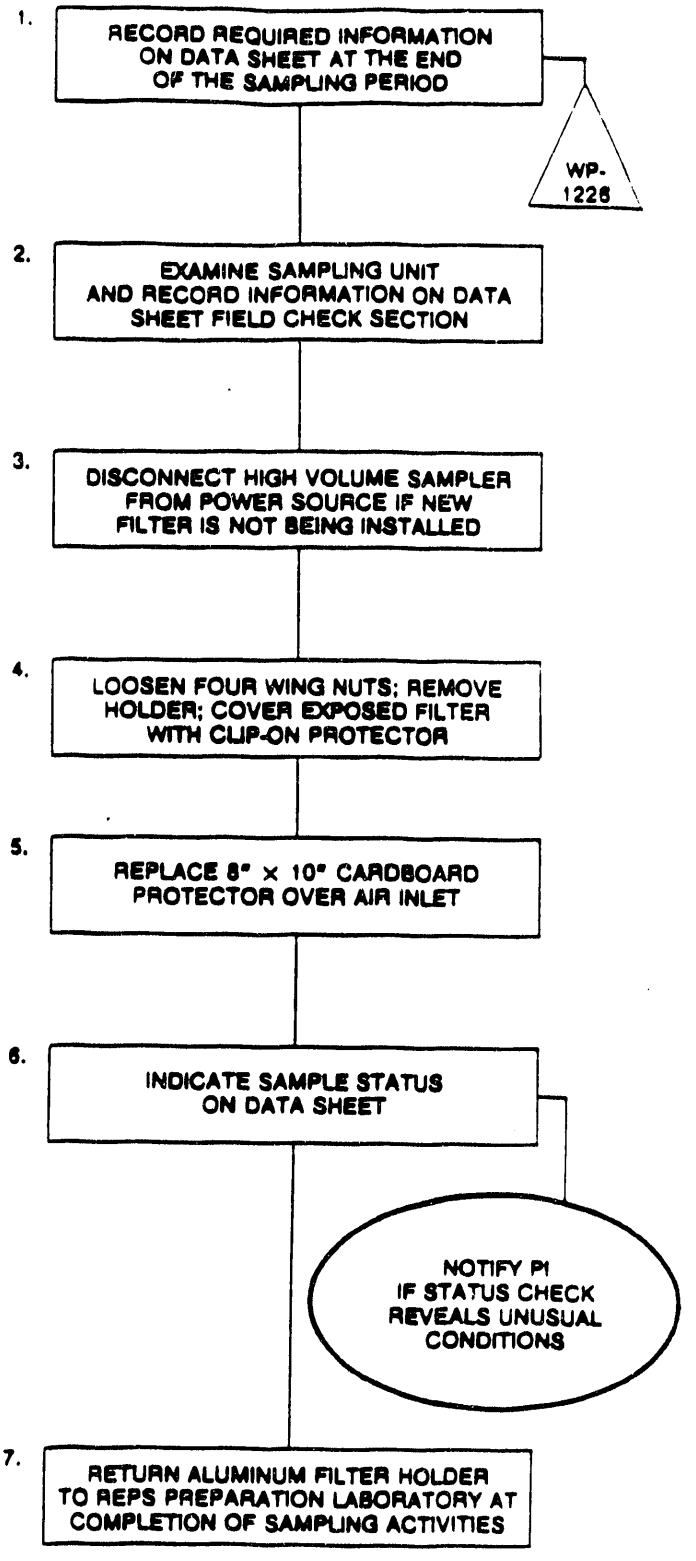
4. Loosen the four wing nuts which hold the filter holder in place, and remove the holder. Cover the exposed filter with the clip-on protector.

5. Replace the 8" x 10" cardboard protector over the air inlet.

6. Indicate the sample status on the data sheet.

   NOTE: Notify the PI if the status checked on WP-1226 is anything but "OK."

7. Return the aluminum filter holder to the REPS sample preparation laboratory when sampling activities are completed.



5.4 Post-Exchange Activities

1. Conduct filter processing as soon as possible after samples have been removed from the high volume sampler units and transported to the laboratory.

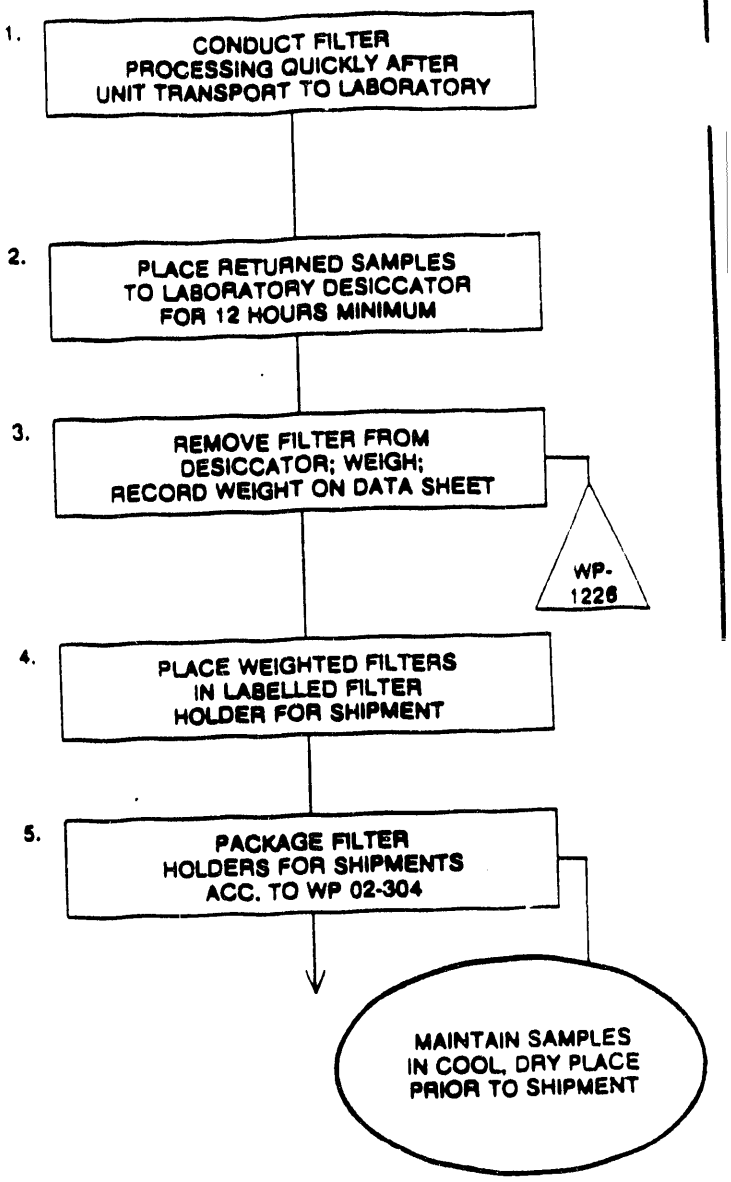
2. Place returned filter samples in the laboratory desiccator for at least 12 hours.

3. Remove the filter samples from the desiccator and weigh to the nearest tenth of a milligram. Record weight on the appropriate data sheet (WP-1226).

4. Place each weighed filter sample in the appropriately labeled plastic filter holder for shipment to the analytical laboratory.

5. Package the filter holders for shipment to the analytical laboratory. Follow procedures in WP 02-304 for transmitting samples for analysis.

NOTE: Maintain samples in a cool, dry place prior to shipment.

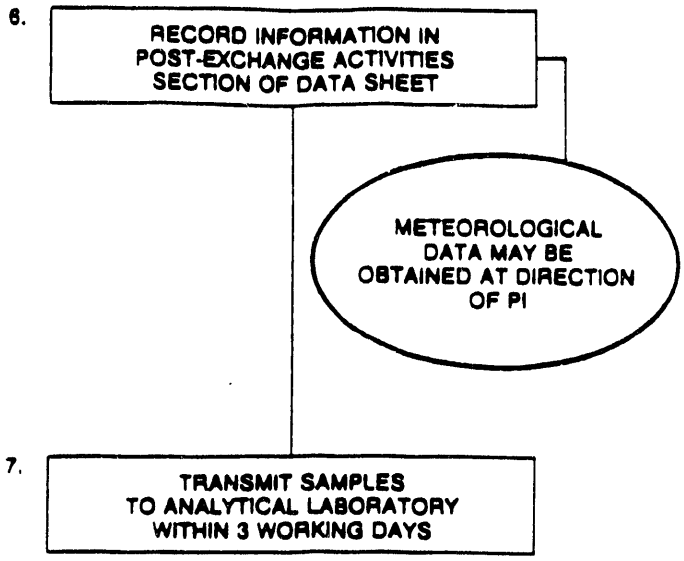


6. Record requested information in the Post-Exchange Activities section of each data sheet; date and initial.

NOTE: Meteorological data for the date of sampling may be obtained from the appropriate sampling locations, and are recorded on each data sheet. This activity is performed at the discretion of the PI.

7. Transmit samples to the analytical laboratory within three working days of retrieval.

167s



GLOSSARY OF TERMS
Radiological Environmental Surveillance

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Background Radiation - The radiation in man's natural environment, including cosmic rays, radiation from the naturally radioactive elements, and fallout from nuclear weapons testing.

Biotic Sample - A sample (beef, vegetation, fish, bird) taken from the local environs. These samples should represent an ecosystem compartment that could represent a critical (exposure) pathway for impact on the local population.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Calibration Source - A standard radiation source that is used for calibration of a measurement system.

Check Source - A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Critical (exposure) Pathway - The chain of environmental transfers from place to place and from one trophic level to another which results in the greatest fraction of an applicable dose criterion to a population group and body organ (or whole body).

Detector - A device for converting radiation flux to a signal suitable for observation and measurement.

Effluent - The liquid or gaseous waste streams released to the environment.

Emission - Any airborne radioactive material released to the environment.

Environmental Medium - A discrete portion of the total environment, animate or inanimate, which may be sampled or measured directly.

Environs - The uncontrolled area at or near the site boundary.

Filter-Carrying Capsule - A container (i.e., small petri dish) used for housing an individual 47 mm. filter and/or particulate sample for storage and transportation.

Grab Sample - A randomly taken, single sample removed from a stream over a short interval of time.

Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

Ionization Chamber - An instrument that detects and measures ionizing radiation by measuring electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Particle - An aggregate of molecules, forming a solid or liquid, ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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DIRECTIONS FOR COMPLETING HIGH VOLUME AIRBORNE PARTICULATE SAMPLING DATA SHEET

The following information applies to the completion of High Volume Airborne Particulate Sampling Data Sheets (Form WP-1226) as specified in the High Volume Airborne Particulate Sampling Procedures. An example of a completed High Volume Airborne Particulate Sampling Data Sheet/Procedure Completion Checklist is shown on page 5 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to WP 02-303.
Unique Identity Code	Unique identity code assigned to the sample referred to on the data sheet as per WP 02-303. Use a preprinted adhesive label when available.
Unit #	The number identifying the sampler unit used to collect the sample.
Preparation:	
Date	Month/day/year that the filter is weighed prior to installation.
Blank Filter Wt.	Weight in grams of the filter (dry) prior to installation.
Calib. Status	Circle "Y" when the sampler unit is scheduled to be calibrated or "N" when calibration is not required.
Recorded by	Initials of the person weighing the filter.
Installation:	
Date/Time	Month/day/year the installation is performed; time the installation is performed.
Clock set at current time	Check the box to indicate that the internal sampler clock has been set to the current time.
Advanced timer set:	
Start	Time at which the sampler has been programmed to start sampling.

Item (Front of Sheet)	Description
Stop	Time at which the sampler has been programmed to stop sampling.
On	The day of the week on which the sampler unit collects the sample.
Date	The date (month/day/year) on which the sampler unit collects the sample.
Flow rate calibrated at	The machine flow rate in cubic feet per minute, to which the sampler has been set during calibration.
No calibrations performed on this day	Check the box when calibration is not formed during installation.
Removal:	
Date	Month/day/year on which the filter is retrieved.
Time	Time (24-hour clock) at which the filter is retrieved.
Total Elapsed Time	The elapsed time (in hours) specified by the sampler.
Recorded by	The initials of the person recording the removal data.
Sample Status	A check mark in the appropriate box indicates status of the sample ("OK" indicates normal); also, the PI should be notified of any non-normal status.
Field Checks	Check "YES" or "NO" for the three listed items as determined by observations made upon sample retrieval, and record action taken for each "NO" response. Check the box when actions taken are recorded in the maintenance log.
Post-Exchange Activities:	
Wt. after 12 hrs. in desiccator	Weight of the retrieved filter (in grams) after drying in the desiccator for at least 12 hours.

Item (Front of Sheet)	Description
Wt. of particulates*	The difference between the filter weight after retrieval and the filter weight before installation, expressed first in grams and then in milligrams (1 gram = 1000 milligrams).
Calculated vol. of air sampled*	The volume of air sampled, in m^3, calculated by multiplying the flow rate by the elapsed time in by the constant 16.98 $min.m^3/hr.ft^3$.
Wt. of particulates per unit of air sampled*	The quotients, in mg/m^3, obtained by dividing the milligrams of particulates by the volume of air sampled.
Recorded by/Date	The initials of the person recording the post-exchange data; the month/day/year the data is recorded.
Meteorological Data:	
Avg. wind speed during 24-hour sampling period	The average wind speed recorded during the sample collection period either at the WIPP site or on a portable recording anemometer placed at the location of the sampler.
Max. wind speed during 24-hour sampling period	The maximum wind speed recorded during the sample collection period either at the WIPP site or on a portable recording anemometer placed at the location of the sampler.
Recorded by	The initials of the person recording the meteorological data.
Checked by/Date	Signature of the PI or designated personnel who reviews/checks sample-specific information and calculations; month/day/year the review/check is performed.

*Calculations need only be performed when RADCOMP is not used for sample logging or when RADCOMP calculations are being verified.

DIRECTIONS FOR COMPLETING HIGH VOLUME AIR SAMPLER CALIBRATION WORKSHEET

The following information applies to the completion of High Volume Air Sampler Calibration Worksheets (Form WP-1226) as specified in the High Volume Airborne Particulate Sampling Procedures. An example of a completed High Volume Air Sampler Calibration Worksheet is shown on page 6 of this attachment.

Item	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to WP 02-303.
Date	Date air sampler is calibrated (month/day/year).
Sampler No.	Number stamped on the high volume sampler which is being calibrated.
Calibrated by	Name of person who is performing the calibration.
Barometric Pressure	Barometric pressure in inches of Hg at the time of calibration, measured at an accepted weather station.
Source of B.P. Data	Location from which barometric pressure is obtained.
Air Temperature	Current air temperature measured at the sampler location.
Calibrator Serial No.	Check one box to indicate calibrator used.
Calculations	Shown formula with variable values in place and final solution of the formula.
Recorded by	Name of person performing calculations.
Checked by/Date	Name of person checking/verifying worksheet; date (month/day/year) on which worksheet is checked.

HIGH VOLUME AIRBORNE PARTICULATE SAMPLING DATA SHEET

RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

UNIQUE IDENTITY CODE: AI-LVG-19880216 UNIT No. 10

PREPARATION:

DATE 2-15-88 BLANK FILTER Wt. 3.8172 g RECORDED BY B. W.

INSTALLATION:

DATE 2-15-88 TIME 1501 RECORDED BY B. W. CLOCK SET AT CURRENT TIME ☑

ADVANCED TIMER SET: START 0000 STOP 2359 ON Mon. DATE 2-15-88

FLOW RATE CALIBRATED AT 40 cfm NO CALIBRATION PERFORMED ON THIS DAY ☐

FOR NON-RESETTABLE TIMER: REMOVAL TIME 74659.2 - INSTALL TIME 73219.2 =

TOTAL ELAPSED TIME 1440 ÷ 60 = 24 hours

REMOVAL:

DATE 2-17-88 TIME 0811

TOTAL ELAPSED TIME 24 hrs RECORDED BY B. W.

SAMPLE STATUS: ☑ O.K. ☐ QUALIFIED/FLAWED ☐ ABORTED ☐ P.I. NOTIFIED

FIELD CHECKS:

	YES	NO
POWER OUTAGE LIGHT OFF:	✓	
UNIT APPEARS TO HAVE COMPLETED A NORMAL CYCLE:	✓	

NOTE: IF RESPONSE IS NO, ACTION IS REQUIRED. PLEASE NOTE ACTION TAKEN: _____

ACTIONS RECORDED IN MAINTENANCE LOG ☐

POST EXCHANGE ACTIVITIES:

Wt. AFTER 12 HRS. IN DESICCATOR 3.9900 g

Wt. OF PARTICULATES: .1728 g 172.8 mg

CALCULATED VOL. OF AIR SAMPLED 1630.08 m^3

Wt. OF PARTICULATES PER UNIT OF AIR SAMPLED .106 mg/m^3

RECORDED BY B. W. DATE 2-18-88

CHECKED BY S. Jones DATE 2-19-88

HIGH VOLUME AIR SAMPLER CALIBRATION WORKSHEET

DATA SHEET No. 001797

DATE 2-15-88

SAMPLER No. 10

CALIBRATED BY B. W

BAROMETIC PRESSURE ABSOLUTE (in. Hg) 30.06 - 3.12 = 26.94

SOURCE OF B. P. DATA C-Bad Airport

AIR TEMPERATURE 24 °C

CALIBRATOR SERIAL No. (Check One) C256 ☑ 3241 ☐ C168 ☐

CALCULATIONS:

$$C = \sqrt{\frac{T + 273}{P}} \times 0.3168 \times Q$$

WHERE:

C = CORRECTED ORIFICE STATIC PRESSURE (in. H_2O)

Q = ORIGINAL ORIFICE STATIC PRESSURE (in. H_2O)

P = BAROMETRIC PRESSURE ABSOLUTE (in. Hg)

T = TEMPERATURE (°C)

$$C = \sqrt{\frac{24 + 273}{26.94}} = \sqrt{\frac{297}{26.94}} = 3.32 \times .3168 = 1.05$$

$1.05 \times 5.2 = 5.46 = 5.5$ inches of water

Flow rate corrected to 5.5 inches of water

NOTE: ORIGINAL ORIFICE STATIC PRESSURE OBTAINED FROM SAMPLER CERTIFICATE OF CALIBRATION

RECORDED BY B. W.

CHECKED BY S. Jones DATE 2-19-88

LIST OF REVIEWERS

Procedure Number: WP 02-311

Revision Number: 1

Procedure Title: High Volume Airborne Particulate Sampling Procedures

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
R. Kehrman	REPS
A. Rodriquez	REPS
R. Youngman	QA

NO: 02-312 REV. 1 ISSUE DATE: 03/03/88

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: LOW-VOLUME AIRBORNE PARTICULATE SAMPLING PROCEDURES*

1.0 SCOPE

This document provides procedures, data sheets, and checklists for continuous airborne particulate sampling using the low-volume continuous flow sampler. Continuous sampling of airborne particulates is conducted as part of the Radiological Environmental Surveillance (RES) Program by the Radiological and Environmental Programs Section (REPS). The preparation and handling of filters and the operation of low-volume samplers will be conducted as described in this document.

2.0 DEFINITIONS

Refer to Glossary of Terms (Attachment 1).

3.0 REFERENCES

WP 02-301, Radiological Environmental Surveillance (RES) Implementation Procedures

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures

WP 02-303, RES Scheduling, Documentation, and Field Preparation Procedures

WP 02-304, RES Sample Tracking Procedures

WP 02-305, RES Data Management Procedures

References and Standards (Attachment 2)

4.0 GENERAL

All activities associated with sampling, handling, and documentation of low-volume continuous airborne particulate monitoring units shall be described in the Environmental Procedure Manual (WP 02-3).

Samples will be collected at times and locations developed according to the procedures in WP 02-303. Data sheets and sample containers are prepared prior to sampling activities according to WP 02-303.

WIPP Quality Assurance department will be notified of any non-conformance conditions by the REPS section manager as specified in WP 02-302. Qualified personnel shall perform the task of this procedure as described in WP 02-301.

Activities are recorded on a Low-Volume Airborne Particulate Sampling Data Sheet (Form WP-1227). An example of a Low-Volume Airborne Particulate Sampling Data Sheet is provided as Attachment 3.

The following Airborne Particulate Sampling procedures are discussed in this document:

5.1 Filter Preparation
5.2 Filter Exchange
5.3 Post-Exchange Activities

*It should be noted that this procedure was issued previously as an instruction. WP 02-312 has undergone such extensive revision that changes will not be indicated singly.

5.0 PROCEDURES

1 Filter Preparation

1. Select one unused low-volume sampling filter for each station where exchange is to be performed.

   NOTE: Prepare one or two extra filters in case a filter is mishandled or lost. Dispose of mishandled filters if necessary.

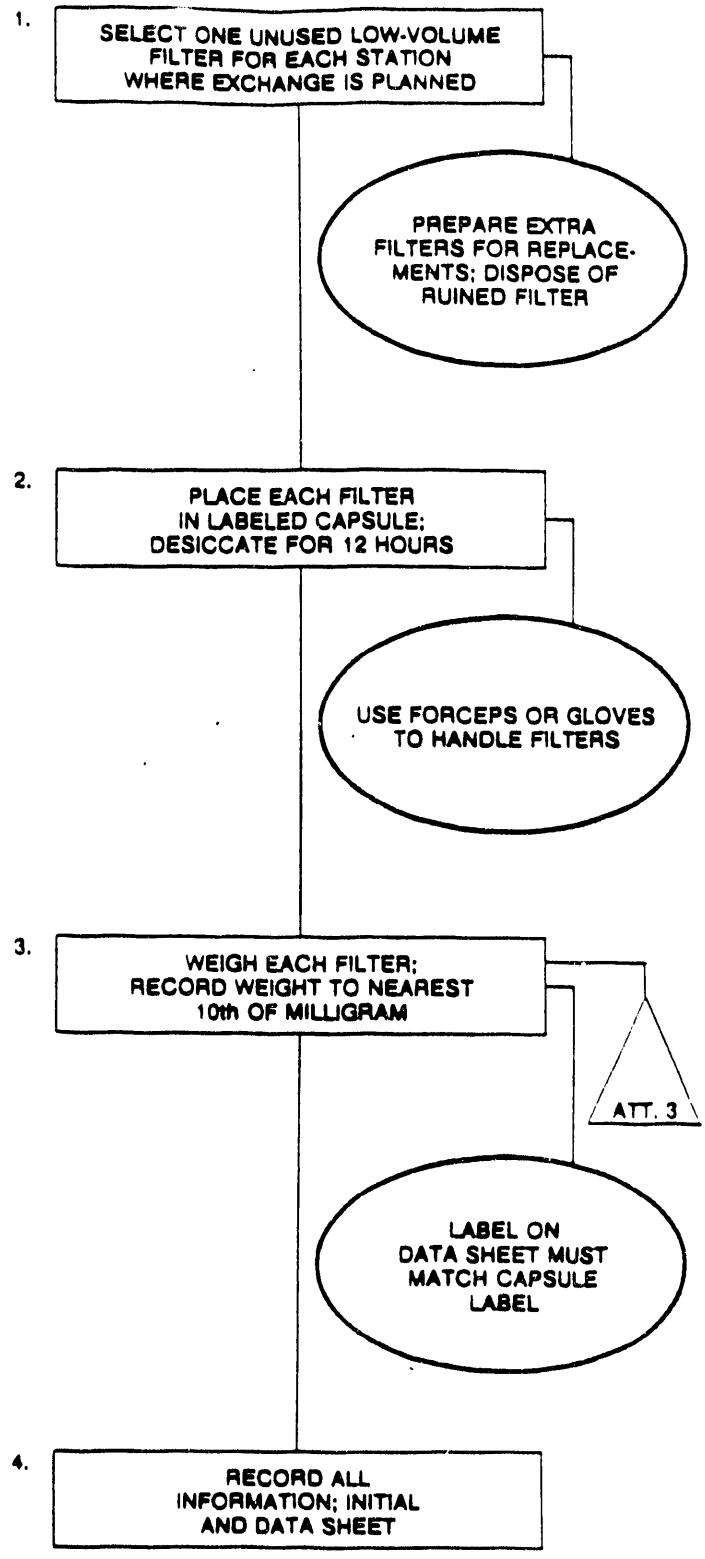
2. Place each filter in a labeled, uncovered filter-carrying capsule, and place in a desiccator for at least 12 hours.

   NOTE: Use forceps or gloves to handle filters. Do not touch with bare hands.

3. Weigh each filter and record its weight to the nearest tenth of a milligram on the Low-Volume Airborne Particulate Sampling Data Sheet (Attachment 3).

   NOTE: The label attached to the filter-carrying capsule shall match the Unique Identity Code label on the data sheet.

4. Record all required information on the matching data sheet; initial and date.



5.2 Filter Exchange

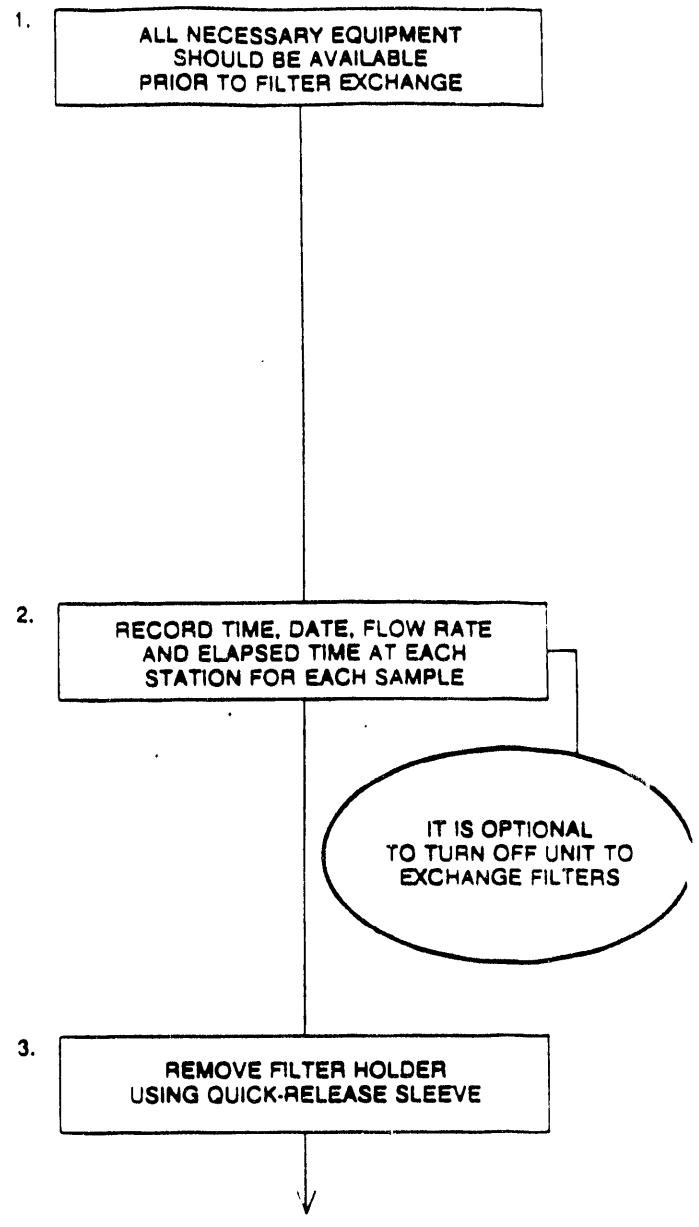
1. The following equipment and supplies shall be available prior to filter exchange:

   - o Data sheets for all stations at which filters will be exchanged;
   - o Filter-carrying capsules containing unused filters to be installed;
   - o Empty filter-carrying capsules to contain filters to be removed;
   - o Clean exhaust filters;
   - o Gloves (optional).

2. Record the time and date of retrieval, flow rate, and elapsed time on the data sheet for the particulate sample being retrieved from each low-volume sampling station.

   NOTE: It is optional to turn off the unit to exchange filters.

3. Filter holder is removed using the quick-release sleeve.



4. Carefully unscrew the retaining ring on the end of the filter holder, observing that the filter does not stick or tear. Remove the used sample filter and place in the labeled filter-carrying capsule.

NOTE: When necessary, wipe the filter holder and retaining ring with a clean, dry lint-free cloth, to remove any adhering particles.

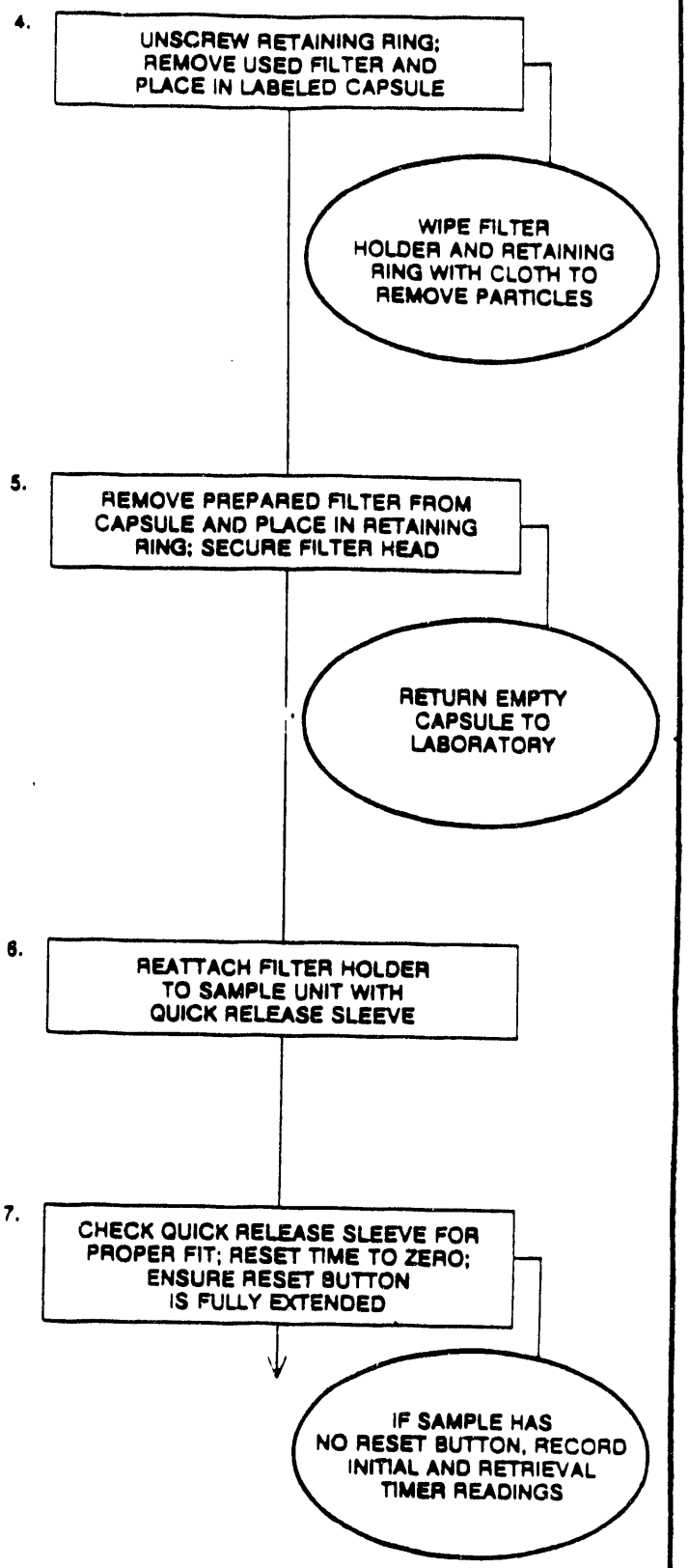
5. Remove the prepared filter from its filter-carrying capsule, and place into the retaining ring with the collision face out. Secure the filter in place with the filter head.

NOTE: Return the empty filter-carrying capsules with their labels to the laboratory storage area until the next filter exchange takes place.

6. Reattach the filter holder to the low-volume sample unit, using the quick-release sleeve.

7. Check the quick-release sleeve to ensure that the filter holder is firmly and properly attached to the sample unit, and reset the elapsed time to zero making sure reset button is fully extended.

NOTE: If sampler does not have elapsed time reset button, then record initial and retrieval timer readings.



8. The exhaust filter shall be replaced at least every third week.

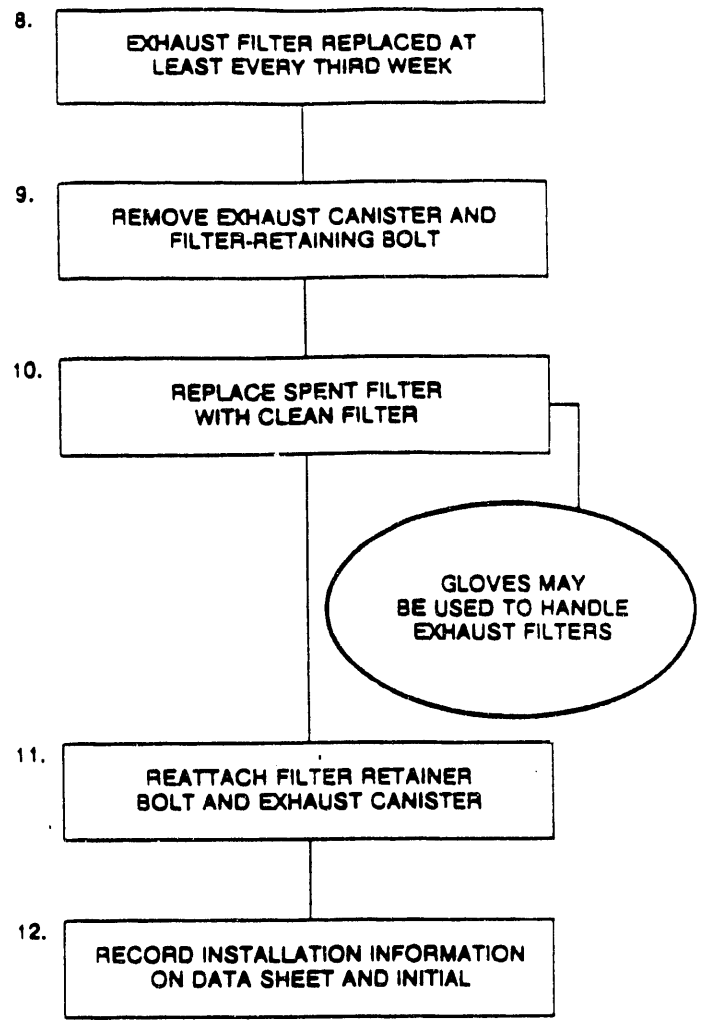
9. To replace filter, remove the exhaust canister and the filter-retaining bolt.

10. Replace the spent filters with new filters.

    NOTE: Gloves may be used to handle exhaust filters.

11. Reattach the filter-retaining bolt and the exhaust canister.

12. Record installation information on the data sheet and initial.



3 Post-Exchange Activities

Return exposed filters to the sample preparation laboratory as soon as possible after removal from the low-volume sampling units.

NOTE: Keep the samples in their filter-carrying capsules to protect them from excessive heat, moisture, or movement.

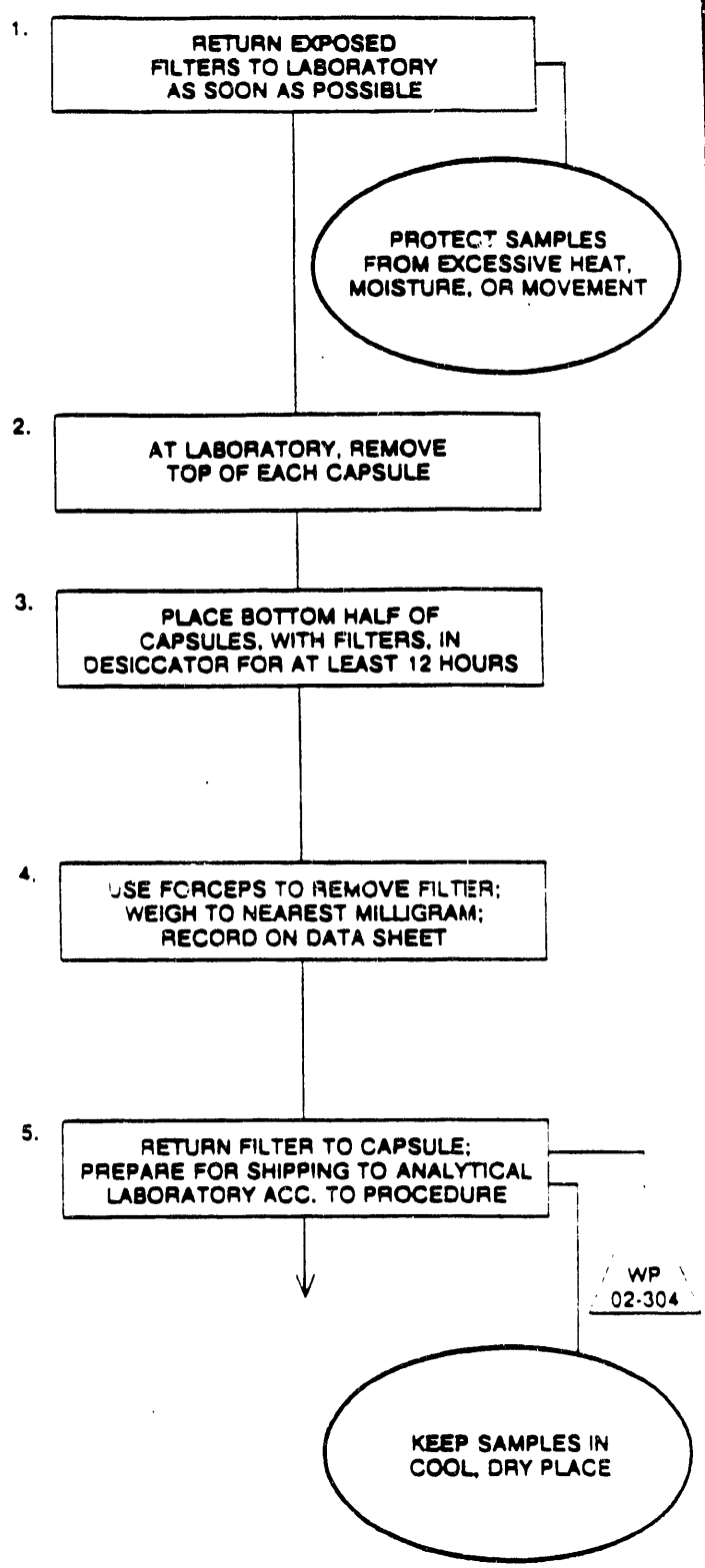
2. At the sample preparation laboratory, remove the top of each filter-carrying capsule.

3. Place the labeled bottom halves of the filter-carrying capsules, with filters, in a desiccator for at least 12 hours.

4. For each sample, use forceps to remove the filter from the capsule and weigh it to the nearest tenth of a milligram Record the weight on the data sheet for that sampler.

5. Return the sample filter to its labeled filter-carrying capsule. Package in a shipping container and send to the analytical laboratory, according to WP 02-304.

NOTE: Samples shall be maintained in a cool, dry place prior to shipment.



6. Record, initial, and date all required information on the data sheet.

7. Transmit samples to the analytical laboratory within three working days of collection.

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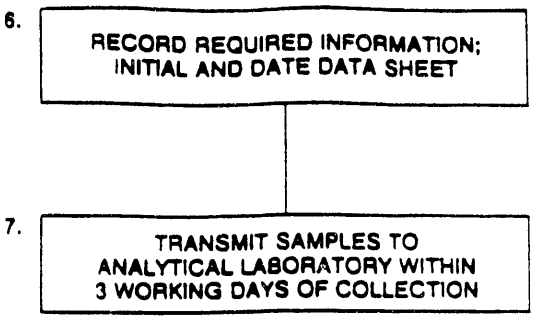

GLOSSARY OF TERMS
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Health Physics - The science concerned with the recognition, evaluation, and control of health hazards from ionizing and non-ionizing radiation.

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Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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Radiological Environmental Surveillance

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DIRECTIONS FOR COMPLETING LOW-VOLUME AIRBORNE PARTICULATE SAMPLING DATA SHEET

The following information applies to the completion of Low-Volume Airborne Particulate Sampling Data Sheets (Form WP-1227) as specified in the Low-Volume Airborne Particulate Sampling Procedures. An example of a completed Low-Volume Airborne Particulate Sampling Data Sheet/Procedure Completion Checklist is shown on pages 4 and 5 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to WP 02-303.
Sample Code Label	Unique identity code assigned to the sample referred to on the data sheet as per WP 02-303. Use a preprinted adhesive label when available.
Sample Specific Information:	
Blank Filter Weight (BFW)	Dry weight of filter, in milligrams, prior to installation.
By/Date	Initials of the person weighing the filter; date filter is weighed (month/day/year).
Loaded Filter Weight (LFW)	Dry weight of filter, in milligrams, after retrieval.
By/Date	Initials of the person weighing the filter; date filter is weighed (month/day/year).
Installation:	
Date	Date filter is installed in sampler unit (month/day/year).
Time	Approximate time samples are installed (24-hour clock).
Unit	Sampler unit identification number.
By	Initials of person performing installation.
Flow Rate	Flow rate in cubic feet per minute as it is read from the AFC-3 flow check instrument.

Item (Front of Sheet)	Description
Retrieval:	
Date/Time	Date filter is removed from sampler unit (month/day/year); time sample is removed (24-hour clock).
Elapsed Time	Machine elapsed time (in hours) which appears on elapsed timer on sampler unit.
Flow Rate	Flow rate (in cubic feet per minute) as it is read from the AFC-3 flow check instrument.
By	Initials of the person recording all retrieval information.
Status	Check one of the first three boxes indicating the sample status ("OK" indicates a normal sample) and check the fourth box to indicate that the PI has been notified of a non-normal sample status (notification is required for aborted samples).
Remarks	Information which may be pertinent to a non-normal status.
Calculations:	Calculations in this section are only to be performed when RADCOMP sample logging is not used or when the RADCOMP calculations are being verified.
Weight of Particulates	Difference between the loaded filter weight and the blank filter weight.
Volume of Air Sampled (VAS)	The product of the machine elapsed time and the conversion constant 3.396 m^3/hr.
PW per unit of air	The quotient obtained by dividing the weight of particulates by the volume of air sampled.
By/Date	Initials of the person who performed calculations; date (month/day/year) that calculations were performed.
Checked by/Date	Signature of PI or designated personnel who reviews/checks sample-specific information and calculations; date (month/day/year) review/check is performed.

Item (Back of Sheet)	Description
Item No.	The specific step listed in the Volume Airborne Particulate Sampling Instructions.
Completed	A check mark indicates that the step has been completed.
Comment	If any step was not performed, explain why it was not performed.

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LIST OF REVIEWERS

Procedure Number: WP 02-312

Revision Number: 0

Procedure Title: LOW-VOLUME AIRBORNE PARTICULATE SAMPLING PROCEDURES

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriquez	REPS
R. Youngman	QA

NO: 02-313 REV. 1 ISSUE DATE: 03/03/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: ENVIRONMENTAL RADIATION MONITORING PROCEDURES*

1.0 SCOPE

This document provides procedures for obtaining measurements of ambient gamma radiation from natural and man-made sources, using the Reuter-Stokes RSS-1012 Environmental Monitoring System. The equipment is used in the Radiological Environmental Surveillance (RES) Program conducted by the Radiological and Environmental Programs Section (REPS). The monitoring of ambient gamma radiation using the RSS-1012 will be conducted according to the procedures described in this document.

2.0 DEFINITIONS

Refer to Attachment 1.

3.0 REFERENCES

WP 02-301, Radiological Environmental Surveillance (RES) Implementation Procedures

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures

WP 02-303, RES Scheduling, Documentation, and Field Preparation Procedures

WP 02-304, RES Sample Tracking Procedures

WP 02-305, RES Data Management Procedures

WP 02-306, RES Equipment Maintenance and Control Procedures

Refer to Attachment 2.

4.0 GENERAL

For detailed information on the routine activation and operation of the RSS-1012, refer to the Reuter-Stokes Operational Manual for the RSS-1012 Environmental Monitoring System. A summary of directions for operation of the RSS-1012 is provided as Attachment 3.

The tasks defined by this procedure are to be implemented only by qualified personnel as described in Section 5.2 of WP 02-301.

Results of operability checks performed according to these procedures are recorded on an Operability Test Item Sheet (Form WP-1232, Attachment 4). Directions for completing Operability Test Item Sheets are provided in WP 02-306. After each procedure is completed, the appropriate area on the Procedure Completion Checklist is to be marked.

The following Environmental Radiation Monitoring procedures are discussed in this document:

5.1 System Checks
5.2 Daily Checks
5.3 Weekly Operability Checks
5.4 Monthly Operability Checks

*It should be noted that this procedure was issued previously as an instruction. WP 02-313 has undergone such extensive revision that changes will not be indicated singly.

5.0 PROCEDURE

System Checks

The following activities should be performed once a week on a random schedule.

1. Display date and time by depressing the "#" key and the number 1 on the 12-digit keyboard.

2. Display system voltages by depressing the "#" key and the number 4 on the 12-digit keyboard.

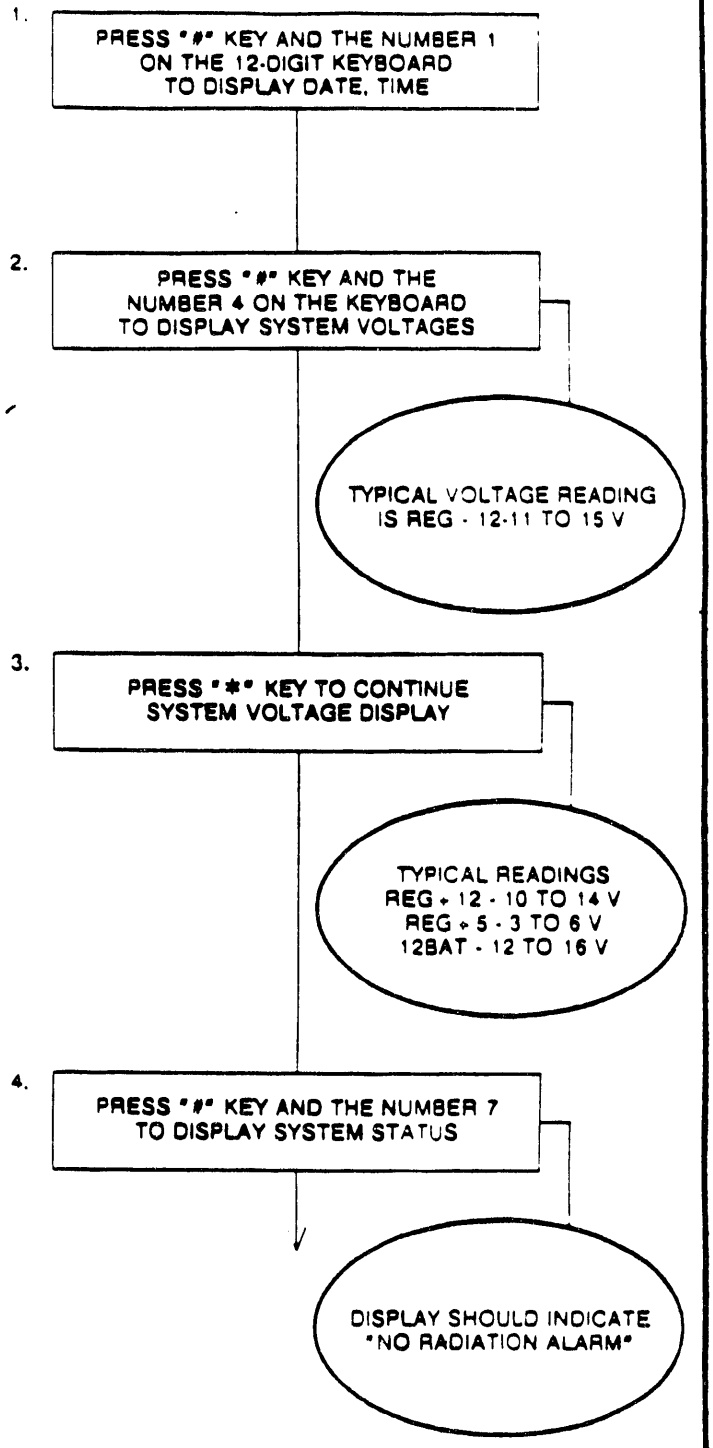
   NOTE: Typical voltage reading is: REG-12 - 11 to 15 V.

3. Depress the "*" key to continue displaying system voltages.

   NOTE: Typical voltage readings are as follows: REG+12 - 10 to 14 V; REG+5 - 3 to 6 V; 12BAT - 12 to 16 V.

4. Display system status by depressing the "#" key and the number 7 on the 12-digit keyboard.

   NOTE: Display should indicate "No Radiation Alarm."

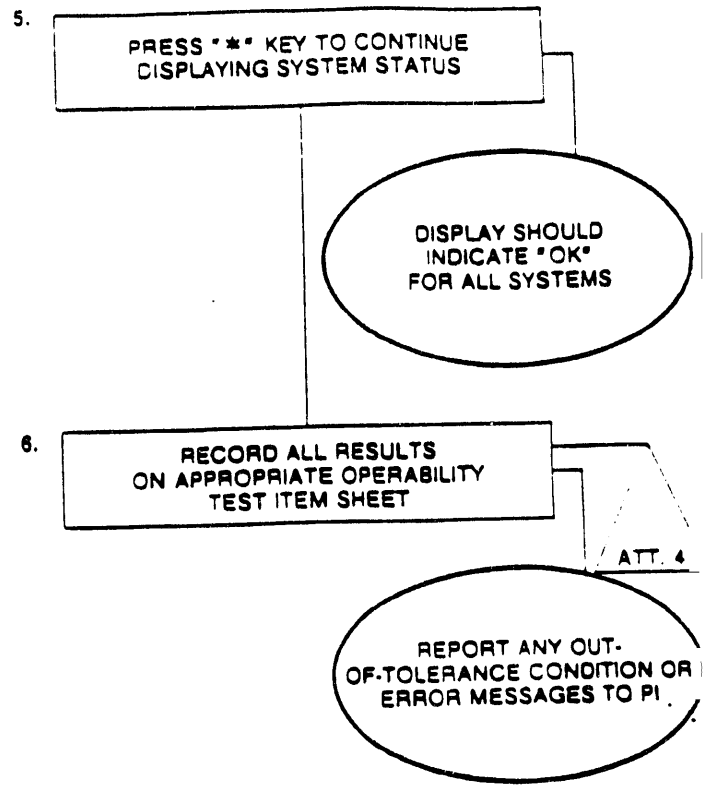


5. Depress the "*" key to continue displaying system status.

NOTE: Display should indicate "OK" status for all systems. See Section 2.2.8 for a list of possible indications.

6. Record the results of all operability checks on the appropriate Operability Test Item Sheet WP 1232 (Attachment 4).

NOTE: Report any out-of-tolerance conditions or error messages to the Principal Investigator (PI) as soon as possible. The PI will determine whether the out-of-tolerance condition constitutes a variance as defined in WIPP-02-302, Quality Assurance/Quality Control.

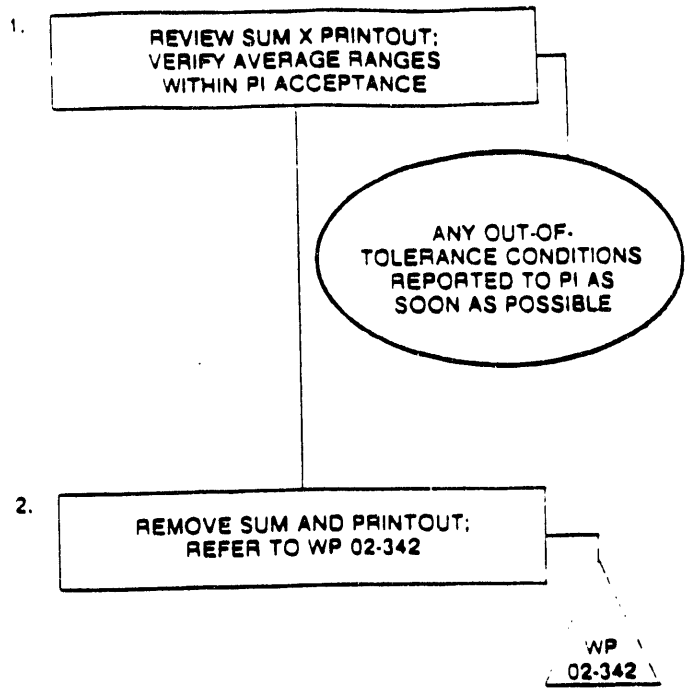


5.2 Daily Checks

1. At the air quality monitoring trailer, review the Sum X printout. Verify that hourly and daily averages are within an acceptable range as determined by the PI.

   NOTE: Any out-of-tolerance conditions should be reported to the PI as soon as possible. The PI will then determine whether the out-of-tolerance condition constitutes a variance as defined in WP 02-302.

2. Remove the Sum X printout; refer to WP 02-342 for instructions on handling and disposition of the printout.



5.3 Weekly Operability Checks

The following activities should be performed once each week on a random schedule.

1. Compare the digital reading on the RSS-1012 display with the value recorded on the strip chart to check for value agreement within 0.5 uR/hr.

2. If the values agree to within 0.5 uR/hr., initial the strip chart and record the date and time.

3. If the values do not agree to within 0.5 uR/hr., notify the PI to initiate the appropriate maintenance or calibration action.

4. Compare the digital reading on the RSS-1012 display with the value listed on the Sum X printout to check for value agreement within 0.5 uR/hr.

5. If the values agree to within 0.5 uR/hr., initial the Sum X printout and record the date and time.

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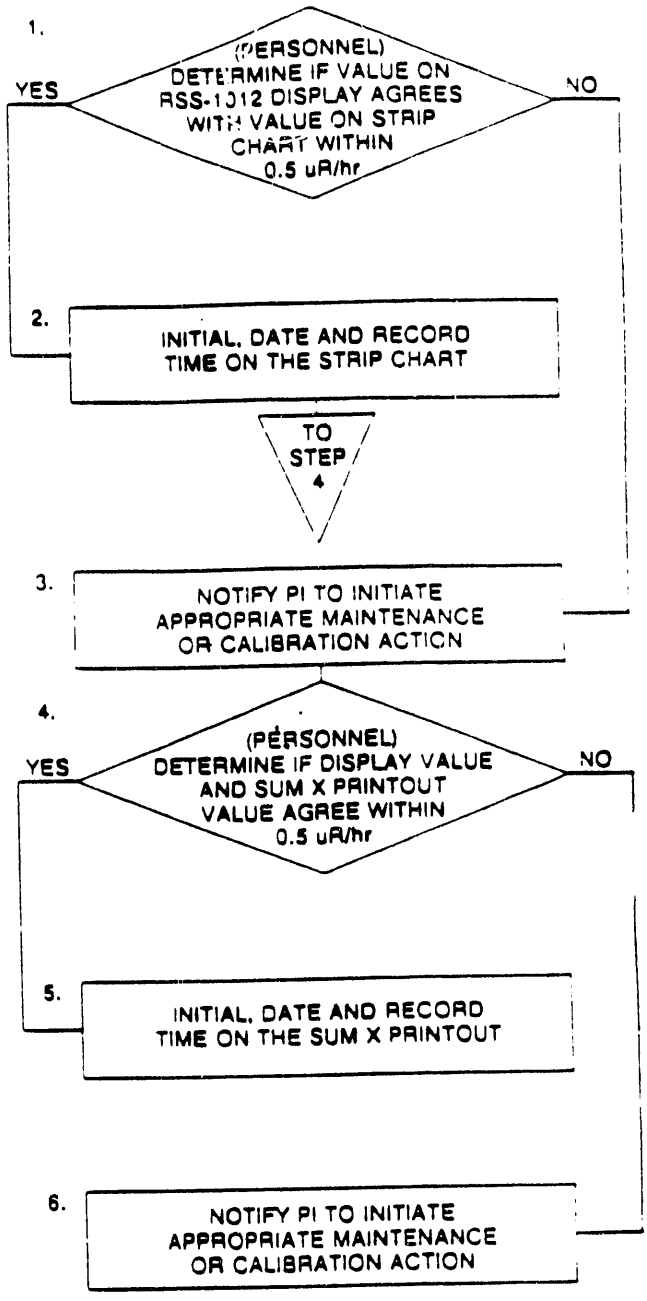

5.4 Monthly Operability Checks

The following steps are to be performed once a month in addition to the weekly checks described in Section 5.3.

1. Place a certified NBS traceable radiation check source, specified by PI, on the ion chamber.

2. Compare readings on the RSS-1012 display, the Sum X printout, and the strip chart recorder.

   NOTE: All readings should be within two percent of the check source. If not, notify the PI as soon as possible.

3. Exchange the strip chart paper according to the directions listed in Attachment 5.

4. Affix Unique Identification Code label to the strip chart roll (WP 02-303). Complete a chain-of-custody form (WP-1178, Attachment 6) unless directed otherwise by the PI.

5. Archive the strip chart roll by filing in appropriate section of REPS files for turnover to MRC.

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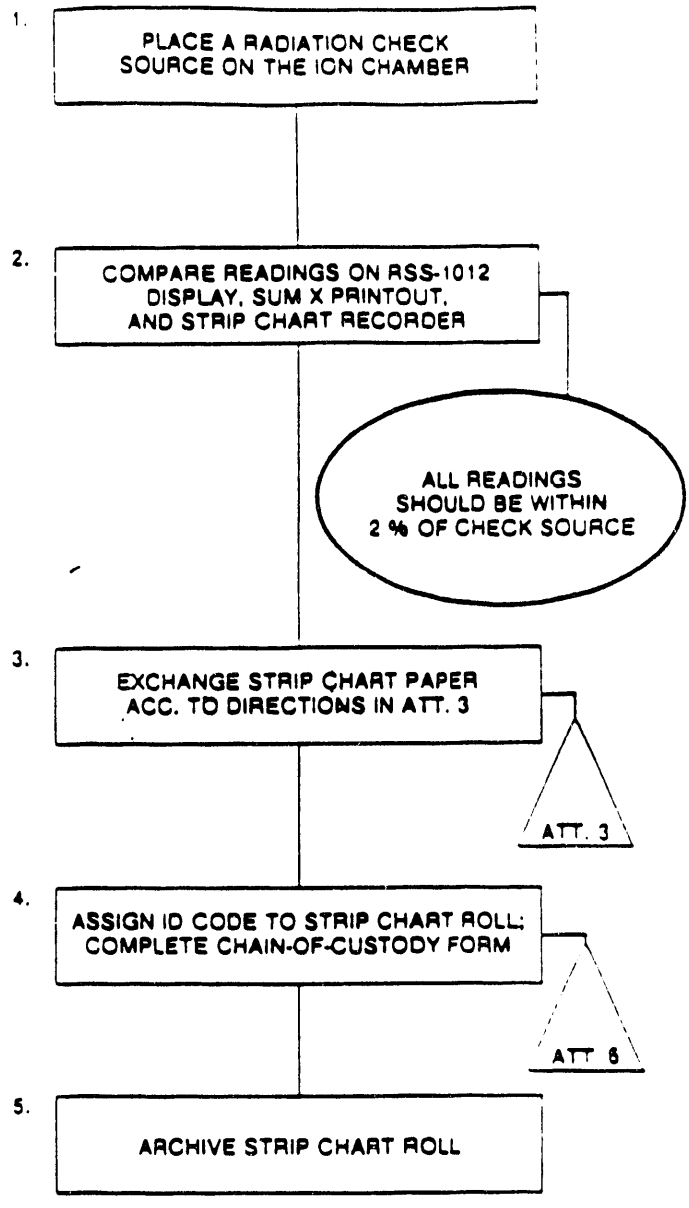

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Monitoring - The accurate quantification of a representative sample of radionuclides in the environmental media being evaluated by generation of a signal representing the radionuclides of interest.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

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Sensitivity - The minimum amount of a radionuclide that can repeatedly be detected by an instrument.

Spiked Sample - A sample to which a known amount of radioactive material has been added. Generally, spiked samples are submitted as unknowns to the analysts.

Split Sample - A homogeneous sample that is divided into parts, each of which is analyzed independently by separate laboratory organizations.

Thermoluminescent Dosimeter - A device used to detect and measure penetrating radiation. A typical thermoluminescent dosimeter (TLD) is composed of multiple thermoluminescent chips sealed in a small packet.

Unique Identity Code (UIC) - A specific alphanumeric number used to individually identify each sample.

Variability - A general term for the dispersion of values in a data set.

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SUMMARY OF DIRECTIONS FOR REUTER-STOKES ENVIRONMENTAL MONITORING SYSTEM RSS-1012

1.0 GENERAL OPERATION

To activate the RSS-1012 system, refer to the Reuter-Stokes Operational Manual for the RSS-1012 Environmental Monitoring System.

For continuous reading of the radiation field, the system provides a "default" display. This display automatically appears two minutes after the last keyboard depression. The right half of the display shows the current radiation reading, which is updated at five second intervals. The left half of the display shows the current time in hours and minutes. If any system abnormalities appear, the time will be replaced by a message telling the operator that some item requires attention (refer to RSS-1012 Operational Manual).

To use the remote electronics, select a function using the 12-digit keyboard and observe the response on the liquid crystal display. There are 10 functions available with the system. To initiate a function, depress the "#" key followed by the function number. The functions are as follows:

0 Set date and time
1 Display date and time
2 Display radiation data
3 Reset integrator
4 Display system voltages
5 Display wind set data (not used)
6 Reset system
7 System status
8 Set radiation alarm level
9 System self-test

Most functions require the display of more than one parameter, such as display of the date followed by time. In order to step through each of the parameters, the "*" key is used.

The following sections describe the functions that may be used in daily operation. For details on those parameters not discussed below, refer to the Operational Manual.

2.0 SPECIFIC DIRECTIONS

2.1 Setting Date and Time

(1) Press "#0".

(2) Enter the month and day as a 4-digit number (e.g., May 9 would be 0509). Press "*".

(3) Enter the year as a 4-digit number (e.g., 1986). Press "*".

(4) Enter the time in 24-hour format (e.g., 2:05 pm would be 1405). Press "*".

(5) As an example, the following steps are required to enter a date and time of May 9, 1986 at 2:05 p.m.:

#0
0509
*
1986
*
1405
*

2.2 Displaying Date and Time

(1) Press "#1" to display the current date in a month, day, and year format. Months are abbreviated to three letters.

(2) Press "*" to display the current time (24-hour format) in hours and minutes.

2.3 Displaying Radiation Data

(1) Press "#2" to display the current dose rate in units of uR/hr.

(2) Press "*" to display the second number, the integrated dose expressed as uR, mR, or R, depending on the total dose.

(3) Press "*" to display the integration time. This corresponds to the amount of time (in hours) that the above dose has been accumulated.

(4) Press "*" to display the current radiation alarm level. If no alarm level has been set, 0 uR/hr. will be indicated.

2.4 Resetting Integrator

(1) Press "#3" to reset the integrator.

NOTE: To prevent the accidental resetting of the integrator, a password must be entered in order to begin the function.

2.5 Displaying System Voltages

(1) Press "#4" to verify that the system power suppliers are operating properly.

NOTE: This function allows the display of all regulated power supplies as well as the 12-V battery voltage.

2.6 System Reset

(1) Press "#6" to reset the entire system to its initial state.

NOTE: Executing this function resets all data integrators and timers to zero, and clears all system error flags. To assure that the function is not activated accidentally, the password must also be entered to complete the execution.

2.7 Checking System Status

(1) Press "#7" to indicate abnormal conditions, i.e., system errors, radiation level exceeding the alarm level.

NOTE: Examples of error messages include Radiation Alarm, A/D Error, CPU Error, Comm. Port Error, 12-Volt Battery Low, and AC Power Low.

2.8 Setting Radiation Alarm

(1) Press "#8" to set radiation alarm level.

NOTE: The alarm level is set in mR/hr. with a minimum level of 10 uR/hr. and a maximum level of 99.99 mR/hr.

(2) Enter password, then all four digits of the alarm level (including zeros). For example, 20 uR/hr. must be entered as 0002.

Operability Test Item Sheet (OTIS)

Item I.D.# CL 75-CE-0325 Description Environmental Rad. Monitor (PIC)

Date	Operability Check	FQ	Performed by	Expected/Observed	Tolerance	Pass	Fail	Corrective Action	Status
	Sum-X Printout	D		7.5 uR/h (5 min. avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (Daily Avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (5 min. avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (Daily Avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (5 min. avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (Daily Avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (5 min. avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (Daily Avg.)	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (5 min. avg.	± 3 uR/h				
	Sum-X Printout	D		7.5 uR/h (Daily Avg.)	± 3 uR/h				

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OPERABILITY TEST ITEM SHEET

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Operability Test Item Sheet (OTIS)

Item I.D.# CL 75-CE-0325 Description Environmental Rad. Monitor (PIC)

Date	Operability Check	FQ	Performed by	Expected/Observed	Tolerance	Pass	Fail	Corrective Action	Status
	Comp. Digital Sum X Reading	W		7.5 uR/h	±0.5 mR/h				
	Comp. Digital Strip Chart	W		Identical	±0.5 mR/h				
	System Reg 12 Volt (#4)	W		13 V	± 2 V				
	System Reg 5 Volt (*)	W		4.5 V	± 1.5 V				
	System 12 BAT Volt (*)	W		13.5 V	± 1.5 V				
	System (#7) Status	W		No Alarm	None				
	System (*) Status	W		OK	None				
	Comp. Digital Sum X Reading	W		7.5 uR/h	±0.5 mR/h				
	Comp. Digital Strip Chart	W		Identical	±0.5 mR/h				
	System Reg 12 Volt (#4)	W		13 V	± 2 V				
	System Reg 5 Volt (*)	W		4.5 V	± 1.5 V				
	System 12 BAT Volt (*)	W		13.5 V	± 1.5 V				
	System (#7) Status	W		No Alarm	None				
	System (*) Status	W		OK	None				

Operability Test Item Sheet (OTIS)

Item I.D.# CL 75-02-0325

Description Environmental Radiation Monitor (PIC)

Date	Operability Check	FQ	Performed By	Expected/Observed	Tolerance	Pass	Fail	Corrective Action	Status
	RAD Source Check Display	M		70 uR/hr	± 4 uR/hr				
	RAD Source Check Strip	M		70 uR/hr	± 4 uR/hr				
	RAD Source Check Sum X	M		70 uR/hr	± 4 uR/hr				
	Cal Due Date	M			Overdue				
	RAD Source Check Display	M		70 uR/hr	± 4 uR/hr				
	RAD Source Check Strip	M		70 uR/hr	± 4 uR/hr				
	RAD Source Check Sum X	M		70 uR/hr	± 4 uR/hr				
	Cal Due Date	M			Overdue				
	RAD Source Check Display	M		70 uR/hr	± 4 uR/hr				
	RAD Source Check Strip	M		70 uR/hr	± 4 uR/hr				
	RAD Source Check Sum X	M		70 uR/hr	± 4 uR/hr				
	Cal Due Date	M			Overdue				

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Operability Test Item Sheet (OTIS)

Item I.D.# CL 75-CE-0325 Description Environmental Rad. Monitor (PIC)

Date	Operability Check	FQ	Performed by	Expected/Observed	Tolerance	Pass	Fail	Corrective Action	Status
	Radium Source Check Display	S		405 uR/hr	± 20 uR/hr				
	Radium Source Check Strip	S		405 uR/hr	± 20 uR/hr				
	Radium Source Check Sum X	S		405 uR/hr	± 20 uR/hr				
	Cobalt60 Source Check Display	S		70 uR/hr	± 4 uR/hr				
	Cobalt60 Source Check Strip	S		70 uR/hr	± 4 uR/hr				
	Cobalt60 Source Check Sum X	S		70 uR/hr	± 4 uR/hr				
	Radium Source Check Display	S		405 uR/hr	± 20 uR/hr				
	Radium Source Check Strip	S		405 uR/hr	± 20 uR/hr				
	Radium Source Check Sum X	S		405 uR/hr	± 20 uR/hr				
	Cobalt60 Source Check Display	S		70 uR/hr	± 4 uR/hr				
	Cobalt60 Source Check Strip	S		70 uR/hr	± 4 uR/hr				
	Cobalt60 Source Check Sum X	S		70 uR/hr	± 4 uR/hr				

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Operability Test Item Sheet (OTIS)

Item I.D.# CL 75-CE-0325 Description Environmental Radiation Monitor (PIC)

Date	Operability Check	FQ	Performed by	Expected/Observed	Tolerance	Pass	Fail	Corrective Action	Status
	Function 9 System Self Test	A		Test #1					
	"	A		Test #2					
	"	A		Test #3					
	"	A		Test #4					
	"	A		Test #6					
	"	A		Test #7					
	"	A		Test #8					
	Function 9 System Self Test	A		Test #1					
	"	A		Test #2					
	"	A		Test #3					
	"	A		Test #4					
	"	A		Test #6					
	"	A		Test #7					
	"	A		Test #8					

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DIRECTIONS FOR EXCHANGING STRIP CHART PAPER

1.0 GENERAL

The strip chart recorder is part of the RSS-1012 electronics package. Standard paper speed is one inch per hour plus or minus two percent. At standard speed, a chart should record data for approximately 30 days.

2.0 SPECIFIC DIRECTIONS

(1) To load the strip chart recorder paper, open the recorder, unlatch the retaining clips and chassis latch, and remove supply roller and takeup rollers.

(2) Slide the supply roller into a full role of chart paper, with the roller shoulder nearest the paper perforations.

(3) Unroll about 12 inches of paper and slide the paper (back side up) between the side plate and latch, steering the paper against the drum to clear the pointer.

(4) Engage the paper perforations into a drum sprocket and drop the roll into the seeding notches.

(5) Slide the cardboard sleeve onto the takeup roller, placing the paper against the disc and taping an end of the paper to the sleeve.

(6) Turn the sleeve one revolution, and check for proper paper alignment.

(7) Tightly roll the paper and straighten it on the takeup roller. Keep the paper taut while dropping the roller into the deeper notch, engaging the gear.

(8) Close the retaining clips and snap up the chassis latch. Close the recorder and advance the paper by depressing and turning the chart recorder advance wheel on the front panel.

CHAIN-OF-CUSTODY RECORD

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE ELECTRIC CORP.
P. O. BOX 2078
CARLSBAD, NM 88221-2078

C/C Control No 00603

R/A Control No _____

SAMPLING PROGRAM _____

SAMPLE TEAM MEMBERS _____

LAB DESTINATION _____

CARRIER/WAYBILL NO. _____

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No.

Special Instructions: _____

Possible Sample Hazards: _____

SIGNATURES (Name, Company, Date and Time)

1 Relinquished By _____

Received By: _____

2 Relinquished By _____

Received By _____

3 Relinquished By: _____

Received By: _____

4. Relinquished By: _____

Received By _____

WHITE To accompany samples
YELLOW Field Copy
PINK Other

WP 11/8 16 861

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LIST OF REVIEWERS

Procedure Number: WP 02-313

Revision Number: 0

Procedure Title: Environmental Radiation Monitoring Procedures

Reviewer's Name	Department
T. Fischer	REPS
J. Cockman	REPS
A. Rodriguez	REPS
R. Kehrman	REPS
R. Youngman	QA

NO: 02-330 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NONRADIOLOGICAL ENVIRONMENTAL SURVEILLANCE (NES) IMPLEMENTATION PROCEDURE

1.0 SCOPE

This procedure defines and delineates the programmatic responsibilities for performance of Nonradiological Environmental Surveillance (NES) by the Radiological and Environmental Programs Section (REPS) of the Safety, Security, and Environmental Protection Department. The NES Program is conducted to monitor nonradiological environmental parameters and to perform specific environmental studies as required by the WIPP mission.

2.0 DEFINITIONS

Accuracy - A qualitative concept in the statistical treatment of measurement data used to describe the agreement between the central tendency of a set of numbers and their correct value (or the accepted reference value). It is also used to describe the agreement between an individual value and the correct value (or the accepted reference value).

Archived Sample - A representative sample which is placed into storage for an unspecified period of time. This sample may or may not be analyzed at some future date.

Calibration - The process of determining the numerical relationship between the observed output of a measurement system and the value, based on reference standards, of the characteristics being measured.

Continuous Sampling - Both noninterrupted sampling and repetitive sequential collection of a small sample obtained automatically at intervals short enough to yield a representative sample for the entire sampling period.

Effluent - The liquid or gaseous waste streams released to the environment.

Monitoring - The accurate quantification of a representative sample of biota in the environment being evaluated routinely over time.

Nonroutine - An activity performed rarely or not at predetermined intervals.

Offsite - Any location beyond the site boundary where a member of the public can be legally situated beyond the control of the owner and operator of the facility.

Onsite - Location within a facility that is controlled with respect to access by the general public.

Precision - A qualitative concept in the statistical treatment of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

Quality Assurance - All planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Control - Those quality assurance actions that provide a means to control and measure the characteristics of systems and processes to established requirements. Thus, quality assurance includes quality control.

Readout - The device that conveys information regarding the measurement to the user.

Reference Test Material - A large batch of homogeneous material from which aliquots may be taken for interlaboratory comparisons or for internal use by the laboratory. The material must be uniform but need not be standardized.

Representative Sample - A sample with the same quality and characteristics as its source at the time of sampling.

Routine - An activity which is repeated at predetermined intervals.

Split Sample - A homogeneous sample that is divided into parts, each of which may be analyzed independently by separate laboratory organizations, or archived.

Variability - A general term for the dispersion of values in a data set.

3.0 REFERENCES

American Conference of Governmental Industrial Hygienists. Air Sampling Instruments for Evaluation of Atmospheric Contaminants, Current Edition.

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U.S. Code of Federal Regulations. Title 40, Part 142, "EPA National Interim Primary Drinking Water Regulations Implementation," Washington, D.C.

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4.0 GENERAL

Nonradiological environmental surveillance for the Waste Isolation Pilot Plant began in 1975 with the general site environmental characterization studies by Sandia National Laboratories. In particular, the WIPP Biology Program (1975-1982) combined scientific and technical expertise of researchers from six universities to develop an extensive baseline of information describing the major components of the Los Medanos Ecosystem prior to the initiation of construction activities.

In 1984, NES activities at WIPP were resumed as the Ecological Monitoring Program (EMP), which is part of the Management and Operating Contract. The principal functions of the EMP are:

- To detect and quantify the impacts of construction and operational activities at the WIPP on the surrounding ecosystem
- To continue the development of the ecological data base for the Los Medanos Ecosystem initiated by the WIPP Biology Program
- To aid in the investigation of unusual and unexpected elements in the ecological and radiological data bases
- To provide environmental data which are important to the mission of the WIPP Project, but which have not or will not be acquired by other programs.

The following procedures are included in this document:

5.1 Organizational Responsibilities
5.2 NES Personnel Training and Qualification
5.3 NES Reporting
5.4 NES Records/Document Control
5.5 Calibration of NES Equipment
5.6 Procurement
5.7 NES Planning and Scheduling
5.8 NES Procedures

5.0 PROCEDURES

Organizational Responsibilities

1. The manager of the Radiological and Environmental Programs Section (REPS) has the responsibility for the overall design and implementation of NES, including but not limited to the following areas:

   - o Approval of specific instructions for the conduct of all NES activities
   - o Establishment of minimum qualification criteria and training requirements for all program personnel
   - o Review and approval of programmatic reports
   - o Oversight of appropriate levels of interaction with outside organizations, agencies, and institutions
   - o Assuring that all NES activities are conducted in accordance with applicable WIPP procedures.

1. MANAGER OF REPS ASSUMES ALL APPROPRIATE RESPONSIBILITY FOR DESIGN, IMPLEMENTATION OF NES



2. The REPS Manager appoints an NES Principal Investigator (PI), whose responsibilities may include but are not limited to the following activities:

- o Direction of NES per written approved instructions
- o Initiation and review of programmatic plans, procedures, and/or instructions
- o Review and evaluation of sample data
- o Preparation and review of programmatic reports
- o Assurance that appropriate samples are collected and analyzed
- o Assurance that adequate technical support is provided to the Quality Assurance (QA) Department during audits and overviews of NES activities.

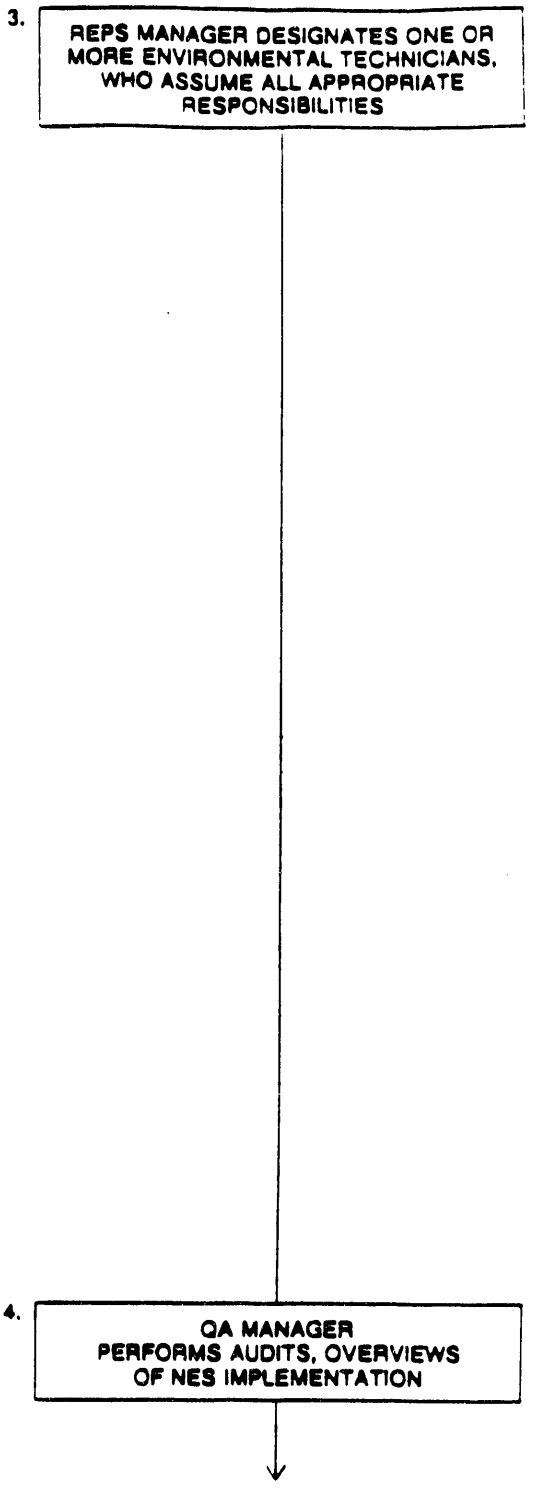
2. REPS MANAGER APPOINTS NES PI WHO ASSUMES ALL APPROPRIATE RESPONSIBILITIES



3. The REPS Manager designates one or more Environmental Scientist/Engineer, or Environmental Technician whose responsibilities include but are not limited to the following items:

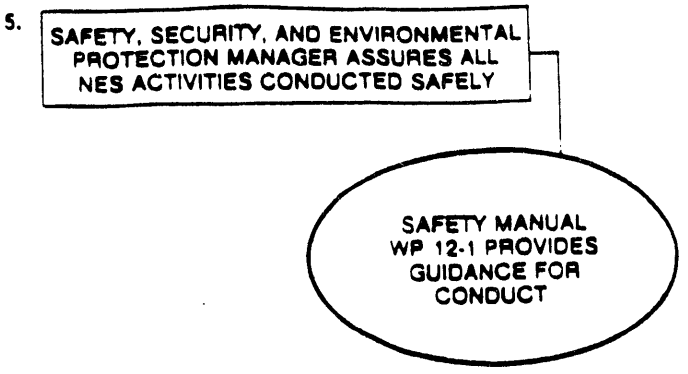
   - o Collection and subsequent distribution of samples
   - o Preparation and maintenance of appropriate data sheets and sample tracking documentation
   - o Monitoring of equipment operability status
   - o Reporting of equipment malfunctions
   - o Reporting of nonconformances to the PI or REPS Manager and QA Department
   - o Initiating Quality Control (QC) checks of data
   - o Conducting field activities in accordance with written instructions
   - o Safe conduct of laboratory activities.

4. The QA Manager or designee performs audits and overviews of NES activities according to the WIPP Quality Program Manual.



5. The Safety, Security, and Environmental Protection Manager or designee assures that all NES activities are conducted in a safe manner.

NOTE: Safety Manual WP 12-1 provides guidance for conduct of safe operations at WIPP.

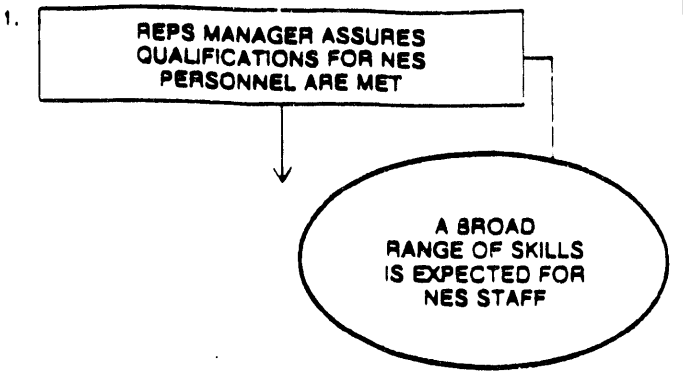


5.2 NES Personnel Training and Qualifications

1. The REPS Manager assures that qualifications for NES personnel are met. The following are representative of the essential levels of qualification required for NES personnel.

NOTE: A spectrum of expertise ranging above these basic qualifications would be expected among NES staff.

- o PI: Technical capabilities and expertise in Ecology, Environmental Science or related field (M.S. degree preferred), and 3 to 5 years experience directly related to NES activities; the ability to understand, analyze, and report environmental data; the ability to effectively supervise the personnel conducting all phases of NES activities; the ability to respond effectively to regulatory issues in a timely manner. The PI should be cognizant of applicable state and federal regulations, and should possess experience in QA/QC activities.



- Environmental Scientist (Sr. Level): Technical expertise in ecology/ environmental sciences (M.S. degree and 3 to 5 years experience preferred); ability to quickly evaluate indicated environmental impacts; demonstrated background in statistical evaluation of sampling programs and analytical results; experience in preparing, editing, and presenting technical papers.

- Environmental Scientist/ Engineer (Entry Level): Technical capabilities in environmental sciences (B.S. degree and 2 to 4 years experience preferred); understanding of analytical techniques; good communication and organizational skills.

- Environmental Technician: High school diploma or equivalent, with 2 years field experience preferred; capability to learn a wide variety of tasks; ability to work reliably and efficiently with little or no supervision after receiving training; demonstrated manual dexterity applicable to handling various types of mechanical equipment.

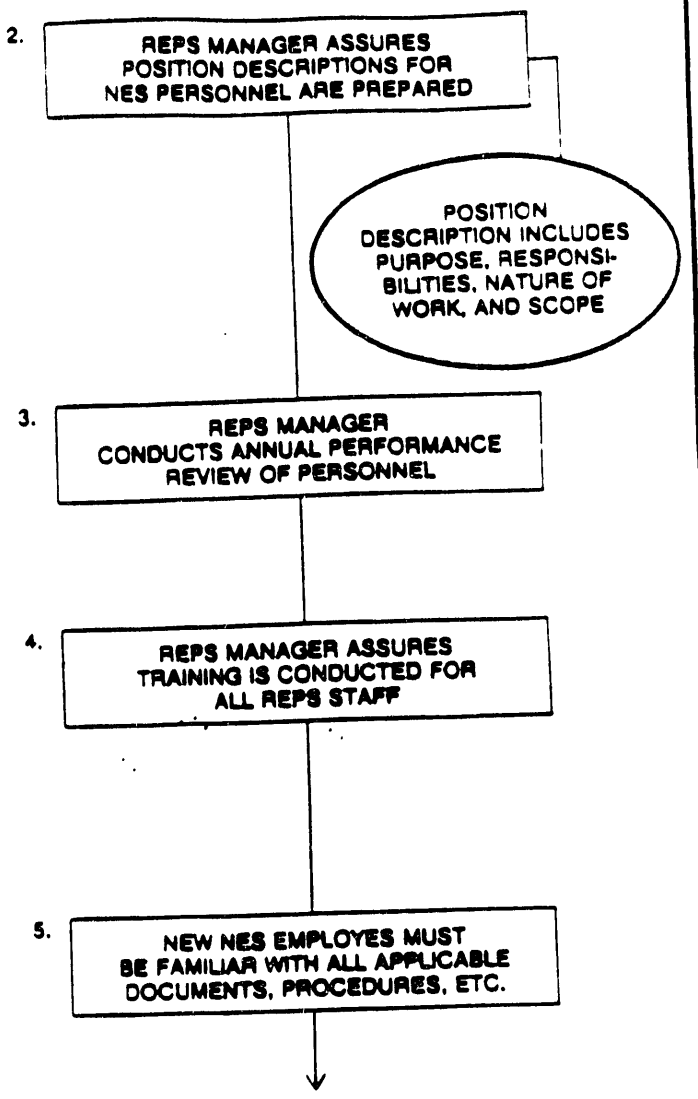
2. The REPS Manager assures that position descriptions for assigned NES personnel are prepared.

   NOTE: Each position description should include position purpose, principal responsibilities, nature of work, and scope.

3. The REPS Manager conducts an annual performance review of personnel according to established guidelines for personnel review.

4. The REPS Manager and/or the PI assures that training is conducted in order to maintain acceptable levels of proficiency for new, temporary and permanent REPS staff commensurate with the level of assigned responsibilities.

5. New NES employes shall be required to review pertinent program documentation, and shall become familiar with applicable procedures prior to undertaking an assigned task.



6. A training record (i.e., letter-to-file) shall be prepared by a REPS Manager or cognizant NES personnel responsible for employe training or retraining.

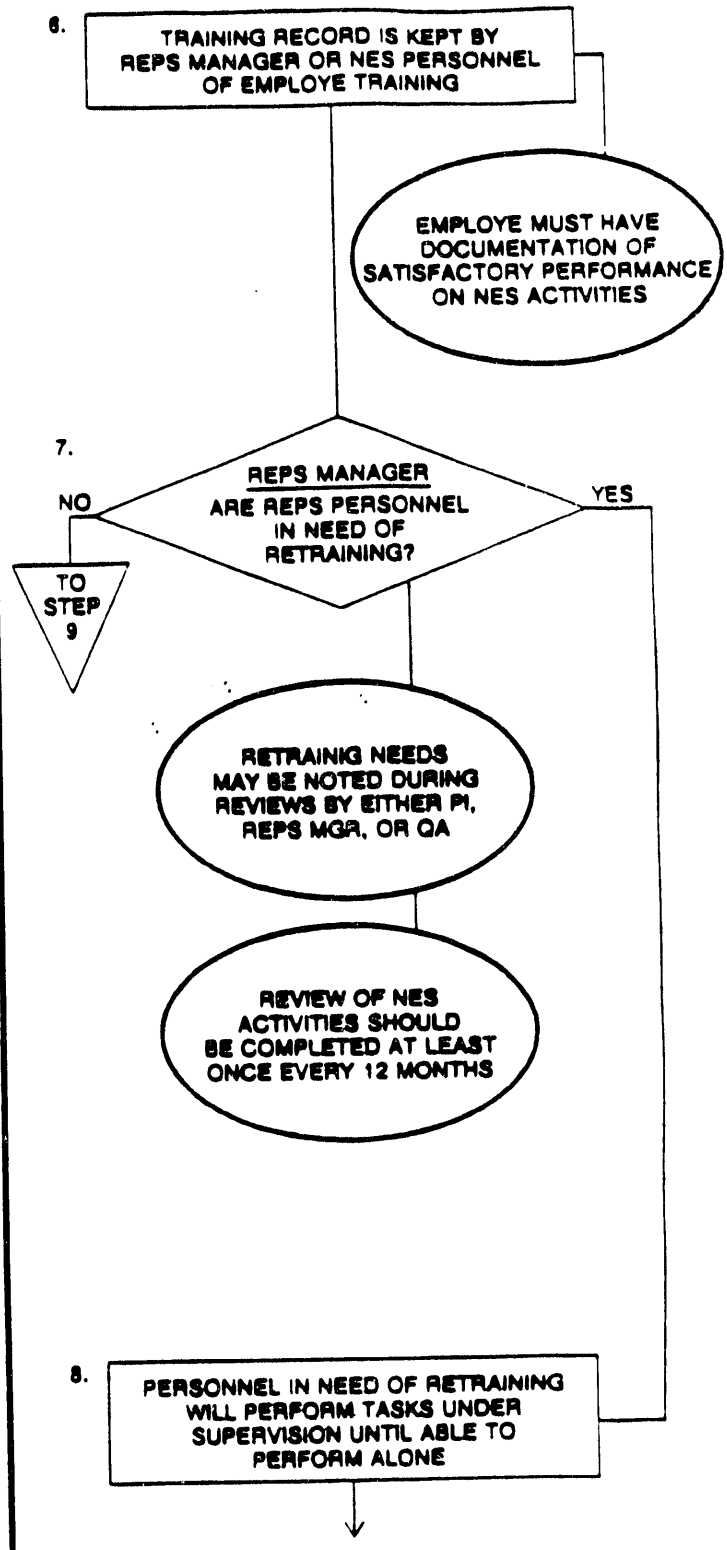
NOTE: No NES employe shall be allowed to conduct an unsupervised NES activity without documentation of prior training in the activity as given by the PI or designee, or as demonstrated through knowledge of previous experience.

7. The REPS Manager and/or the PI have the responsibility to determine the need for retraining of REPS personnel.

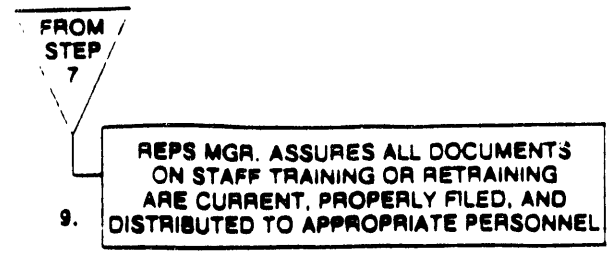
NOTE: Indication of a need for retraining may be noted (1) during a review initiated by the PI or REPS Manager; or (2) by QA, during any overview or audit.

NOTE: A review of the conduct of all NES activities by REPS internal review should be completed and documented at least once during any calendar year.

8. Personnel in need of retraining will perform tasks under supervision of the PI or designee until their ability to perform assigned tasks is demonstrated to the satisfaction of the PI or designee. Retraining will be documented in a training record.



9. The REPS Manager shall assure that all documents detailing all staff training or re-training are up to date and properly filed and distributed to appropriate personnel.



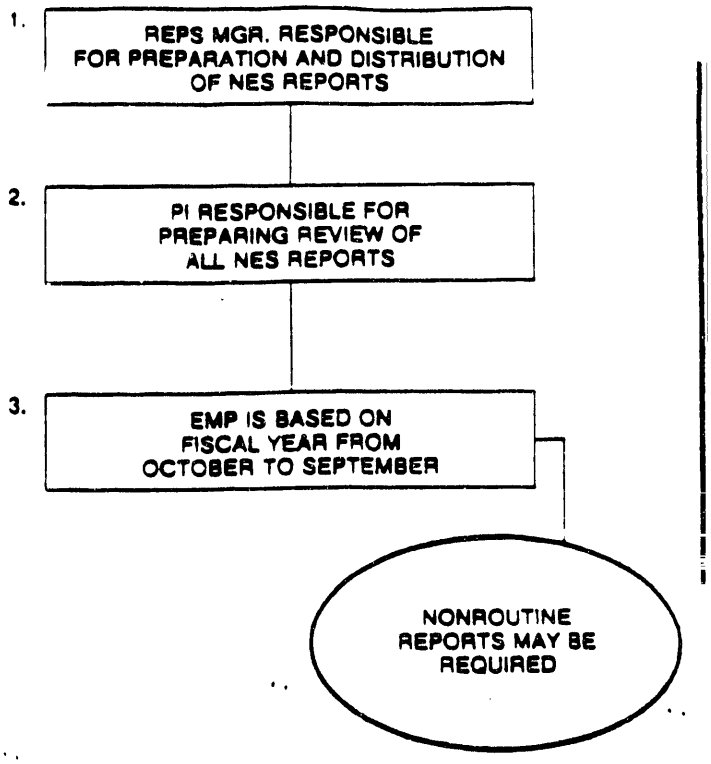
5.3 NES Reporting

1. The REPS Manager is responsible for preparation and distribution of NES reports.

2. The PI is responsible for coordinating the preparation and review of routine and nonroutine NES reports.

3. The Ecological Monitoring Program (EMP) Annual Report is the only routinely produced report. It is based on the fiscal year from October through September (FY Oct.-Sept.) and reports routinely collected NES data for each fiscal year.

NOTE: Nonroutine reports may be required as a result of unusual operational occurrences or in support of specific regulatory activities at the direction of the REPS Manager.



NES Records/Document Control

1. NES records are administered by the REPS Manager in accordance with WP 15-030.

2. Records (such as reports of analyses, sample receipt forms, etc.) transmitted to REPS by a contract analytical laboratory shall be dated upon receipt and a copy made for subsequent review.

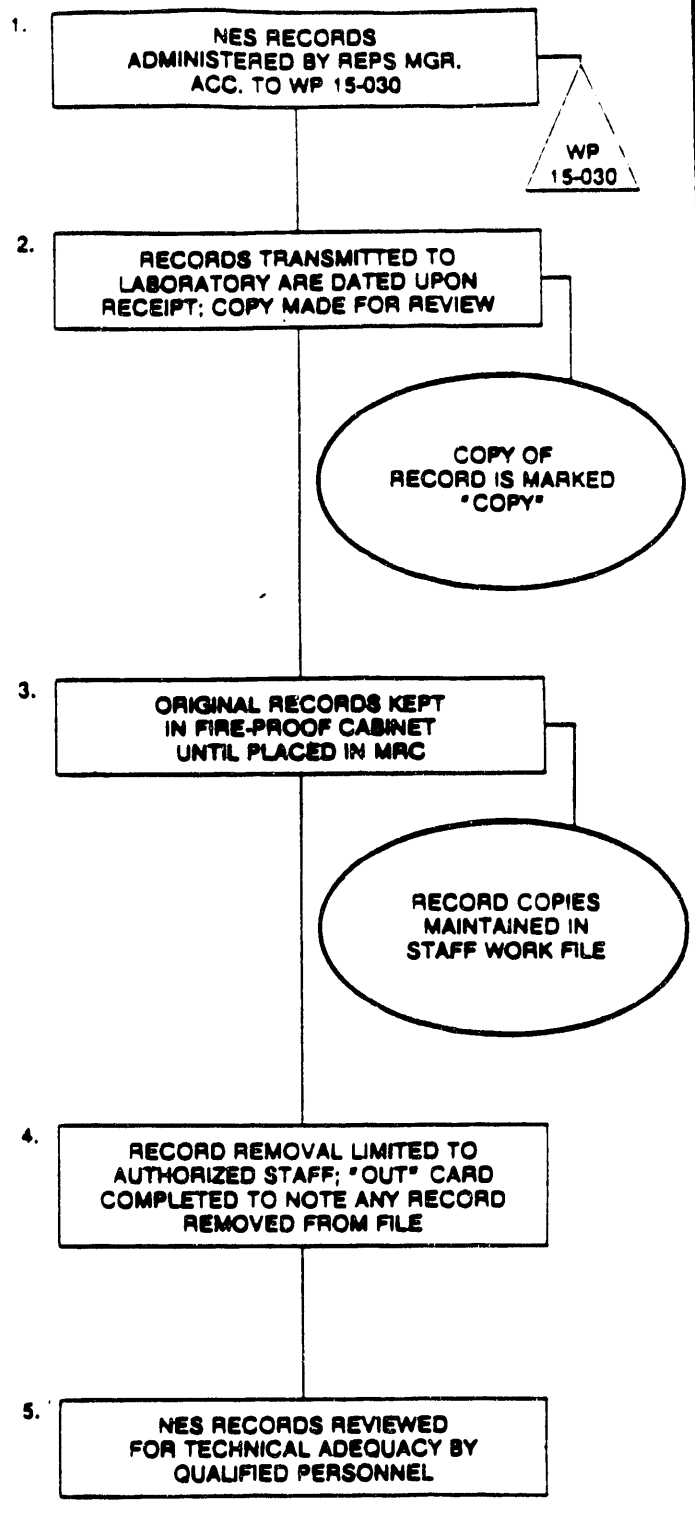
   NOTE: The copy of the record should be marked "copy."

3. The original records shall be maintained in a fire-proof file cabinet in accordance with WP 15-030.

   NOTE: Copies of records may be maintained by REPS staff in their working files.

4. Removal of records from REPS files shall be limited to authorized staff. An "OUT" card shall be completed and filed to note any record removed from the file.

5. An NES record originating in the REPS shall be reviewed for technical adequacy by qualified personnel. The review shall be documented prior to transmittal of the document beyond the Safety, Security, and Environmental Protection Department.



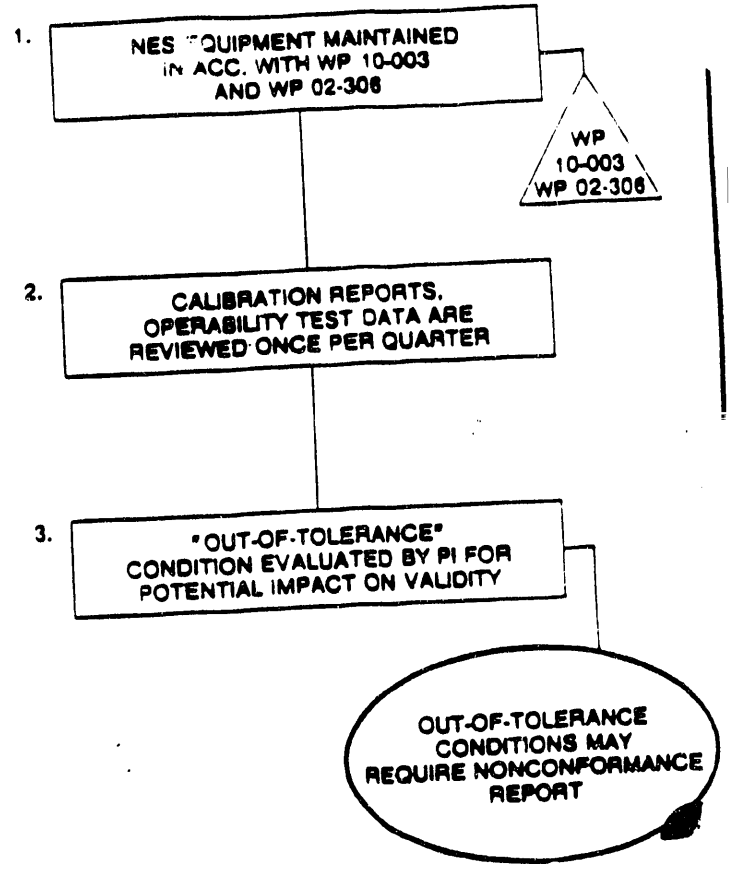
5.5 Calibration of NES Equipment

1. NES equipment shall be maintained in accordance with the requirements of WP 10-003 and WP 02-306.

2. Calibration reports and operability test data shall be reviewed at least once per quarter.

3. Any "out-of-tolerance" condition shall be evaluated by the PI or designee for potential impact on the validity of data.

NOTE: An "out-of-tolerance" condition may require that a Nonconformance Report be initiated according to WP-QPM.XV.

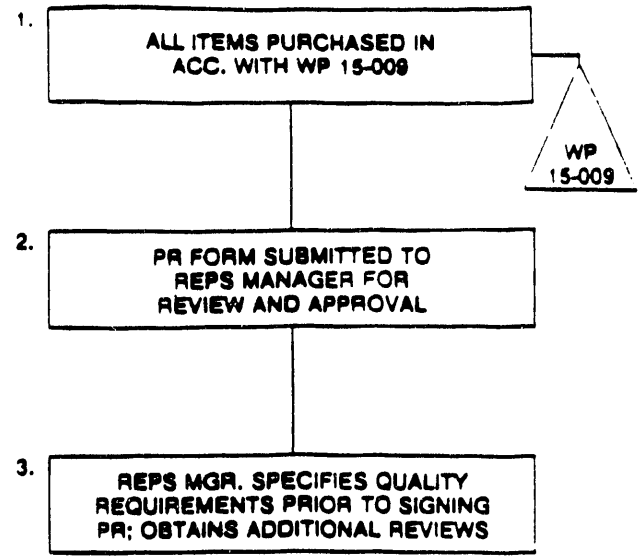


5.6 Procurement

1. All items purchased for use in the NES will be processed in accordance with WP 15-009.

2. The requisitioner submits the Purchase Requisition (PR) form to the REPS Manager for review and approval.

3. REPS Manager specifies the appropriate quality requirements prior to signing the PR and obtaining the additional departmental reviews.



5.7 NES Planning and Scheduling

1. The PI is responsible for maintaining a Sampling Activity Master Schedule. The PI is also responsible for revising the schedule as needed to assure that the program objectives and milestones are maintained.

1. PI MAINTAINS SAMS AND SCHEDULE TO ASSURE PROGRAM OBJECTIVES AND MILESTONES ARE MAINTAINED

5.8 NES Procedures

This section establishes the process for preparing, utilizing, revising, and controlling NES procedures, to provide a detailed record of the conduct of NES activities.

1. The PI prepares/revises NES procedures in accordance with WP 15-101.

2. The PI submits a draft procedure to Publications and Procedures (P&P) prior to internal or managerial review.

3. A P&P editor prepares draft for review and returns it to the author, who prepares draft for manager review according to WP 15-101.

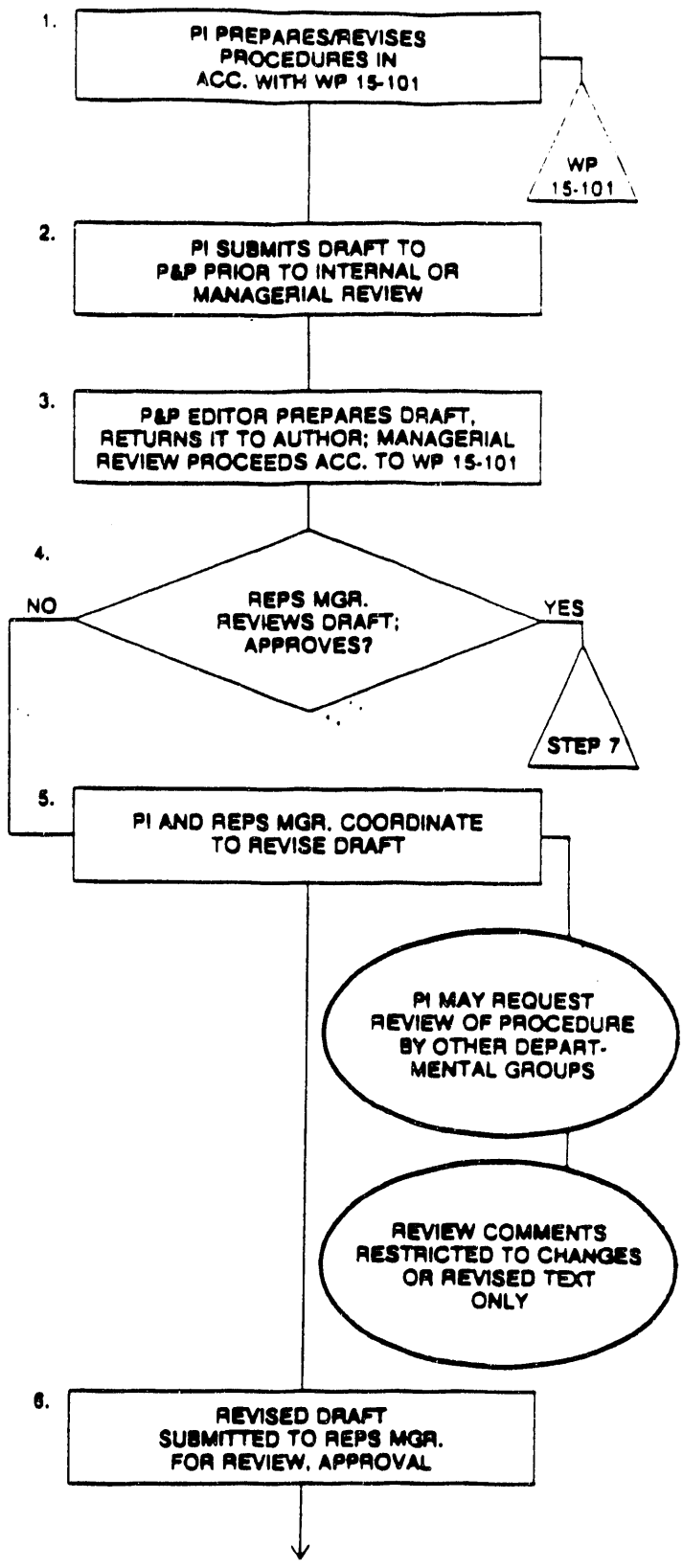
4. The REPS Manager reviews draft to determine approval.

5. If the draft is not approved, the PI and REPS Manager coordinate to revise draft.

   NOTE: The PI shall request review of a procedure by other departmental groups.

   NOTE: Review comments on procedure revisions should be restricted to the sections in question.

6. When all review comments have been resolved and incorporated, a revised draft is submitted to the REPS Manager for review and approval.



7. A final NES procedure, once completely reviewed and all comments resolved, is sent with the appropriate review documentation to P&P for controlled distribution.

8. The final NES procedure, with the authorizing signature, is transmitted to Document Control for issue to Environmental Procedure Manual, WIPP-02-3.

NOTE: WP 15-006 details the process for preparing/ submitting documents for controlled distribution.

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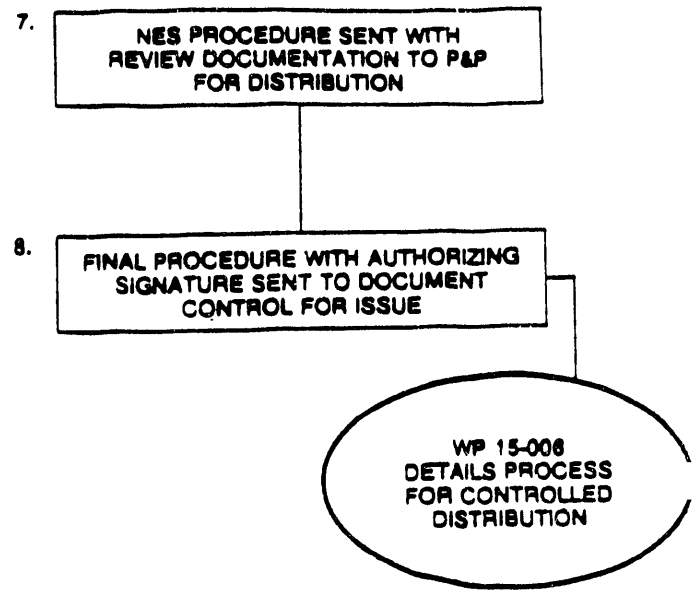


LIST OF REVIEWERS

Procedure Number: wp-02-330

Revision Number: 0

Procedure Title: Nonradiological Environmental Surveillance (NES) Implementation procedure

Reviewer's Name	Department
R. Youngman	QA

NO: 02-332 REV. 0 ISSUE DATE: 03/02/88

APPROVAL SIGNATURE: R. D. Boyer for TKC

PROCEDURE AUTHOR: J. Cockman

TITLE: NES SCHEDULING, DOCUMENTATION, AND FIELD PREPARATION PROCEDURE

1.0 SCOPE

This document describes the procedures to be followed for the scheduling of sampling activities, and for the preparation of the necessary documentation for tracking both the collected sample and information pertaining to that sample. This procedure is pertinent to sample collection activities of the Radiological and Environmental Section (REPS), in support of the Non-radiological Environmental Surveillance Program. These procedures are in accordance with WP 02-302.

2.0 DEFINITIONS

PSAQS - Preliminary Sampling Activity Quarterly Schedule

SAMS - Sampling Activity Master Schedule

Sample Suite - A list of potential sampling activities where sampling activity will normally take place

STLB - Sample Tracking Log Book

3.0 REFERENCES

Refer to Attachment 1.

4.0 GENERAL

This procedure is divided into two parts. The first part, Section 5.1, describes the preparation of the Sampling Activity Quarterly Schedule (SAQS). The second part, Section 5.2, describes the weekly preparation of sample tracking documentation for each scheduled sample. This procedure also provides steps for scheduling, labeling, and sample documentation performed manually.

The NES Principal Investigator (PI) or designee will assure that a Sampling Activity Master Schedule (SAMS) for the NES Program is maintained in accordance with the program plan. This master schedule will be reviewed annually

to assure that the objectives of the program are achieved. SAMS will contain two types of information for each sampling activity:

- o A description of the frequency or periodicity with which each sampling activity will normally be performed, or specific times when the sampling activity will take place.

- o A list of potential sampling locations, or sample location "suite" at which the sampling activity will normally take place.

An example of SAMS is included in Attachment 2.

The tasks defined by this procedure are to be implemented only by qualified personnel as described in Section 5.2 of WP 02-301. Equipment calibration shall be performed in accordance with WP 02-306.

The following activities are described in this document:

5.1 Manual Preparation of the Sampling Activity Quarterly Schedule (SAQS)
5.2 Manual Preparation of Sample Tracking Information

5.0 PROCEDURE

1 Manual Preparation of the Sampling Activity Quarterly Schedule (SAQS)

1. Within two weeks of the beginning of a new quarter, the PI or designee consults the SAMS and prepares a Preliminary Sampling Activity Quarterly Schedule (PSAQS).

   NOTE: PSAQS consists of a linear calendar for the upcoming quarter and the associated sampling activities.

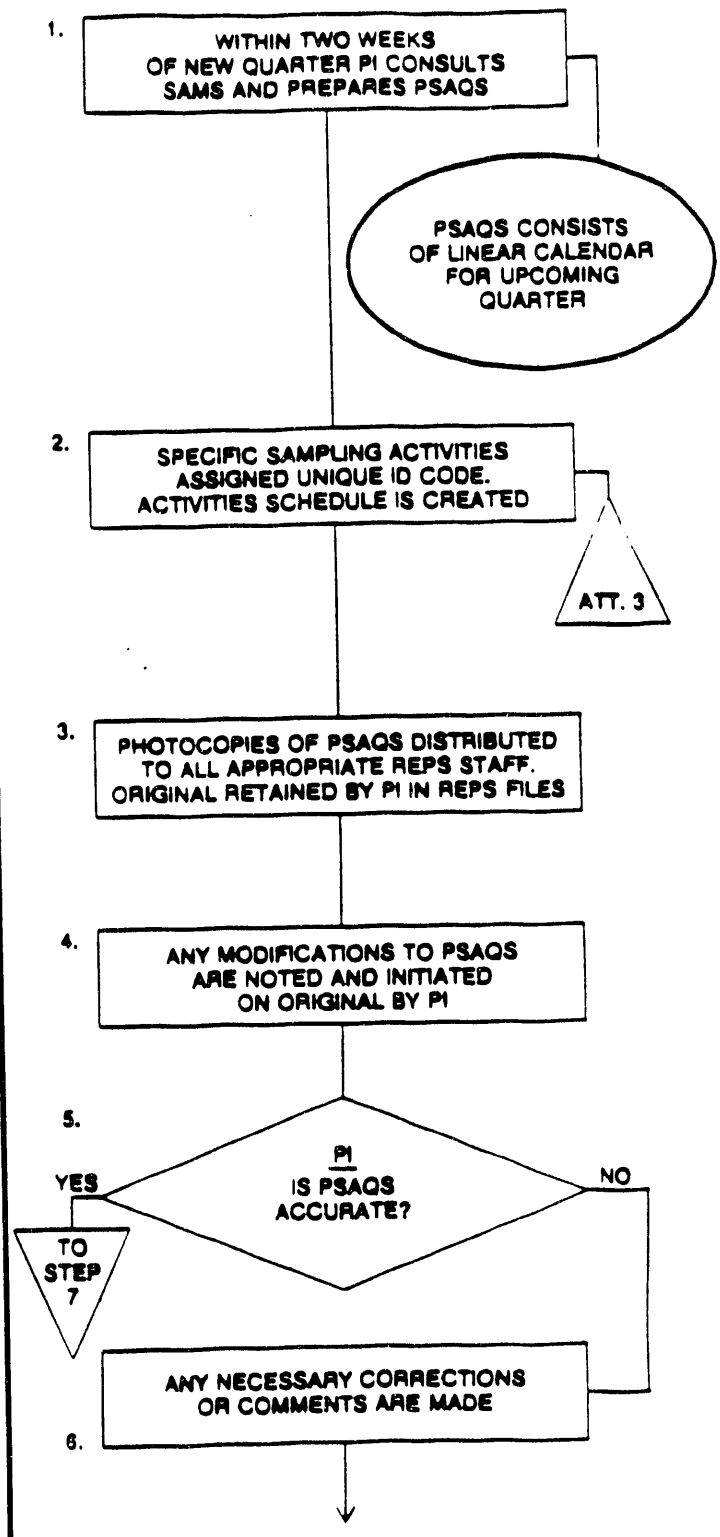
2. Specific sampling activities in each program are assigned a unique identity code listed on Attachment 3. The PSAQS assigns sampling activities to be performed on a specified date, or during the week beginning on a specified date.

3. Photocopies of the PSAQS are distributed to all appropriate REPS staff members. The original is retained by the PI in the REPS files.

4. Necessary modifications to the PSAQS shall be noted and initialed on the original PSAQS by the PI.

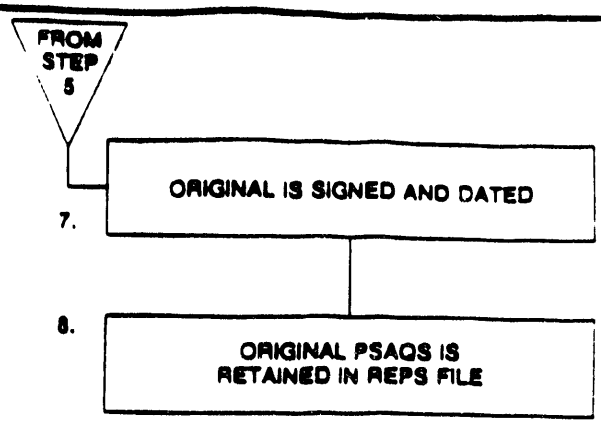
5. At the end of the quarter, the PI reviews the annotated original PSAQS for accuracy.

6. Any necessary corrections or comments shall be made.



7. The original is signed and dated by the PI.

8. The original PSAQS is retained in the REPS file.



5.2 Manual Preparation of Sample Tracking Information

1. Each workweek, the REPS staff consults the PSAQS for sampling activities scheduled for that week. Staff members confer with the PI to confirm scheduled activities and to be advised of sampling locations, the need for multiple samples, or any modifications to the normal sampling schedule.

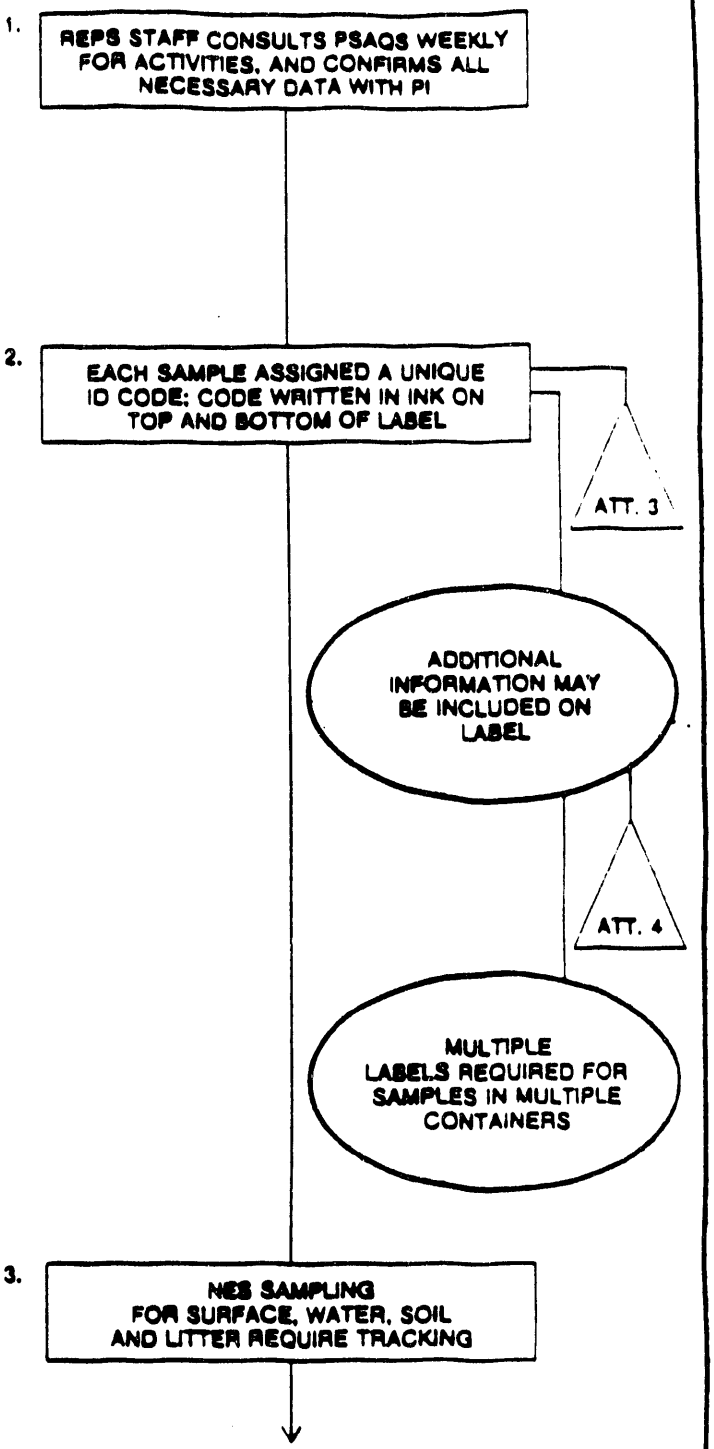
2. Each sample to be collected is assigned a unique identity code using the method described in Attachment 3. This unique sample identity code is written in ink on both the top and bottom of an adhesive label.

   NOTE: Additional information may be included on the label for clarification (Attachment 4).

   NOTE: More than one label per sample may be needed if the sample will require more than one container.

3. NES sampling activities which require sample tracking include:

   Surface water sampling
   Soil sampling
   Litter decomposition



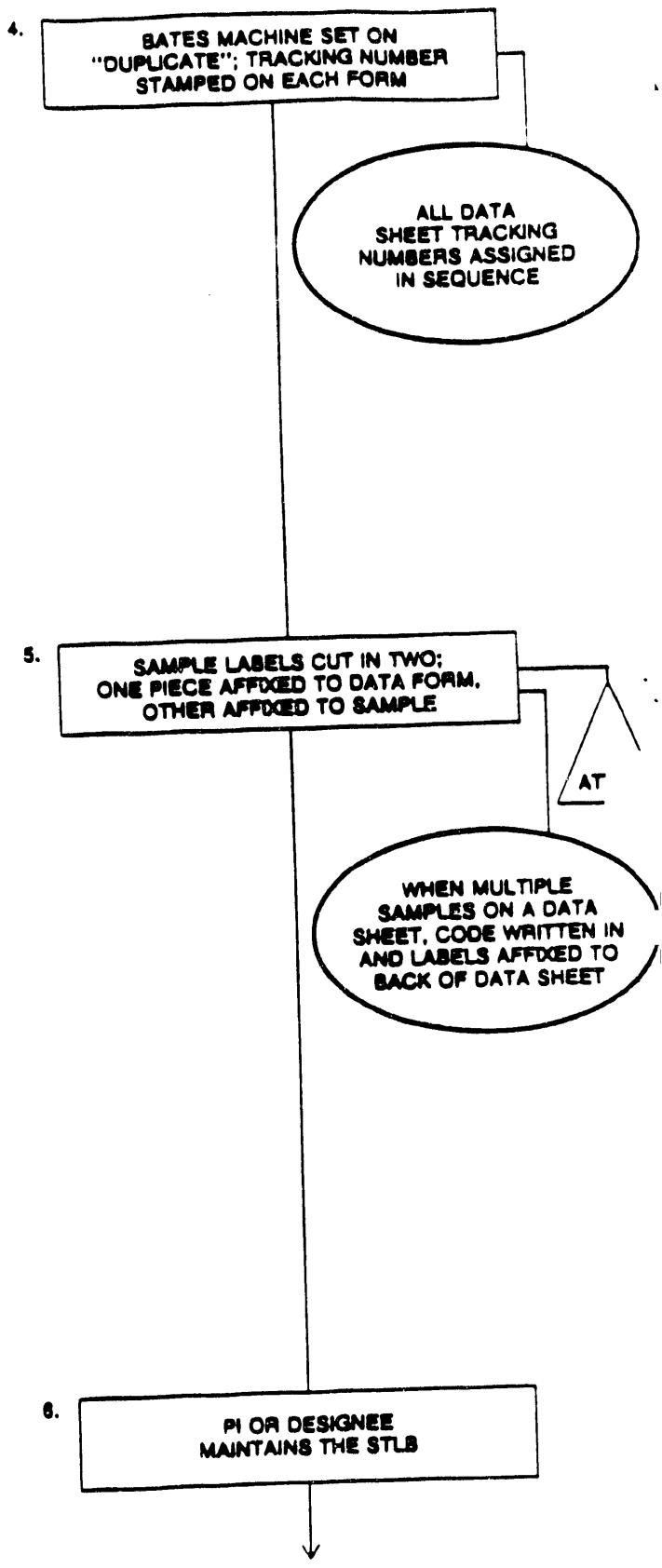
4. The Bates numbering machine is set on the "duplicate" numbering position and a data sheet tracking number is stamped in the upper right-hand corner of each form. The duplicate number is stamped onto the first open line of the Sample Tracking Log Book (STLB).

NOTE: All data sheet tracking numbers are assigned in sequence irrespective of the RES or NES sample program identification. Once numbered, the form will be referred to as a data sheet.

5. The prepared sample labels (Attachment 4) are cut into two pieces, each with the same unique sample identity code. One piece is affixed to a blank data form while the other is retained to attach to the sample itself.

NOTE: When more than one sample is included on a data sheet (e.g., soil sampling for deep soils) the sample identity codes are written on the data sheet in the appropriate spaces; coded labels for all samples in the "suite" are then affixed to the back of the data sheet.

6. The STLB is maintained by the PI or designee in the REPS files and contains information on the status of samples sent for analysis or held for archiving.



7. Data sheet numbers, corresponding unique sample identity codes and date of collection information is recorded in STLB, in addition to tracking information described in sample tracking procedure WP 02-304.

NOTE: When more than one sample is included on a data sheet, suite or circuit names may be recorded in the STLB, with sample identity codes listed individually.

8. REPS staff carrying out sampling activity will obtain appropriate containers and equipment as specified in the applicable sampling procedure. The remaining piece of the sampling label will be placed on the appropriate sample container.

NOTE: If filling the container may damage the label, it may be retained with the data sheet in the field until the container is filled.

9. Forms that should be taken to the field include:

Data sheets
Unattached labels
Blank, unnumbered forms
Blank labels (spares)

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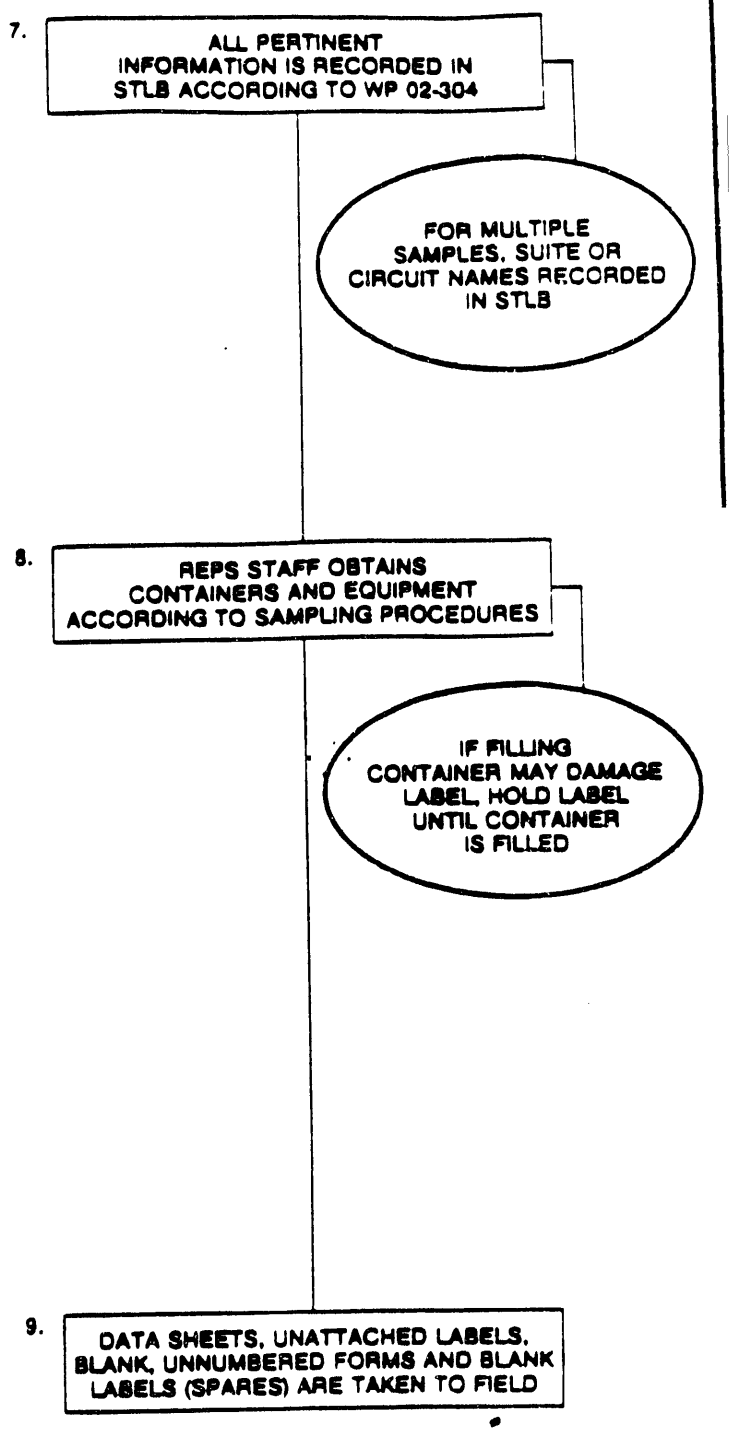

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Non-Radiological Environmental Surveillance

Primary References and Standards

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U.S. Code of Federal Regulations; Title 40, Part 120; "EPA Regulations on Water Quality Standards"; Washington, DC.

U.S. Code of Federal Regulations; Title 40, Part 141; "EPA National Interim Primary Drinking Water Regulations"; Washington, DC.

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NES SAMPLING ACTIVITY MASTER SCHEDULE (SAMS)

The following is a list of routine sampling activities performed in the Radiological and Environmental Programs Section (REPS) in support of the Nonradiological Environmental Surveillance (NES) Program.

Sampling Activity	Location	Time Frame
Small Mammal Census	Ecological Monitoring Plots	Summer*
Bird Census	Ecological Monitoring Plots	Spring*
Vegetation	Ecological Monitoring Plots	Spring, Summer/Fall*
Litter Bags	Ecological Monitoring Plots	Placed in February, collected quarterly
Soil	Ecological Monitoring Plots	Quarterly*
Surface Water and Sediment	Red Tank, Laguna Grande, Indian Tank, Hill Tank, other surface water bodies in vicinity	Spring, Fall*
Air Quality (continuous gas monitoring)	Site	Daily
NOAA	Site	Daily 4PM - 4PM
Photography		
Surface	Ecological Monitoring Plots	June/July, Nov./Dec.
Aerial	16 section area, North Access Road, South Access Road, Railroad Spur	June/July, Nov./Dec.

* Sampling activities performed seasonally or quarterly will be determined as needed. Exact sampling time may fluctuate each year due to changes in weather patterns, local weather, and other environmental factors.

INSTRUCTIONS FOR ASSIGNING UNIQUE SAMPLE IDENTITY CODES

The sample identity codes used in both the Radiological and Nonradiological Environmental Surveillance programs in the Radiological and Environmental Programs Section are unique to each individual sample prepared for potential analysis. An individual sample may consist of the entire quantity of material collected at a single location and time, a composite of materials which will be analyzed as a single unit, one of a group of replicate samples which were independently collected at a single location and time for separate analysis, a portion, or "split," of a sample prepared for independent analysis, or some other analyzable quantity of material (e.g., a "blank" sample).

The Unique Sample Identity Codes are structured as a four-tiered hierarchy of sample-specific information. The four tiers are arranged in descending order of importance to the identification of the sample. They are: (1) Subprogram, (2) Location, (3) Date, and (4) Specification. A list of the subprogram and location codes used in the program will be maintained by the Principal Investigator.

Subprogram: The Subprogram code consists of two alphabetic characters which identify the sample type. Typically the first letter is an identification of the general subprogram (e.g., A for air, H for hydrologic, B for biotic) and the second letter is a specifier of the type of sample within that subprogram (e.g., AC = Continuous Air sampling, HS = Surface Hydrologic sampling, BF = Fish Biotic tissue sampling).

Location: The Location code consists of three alphanumeric characters which identify the site from which the sample was collected. The first character of this code is alphabetic, the other two may be either alphabetic or numeric. Abbreviations of accepted location names are preferred. Establishment of standardized codes is recommended, for example, the use of the letter "R" as the last character has been reserved to indicate a ranch name (SMR = Smith Ranch). It is also preferred that the same location code be used for all subprograms when the location is a point of multiple sample acquisition.

Date: The Date consists of six or eight numbers specifying the year, month, and day, in that order, for which the sampling activity is scheduled. This is not necessarily the exact date of collection (see WP 02-020 for scheduling procedure). The year may be either four digits or abbreviated to the last two (1986 or 86). Both the month and day are two digit, with "0" preceding any single digit numbers. No spaces are used between these three numbers (for example, September 1, 1986 would be either 19860901 or 860901).

Specification: The Specification code is used to identify a particular sample from a possible group of samples of a single type, collected at a single location, and scheduled for the same date.

The specification is a numeric code consisting of two numbers separated by a decimal point. The first number identifies the sample from all other samples in the group and the second number indicates the number of samples in the group. For example, a sample specification of 2.10 indicates that it is sample number 2 of a group of 10 which were all taken from the same location and time (possibly 10

replicate samples, or 5 replicates with 2 splits of each, etc.). A specification of 1.1 indicates that only one sample was scheduled for that time and location. Note that no information is given detailing the group of samples. This information is to be recorded on the appropriate data sheet.

An example of a complete sample code is as follows:

AC-SMR-19860901-1.2

This Unique Sample Identity Code represents that the sample is the first of two continuous air samples scheduled for collection from the Smith Ranch on September 1, 1986.

SAMPLE LABELS

SC-SE2-19871012-1 of 6
SOIL CHEMISTRY
SOUTHEAST-2
Collection Date: _____
Replicate :

SC-SE2-19871012-1.6

SC-SE2-19871012-2 of 6
SOIL CHEMISTRY
SOUTHEAST-2
Collection Date: _____
Replicate :

SC-SE2-19871012-2.6

SC-SE2-19871012-3 of 6
SOIL CHEMISTRY
SOUTHEAST-2
Collection Date: _____
Replicate :

SC-SE2-19871012-3.6

SC-SE2-19871012-4 of 6
SOIL CHEMISTRY
SOUTHEAST-2
Collection Date: _____
Replicate :

SC-SE2-19871012-4.6

SC-SE2-19871012-5 of 6
SOIL CHEMISTRY
SOUTHEAST-2
Collection Date: _____
Replicate :

SC-SE2-19871012-5.6

SC-SE2-19871012-6 of 6
SOIL CHEMISTRY
SOUTHEAST-2
Collection Date: _____
Replicate :

LIST OF REVIEWERS

Procedure Number: WP 02-332

Revision Number: -0-

Procedure Title: NES Scheduling, Documentation, and Field Preparation Procedure

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
R. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-334 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES DATA MANAGEMENT PROCEDURE

1.0 SCOPE

This document describes procedures for managing Radiological and Environmental Programs Section (REPS) data in support of the Nonradiological Environmental Surveillance (NES) Program in accordance with WP 02-331, Quality Control Procedure.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-302, NES/RES Quality Assurance/Quality Control Implementation Procedure

WP 02-331, NES/RES Quality Control Procedure

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedure

WP 02-333, NES Sample Tracking

4.0 GENERAL

This procedure is divided into four sections corresponding to various types of data which are handled by the NES Program. Section 5.1 outlines procedures for handling data from the field data sheets defined in WP 02-332. Section 5.2 outlines protocol for the management of analytical results of NES samples. The management of photographs is described in Section 5.3. Management of NES data output from continuous monitors is outlined in Section 5.4. All data management shall be performed in compliance with WP 02-302, which documents QC requirements for the RES and NES Programs. Integrity of sampling data will be assured by compliance with WP 02-332 and WP 02-333.

5.0 PROCEDURE

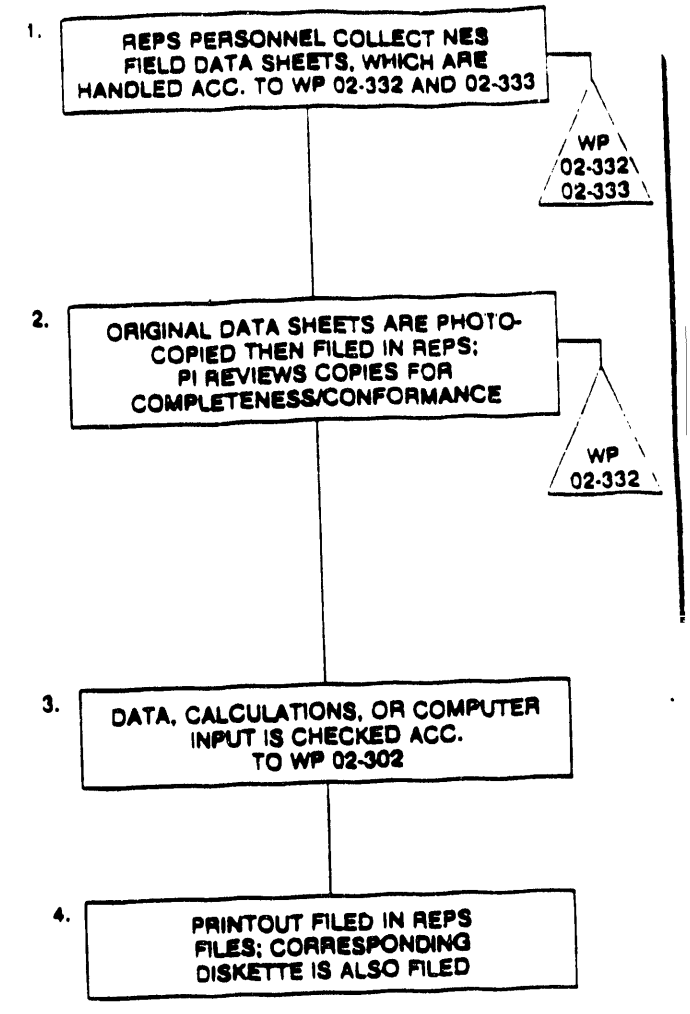
5.1 Management of Field Data Sheets

1. REPS field personnel collect NES field data. Data sheets are handled in accordance with specific sampling, documentation, and tracking procedures (WP 02-332 and WP 02-333.

2. Original data sheets (DS) required by WP 02-332 are photocopied and filed in the REPS file. Copies will be reviewed by the Principal Investigator (PI) or designee. Data is reviewed for accuracy, completeness, and conformance to specific sampling procedures.

3. Data, calculations, or computer input is checked according to procedures in WP 02-302.

4. The printout will be filed in the REPS files. The corresponding data diskette or other data storage device should also be placed in the REPS file.



5.2 Management of Analytical Results

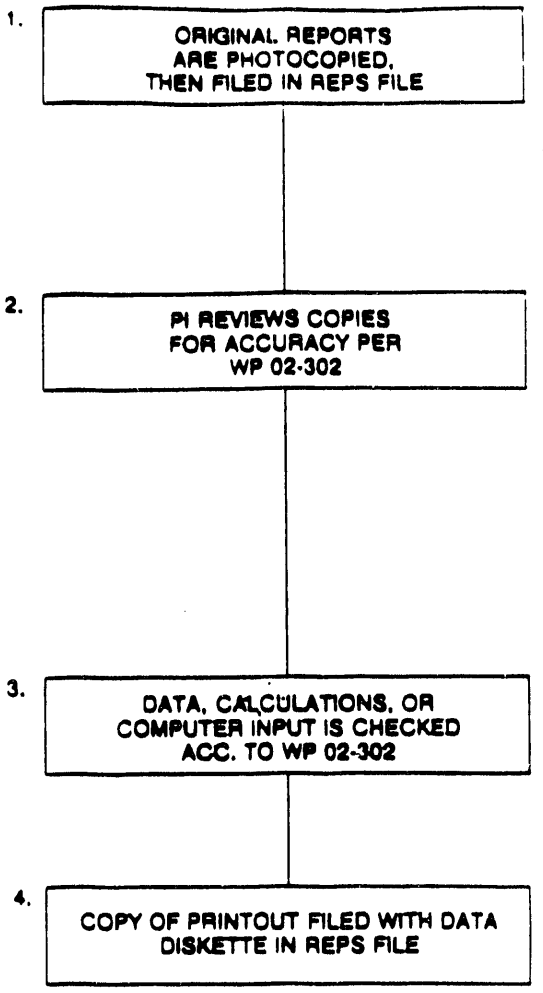
Samples may be analyzed onsite or by an analytical lab. In either case, the following procedure will be followed.

1. Original analytical reports are photocopied and filed in the REPS file.

2. The copy of analytical results and any required data reductions, computations, or analyses performed are reviewed by the PI or designee in accordance with WP 02-302.

3. Data, calculations, or computer input shall be checked according to procedures outlined in WP 02-302.

4. A copy of the printout will be maintained with the data diskette in the REPS file.



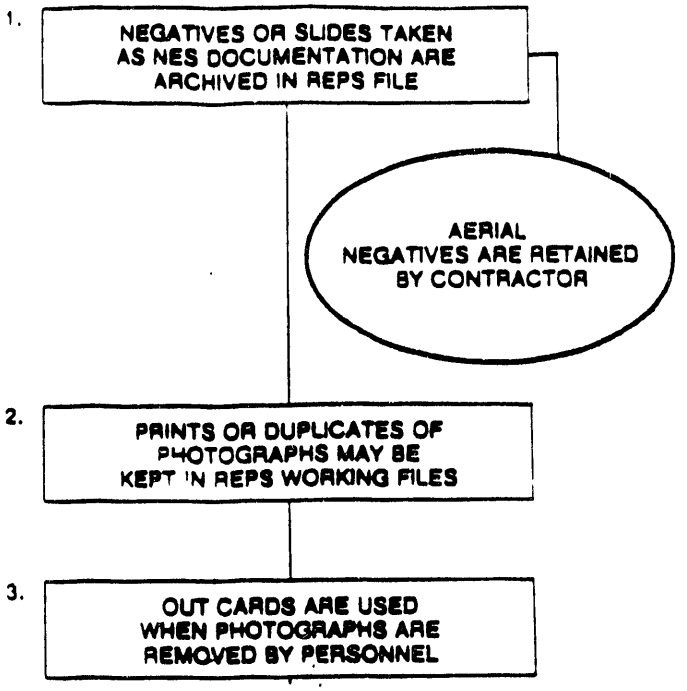
5.3 Management of Photographs

1. Negatives or slides (transparencies) taken as a documentation of a condition or item in support of the NES Programs shall be archived in the REPS file.

   NOTE: Negatives of aerial photography are retained by the contractor.

2. Prints or duplicates of these photographs may be kept in the REPS working files.

3. "Out cards" shall be used when photographs are removed by personnel.



5.4 Management of Continuous Monitor Output Data

1. Environmental monitoring data collected on a continuous basis is recorded automatically as a computer printout or as a strip chart.

2. Computer printouts are reviewed by the PI or designee for flagged values and gaps in the continuity of the record.

3. Data of interest recorded on strip charts will be transferred to separate summary sheets.

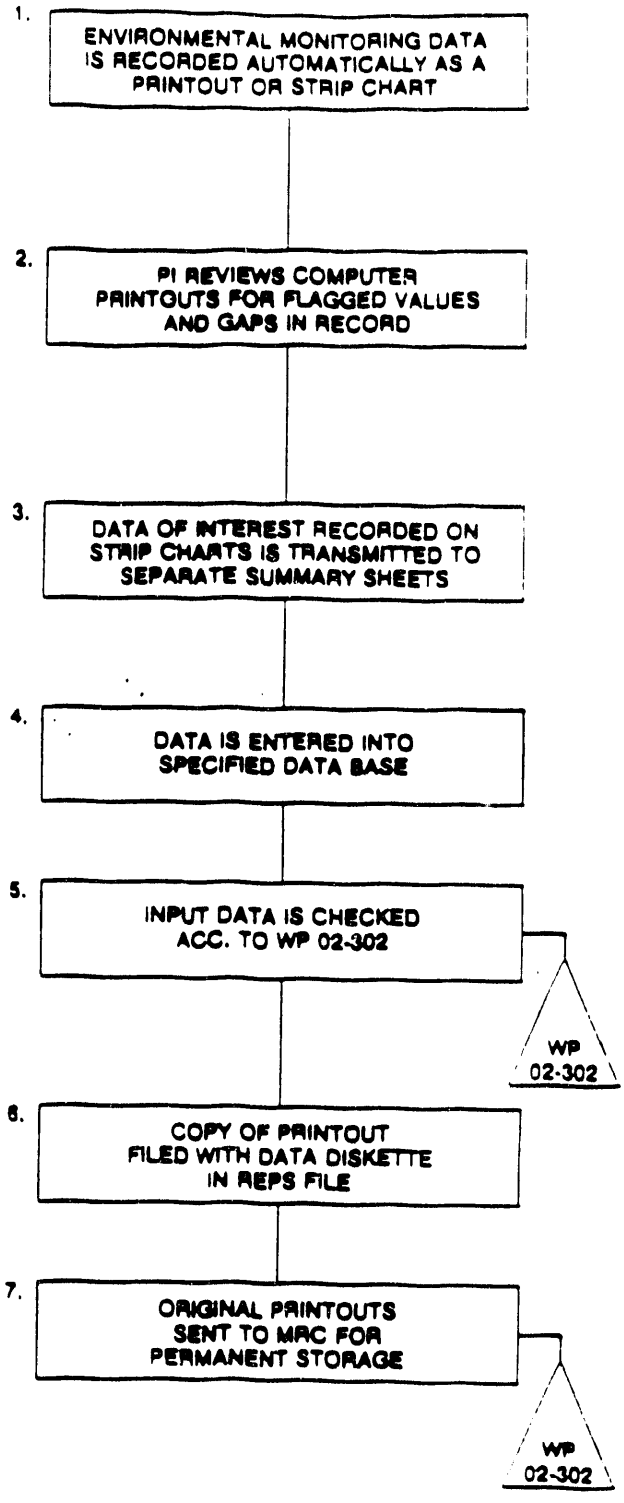
4. Data is entered into a computer data base.

5. The input data is checked by comparing the printout of the data with the original input form according to procedures in WP 02-302.

6. A copy of the printout will be filed with the data diskette in the REPS file.

7. Original printouts will be sent to Master Records for permanent storage in accordance with WP 02-302.

186s



LIST OF REVIEWERS

Procedure Number: WD-02-334

Revision Number: 0

Procedure Title: NFS Data Management Procedure

Reviewer's Name	Department
R. Youngman	QA

NO: 02-336 REV. 0 ISSUE DATE: 02/05/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES SOIL SAMPLING PROCEDURE

1.0 SCOPE

This procedure describes the methods for collecting soil samples for the Nonradiological Environmental Surveillance (NES) Program of the Radiological and Environmental Programs Section (REPS). Soil sampling and soil handling shall be performed as described in this procedure.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures

WP 02-330, Non-Radiological Environmental Surveillance (NES) Implementation Procedures

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedures

WP 02-333, NES Sample Tracking Procedures

WP 02-334, NES Data Management Procedures

N. C. Brady. 1974. The Nature and Properties of Soils. Macmillan Publishing Co., Inc., New York.

G. V. Johnson. 1982. Los Medanos Project Soil Studies. Report on studies completed December 1980 September 1981. Report submitted to Westinghouse Corporation.

G. V. Johnson, J. W. Deichmann, C. C. Gage, and J. W. Potter. 1978. Soils and Plant Productivity Studies. Contract No. 07 8239. Report submitted to Sandia Laboratories.

J. A. Ludwig and K. E. Freas. 1978. Primary Production Patterns on the Los Medanos WIPP Study Area. Contract No. 07 9252. Report submitted to Sandia Laboratories.

R. D. Pettit, B. E. Dahl, and D. Northington. 1978. Plant Successional Studies on the Los Medanos Waste Isolation Pilot Plant (WIPP) and Gnome Sites Southeastern New Mexico. Contract No. 13 0806. Report submitted to Sandia Laboratories.

R. R. Sokal and F. J. Rohlf. 1969. Biometry. W. H. Freeman and Company, San Francisco.

W. G. Whitford, N. Z. Elkins, T. Marr, R. Repass, D. Schaefer, and W. Widsom. 1978. The Arthropods of the Los Medanos WIPP site, with Emphasis on the Social Insects and Soil Microarthropods. Submitted to Sandia National Laboratories under Contract No. 07 9252.

H. G. Wolfe. 1977. Biotic Resources: Vegetational Baseline Study for the Los Medanos Study Area. Report submitted to Sandia National Laboratory.

4.0 GENERAL

All activities associated with the collection, handling, data and quality control review, and management of soil samples shall be described in the Environmental Procedures Manual (WP 02-3) which shall be maintained by the Principal Investigator (PI) or designee, in accordance with the requirements of WP 02-302.

Soil samples shall be collected and scheduled in accordance with WP 02-332.

The tasks defined in this procedure are to be performed by qualified personnel in accordance with Section 5.2 of WP 02-330.

The following Soil Sampling methods are defined in this procedure:

5.1 Preparation for Field Sampling
5.2 Sample Collection
5.3 Post Sampling Activities

5.0 PROCEDURE

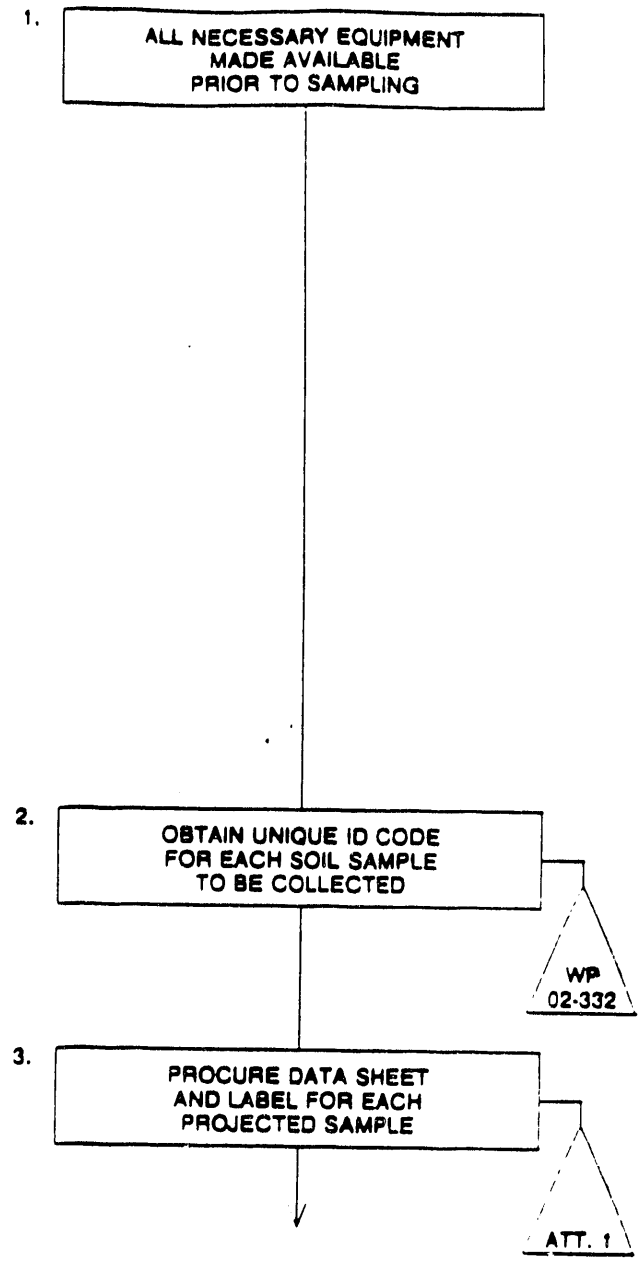
1 Preparation for Field Sampling

1. Prior to field sampling, the following equipment shall be available as appropriate:

   - o Appropriately labeled, plastic sample bags
   - o Appropriately numbered data sheets
   - o Soil sampling auger, marked at appropriate intervals (depth series samples only)
   - o Soil sampling templates (10 cm x 10 cm x 10 cm) (surface samples only)
   - o Spatula or equivalent implement
   - o Compass (optional)
   - o Pens, markers.

2. Following the procedures described in WP 02-332, obtain a Unique Identity Code for each soil sample to be collected.

3. Obtain an appropriately numbered data sheet (Attachment 1) and label for each projected sample or depth series.

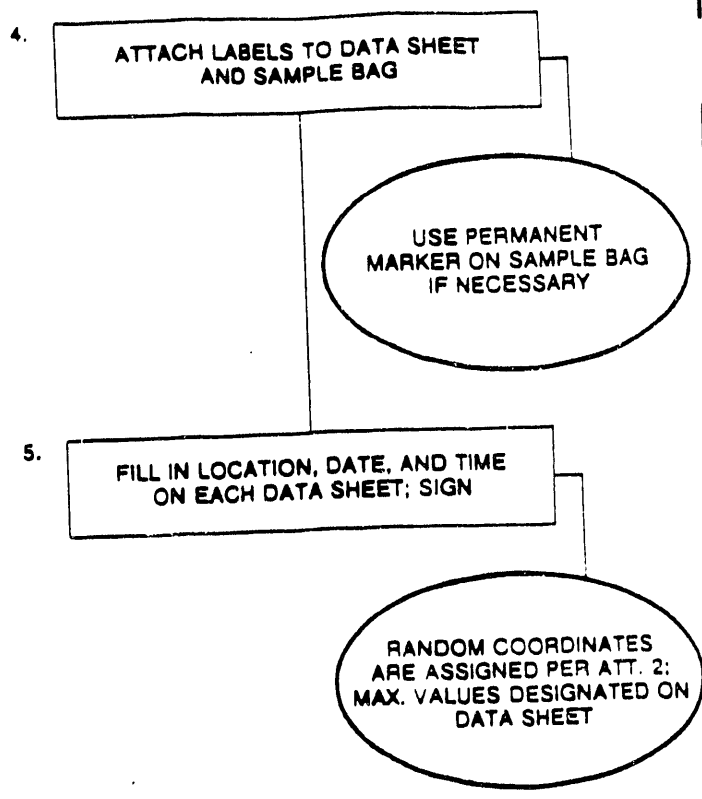


4. Attach a label to the appropriately numbered data sheet, and attach a corresponding label to the designated sample bag.

NOTE: If labels are unavailable, label bag with permanent marker.

5. Fill in the location, date, and time information on each data sheet and sign.

NOTE: Random coordinates are assigned as described in Attachment 2; maximum values are designated on the data sheet.



5.2 Sample Collection

1. To locate each of the soil sampling points within the Ecological Monitoring Plots, begin at sign post in the center of each plot, and follow the steps outlined in Attachment 2.

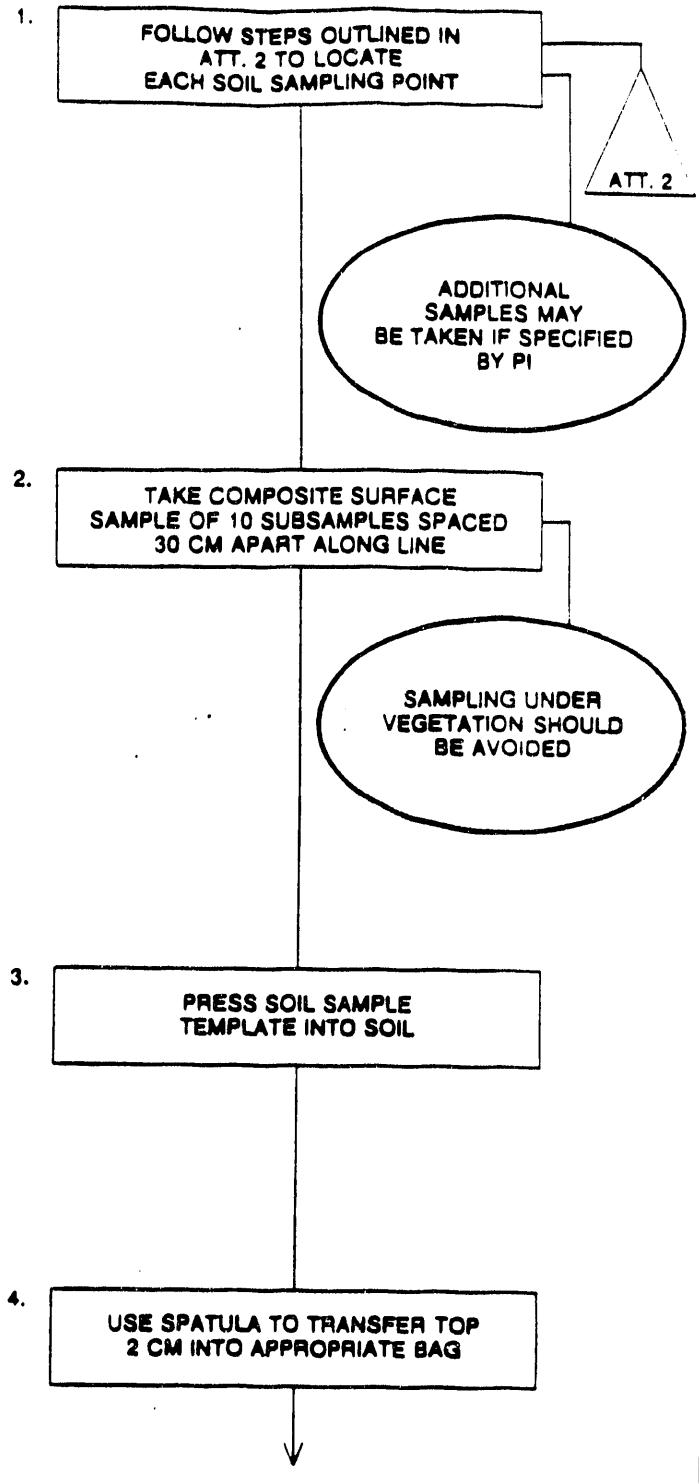
   NOTE: Additional samples may be collected at depths and locations specified by the PI.

2. At each of the six sampling points, take a composite surface sample consisting of 10 subsamples collected with the soil template, each spaced a minimum of about 30 cm apart along the line last traversed to the sampling point.

   NOTE: Avoid sampling under vegetation where possible.

3. Press the soil sample template into the soil. A flat piece of wood placed over the top of the template may be used to prevent undue disturbance of the surface soil layers.

4. Using a spatula or equivalent implement, transfer the top two centimeters of material inside the template into the appropriate, labeled plastic bag. A subsample is complete when the surface inside the template is level at the correct lower depth.



5. Repeat steps 3 and 4 for each of the 10 subsamples, compositing all subsamples into the same bag.

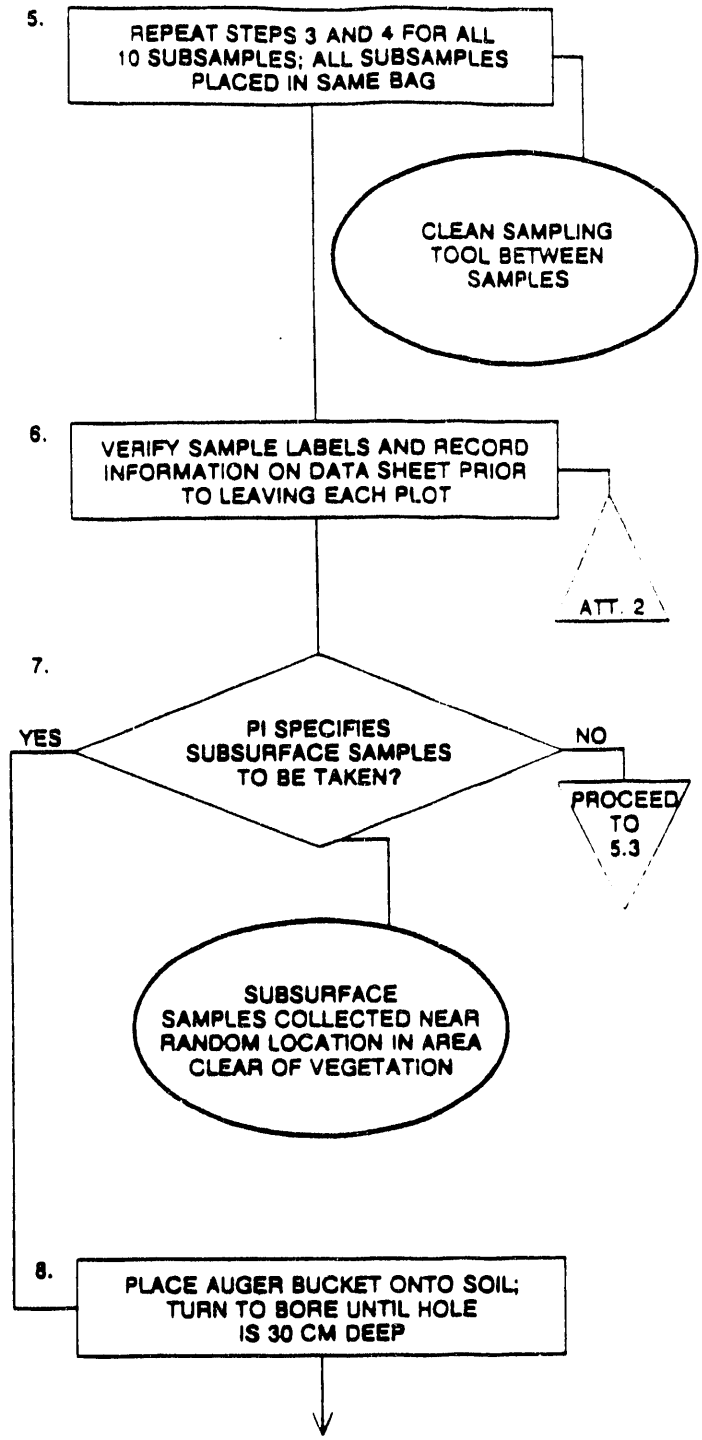
NOTE: Clean sampling tool between samples.

6. Verify that samples are labeled properly. Record specified field information on the soil sampling data sheet (WP 1439: Attachment 1). Data must be recorded prior to leaving each plot.

7. When the PI specifies two subsurface samples (30 to 45 cm and 60 to 75 cm), these will be collected at some or all of the sample points (specified by the PI) using the soil auger. If no subsurface samples are required, proceed to Section 5.3.

NOTE: When required, subsurface samples shall be collected at a point near the random location which is relatively clear of vegetation.

8. To collect a subsurface sample, place the auger bucket onto the soil surface and turn until the auger bucket is full. Remove the auger and pile the soil material to the side. Continue to remove soil from the hole until the auger reaches 30 cm (the 30 cm mark is at the ground surface level).



9. Wipe the auger clean, insert it into the hole, and collect the sample, emptying the auger bucket into the appropriate sample bag.

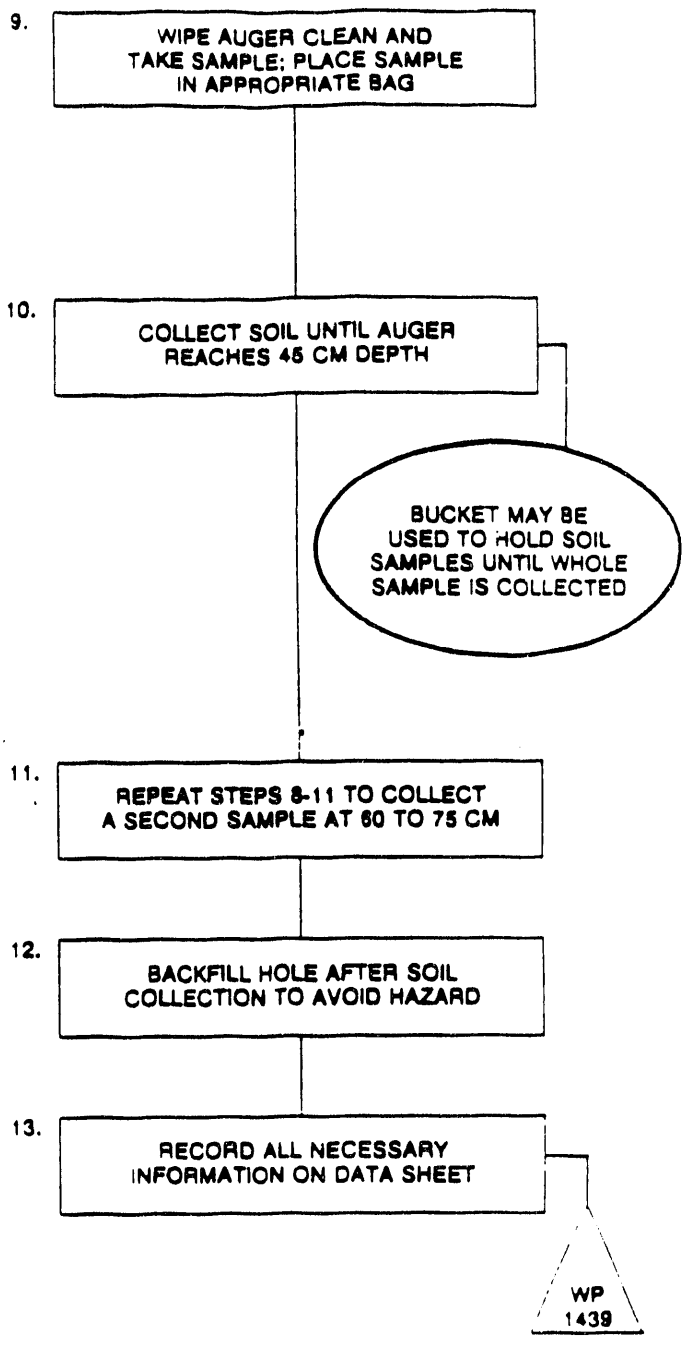
10. Continue to collect soil samples until the auger reaches 45 cm in depth.

    NOTE: A bucket may be used to hold soil samples until the entire sample is collected. The sample bag will be filled from the bucket. The bucket should be wiped clean before each use.

11. In the same hole, repeat steps 8 through 11 to remove intervening soil and collect a second depth (60 to 75 cm) soil sample.

12. After all samples are collected, backfill to prevent hazard to wildlife or livestock.

13. Record all necessary information on the appropriately numbered data sheet (WP 1439) before leaving the sampling station.



5.3 Post-Sampling Activities

1. Return samples to the sample preparation laboratory promptly after sampling is completed.

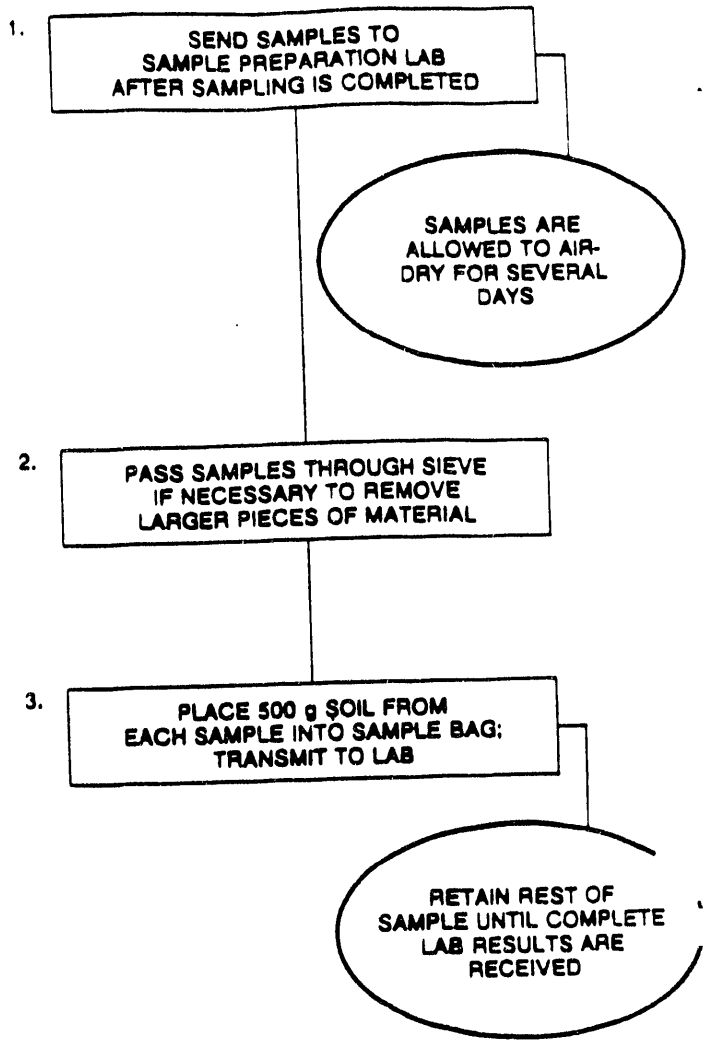
   NOTE: Sample bags should be left open a minimum of 48 hours to air-dry soil.

2. When necessary, pass samples through a sieve (No. 10 to 20 U.S. Standard sieve sizes are acceptable) to remove large pieces of organic material, pebbles, etc.

3. Place at least 500 g of soil from each sample into the appropriately labeled sample bag, and transmit to analytical lab as specified in WP 02-333.

   NOTE: Retain the rest of the sample until analytical results have been received from the analytical lab and reviewed for completeness.

175s



DATA SHEET No. _____

SOIL SAMPLING DATA SHEET

ECOLOGICAL MONITORING PROGRAM

SAMPLES COLLECTED ACCORDING TO PROCEDURE WP 02-336

ECOLOGICAL MONITORING PLOT _____ SAMPLE No. (1-6) _____

DEPTH SERIES : ____ YES ____ NO

RANDOM COORDINATES : _____ _____ _____

Direction	Paces (0-100)	Paces (0-100)

PREPARED BY _____ DATE _____

COLLECTION : DATE _____ TIME _____ FIELD PERSONNEL _____

SURFACE SAMPLE (0-2 cm) SAMPLE CODE _____ (Use label when available)

NUMBER OF SAMPLES COMPOSITED : _____

STATUS : _____ OK _____ QUALIFIED _____ FLAWED _____ ABORTED

COMMENTS : _____

INTERMEDIATE DEPTH SAMPLE (30-45 cm) SAMPLE CODE _____ (Use label when available)

NUMBER OF SAMPLES COMPOSITED : _____

STATUS : _____ OK _____ QUALIFIED _____ FLAWED _____ ABORTED

COMMENTS : _____

DEEP SAMPLE (60-75 cm) SAMPLE CODE _____ (Use lable when available)

NUMBER OF SAMPLES COMPOSITED : _____

STATUS : _____ OK _____ QUALIFIED _____ FLAWED _____ ABORTED

COMMENTS : _____

CHECKED BY _____ DATE _____

IDENTIFYING RANDOM LOCATIONS

1. SCOPE

This attachment describes the steps required to randomly locate sampling stations or points in the NES Program at the WIPP facility. These steps shall be followed to select a random location for collecting soil samples, placing litter bags, evaluating vegetation parameters, or other sampling activities where random locations within a rectangular area are required.

2. LOCATING A RANDOM SAMPLING STATION OR POINT

a. A starting point shall be defined at each sampling station for which these steps are used.

b. Draw a random number to represent one of the four major compass headings (N=1, S=2, E=3, and W=4) using a random number generator or a random number table. This will be the starting direction.

c. Draw a random number between 1 and a predetermined maximum value (integer) to represent the number of paces to proceed in the starting direction (see step a).

d. Draw a second random number between 1 and a predetermined maximum value (integer) to represent the number of paces to proceed in the second direction.

e. Enter these numbers in the appropriate blanks on the Sample Data Sheet for each sample.

3. IDENTIFICATION OF SAMPLING LOCATION IN THE FIELD

At the sampling station:

a. Proceed to the permanent marker or starting point.

b. Using a compass or the directional markers in place at the plots, find the starting direction indicated on the data sheet for the current sample or subsample.

c. Proceed in that direction for the number of paces determined by the first random number listed on the data sheet. Turn left 90 degrees and proceed in the second direction for the number of paces determined by the second random number listed on the data sheet.

d. If the selected location is inaccessible or inappropriate (e.g. man-made barrier), draw a new starting direction and proceed to the random location using the previously selected coordinates.

LIST OF REVIEWERS

Procedure Number: WP 02-336

Revision Number: 0

Procedure Title: NES Soil Sampling Procedures

Reviewer's Name	Department
T. Fischer	REPS
J. Cockman	REPS
A. Rodriguez	REPS
R. Kehrman	REPS
R. Youngman	QA

NO: 02-337 REV. 0 ISSUE DATE: 03/02/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES VEGETATION SAMPLING PROCEDURE

1.0 SCOPE

This procedure describes the methods for measuring vegetation density and foliar coverage for the Nonradiological Environmental Surveillance (NES) Program of the Radiological and Environmental Monitoring Program Section (REPS). The measurement of vegetation density and coverage in the Ecological Monitoring Plots at the WIPP site shall be performed as described in this procedure.

2.0 DEFINITIONS

Vegetation Density - The exact number of annual plant species and seedlings of all plant species rooted within a sampling area.

Foliar Coverage - The estimated percentage of the total sampling area that is covered by the leaf portion of a plant species. Individual plants may be annual or perennial, rooted inside or outside of the sampling area.

3.0 REFERENCES

WP 02-302, Radiological Environmental Surveillance (RES) Quality Assurance/Quality Control Implementation

WP 02-330, NES Implementation Procedure

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedure

WP 02-333, NES Sample Tracking Procedures

WP 02-335, NES Equipment Maintenance and Control Procedure

Best, T. L. and D. W. Jackson, 1981. Statistical Evaluation of Plant Density Data Collected at the Los Medanos Site, New Mexico (1978-1980). Report submitted to Westinghouse Electric Corporation.

Cain, S. A. and G. M. Castro, 1959. Manual of Vegetation Analysis. Harper & Brothers, New York.

Martin, W. C. and C. R. Hutchins, 1980. A Flora of New Mexico, Volumes I and II. J. Cramer, Germany.

Sokal, R. R. and F. J. Rohlf, 1969. Biometry. W. H. Freeman and Company, San Francisco.

4.0 GENERAL

Field measurements of the vegetation parameters of interest will be performed on a schedule outlined in the Ecological Program Plan, and as established by the Principal Investigator (PI). All sampling shall be conducted by qualified individuals. Personnel shall be qualified in accordance with WP 02-332, and shall be knowledgable of plant species likely to be found in the area. All activities associated with the collection and processing of data shall be described in the procedures manual (WP 02-3) maintained by the PI.

The WIPP Quality Assurance Department will be notified of any nonconformance conditions by the REPS Section Manager, in accordance with WP 02-302.

During each vegetation sampling period, a minimum of 20 randomly located quadrats (2.0 m x 0.5 m) shall be sampled in each Ecological Monitoring Plot. The following information shall be recorded for each quadrant of the sampling quadrat:

- Estimated percentage of the total area covered by the leaf portion of each species present
- Number of individuals of each annual species and number of seedling of any species present.

Each quadrat shall be identified by the plot designation (i.e., SE1, NW2), the date, and the random numbers which determine the quadrat location within the plot Data Sheet Instruction (Attachment 1).

Additional samples may be taken to support special projects in the REPS program, at the direction of the PI.

The following activities are described in this procedure:

5.1 Preparation for Field Activities
5.2 Taking Field Measurements
5.3 Post-Field Activities

5.0 PROCEDURE

1 Preparation for Field Activities

NOTE: The following equipment will be available for use during field activities:

- o Quadrat frame (2.0 m x 0.5 m)
- o Numbered data sheets (one for each quadrat to be sampled)
- o Clipboard
- o Pen (with dark ink)
- o Plant press prepared for field use

1. Following the steps described in Attachment 1, three random numbers are recorded on the numbered data sheet (Attachment 2) for each quadrat to be sited within each plot.

1. RECORD RANDOM NUMBERS ON DATA SHEET FOR EACH QUADRAT WITHIN PLOT

ATT. 1 & 2

5.2 Taking Field Measurements

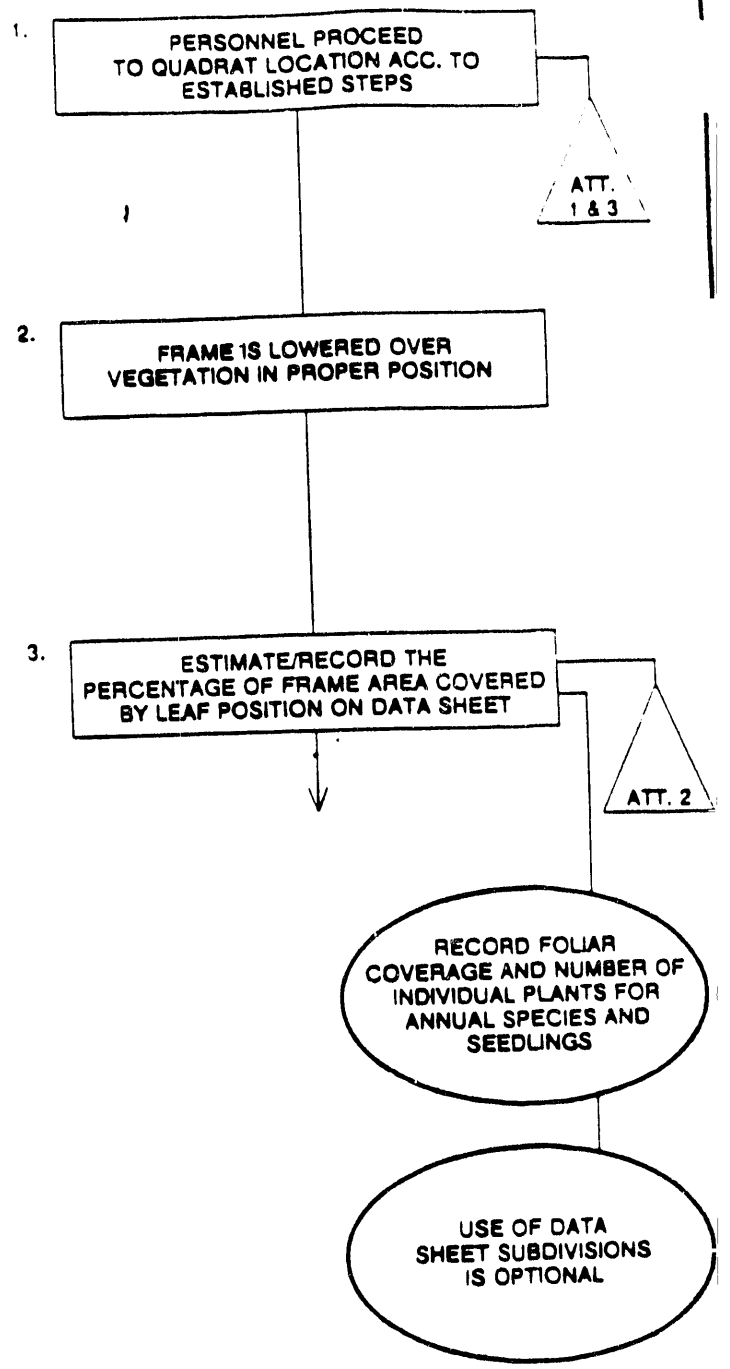
1. Using the center identification post in each Ecological Monitoring Plot, the steps outlined in Attachment 1, and the steps outlined in Attachment 3 (random location) quadrat, personnel proceed to the first quadrat location.

2. At a random location, personnel continue to face the direction of progress and hold the frame upright (with the long axis vertical). Lay the lower edge of the frame on the ground with the right-hand corner immediately in front of the left toe and lower the frame forward over the vegetation.

3. For each species in the frame, estimate and record the percentage of the frame area covered by the leaf portion of the species on the field data sheet (Attachment 2).

NOTE: For annual species and seedlings of all species record (in addition to the foliar coverage) the number of individual plants which are rooted within the quadrat frame.

NOTE: The data sheets and quadrat frames provide for subdividing the frame into quarters to facilitate coverage estimations and density counts. The use of these subdivisions is optional.

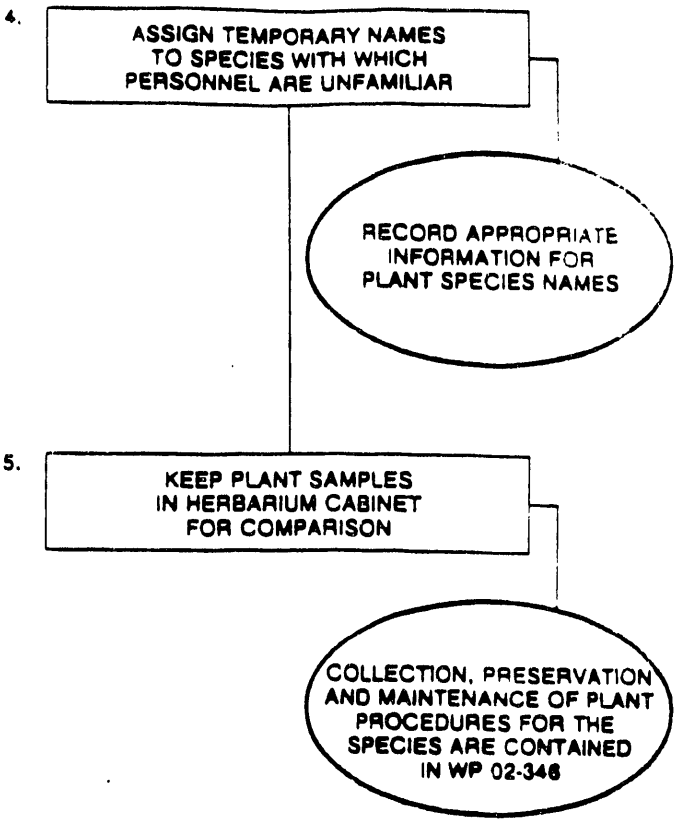


4. When field personnel are unfamiliar with a species present in the plot, a temporary name may be assigned to the plant (i.e., Unk A, blue sticky plant).

NOTE: The appropriate information should be recorded on the quadrat data sheet for that name, and a specimen should be prepared for identification.

5. Samples of plant species found in the area are kept in the Herbarium Cabinet in the sample preparation laboratory, and may be used for comparison in species identification.

NOTE: Procedures for the collection, preservation, and maintenance of plant specimens are included in Plant Specimen Collection and Herbarium Management (WP 02-346).

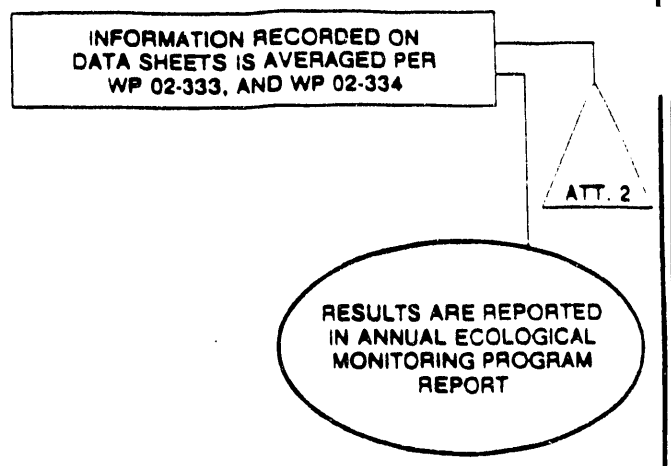


5.3 Post-Field Activities

1. Information recorded on the quadrat data sheets (Attachment 2) will be averaged according to steps outlined in WP 02-333 and WP 02-334.

NOTE: Results shall be reported in the annual Ecological Monitoring Program Report.

193s



INSTRUCTIONS FOR THE VEGETATION DATA SHEET

Heading

Plot - Ecological Monitoring Plot designation (CT1, CT2, SE1 . . .)
Date - month, day, year
Field Personnel - first and last name of person conducting survey
Coordinates - random coordinates drawn to locate quadrat

Perennial Foliar Cover

List perennials by scientific acronym (first two letters of the genus name and first two letters of the specific epithet, e.g., Gutierrezia sarothrae = GUSA; or use the first five letters of the genus name, e.g., Andropogon = ANDRO). Estimate foliar coverage in each of the four quarters of the frame. Average the four figures in the AVG column.

Annual Density and Foliar Cover

List annuals by scientific acronym. Estimate foliar coverage in each quarter of the frame and list the percentage on the FC line. Count individuals in each quarter of the frame and list the number on the D line. Average FC figures. Sum D figures.

VEGETATION DATA

Plot _____ Date _____ Field Personnel _____

Coordinates _____

Perennial Foliar Cover	1	2	3	4	Avg
_____					
_____					
_____					
_____					
_____					
_____					
_____					
_____					
_____					

Annual Density & Foliar Cover						Avg/Sum
	FC					
_____	D					
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WP Form 1434

SELECTING RANDOM LOCATIONS

1. SCOPE

This attachment describes the steps required to randomly locate sampling stations or points in the RES Program at the WIPP facility. These steps shall be followed to select a random location for collecting biotic samples, or other sampling activities where random locations within a rectangular area are required.

2. LOCATING A RANDOM SAMPLING STATION OR POINT

a. A starting point shall be defined at each sampling station for which these steps are used.

b. Draw a random number to represent one of the four major compass headings (N=1, S=2, E=3, and W=4) using a random number generator or a random number table. This will be the starting direction.

c. Draw a random integer between 0 and 100 to represent the number of paces to proceed in the starting direction (see Step 1).

d. Draw a second random integer between 0 and 100 to represent the number of paces to proceed in the second direction.

e. Enter these numbers in the appropriate blanks on the Sample Data Sheet for each sample.

3. IDENTIFICATION OF SAMPLING LOCATION IN THE FIELD

At the sampling station:

a. Proceed to the permanent marker or starting point.

b. Using a compass or the directional markers in place at the plots, find the starting direction indicated on the data sheet for the current sample or subsample.

c. Proceed in that direction for the number of paces determined by the first random number listed on the data sheet. Turn left 90 degrees and proceed in the second direction for the number of paces determined by the second random number listed on the data sheet.

d. If the selected location is inaccessible or inappropriate (e.g. man-made barrier), draw a new starting direction and proceed to the random location using the previously selected coordinates.

LIST OF REVIEWERS

Procedure Number: WP 02-337

Revision Number: -0-

Procedure Title: NES Vegetation Sampling Procedures

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
R. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-338 REV. 0 ISSUE DATE: 03/02/88

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES LITTER BAG HANDLING PROCEDURES

1.0 SCOPE

These procedures describe the methods for the preparation of litter bags and the measurement of litter decomposition in the ecological monitoring plots around the WIPP facility as conducted by the Nonradiological Environmental Surveillance (NES) Program that is part of the Radiological and Environmental Programs Section (REPS). Litter bags will be constructed, placed, collected, and processed as described in this document.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-302, Radiological Environmental Surveillance (RES) Quality Assurance/ Quality Control Implementation Procedures

WP 02-330, Non-Radiological Environmental Surveillance (NES) Implementation Procedures

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedures

WP 02-333, NES Sample Tracking Procedures

WP 02-334, NES Data Management Procedures

Schnurer, J. and T. Rosswall, 1982. Fluorescein diacetate hydrolysis as measure of total microbial activity in soil and litter. Applied and Environmental Microbiology 436: 1256-1251.

4.0 GENERAL

This procedure specifies the method for making, placing, and collecting litter bags to measure decomposition rates and microbial activity. Litter samples shall be prepared, emplaced, and collected according to a schedule outlined in the Ecological Program Plan (WP 02-2). The Principal Investigator (PI) is responsible for the implementation of this procedure.

Qualified personnel shall perform the task of this procedure, as described in WP 02-301. The WIPP Quality Assurance Department will be notified of any non-conformance condition by the REPS section manager as specified in WP 02-302.

The following activities are described in this procedure:

5.1 Collection of Leaves and Construction of Litter Bags
5.2 Placement of Litter Bags
5.3 Collection of Litter Bags
5.4 Processing of Litter Samples
5.5 Determining Ashed Weights

5.0 PROCEDURE

Collection of Leaves and Construction of Litter Bags

1. Leaves of shinnery oak (Quercus havardii) are collected after leaves have fallen from the shrubs in the areas adjacent to the Ecological Monitoring Control Plots.

   NOTE: Leaves which have turned brown and which do not appear to have been decomposed shall be collected.

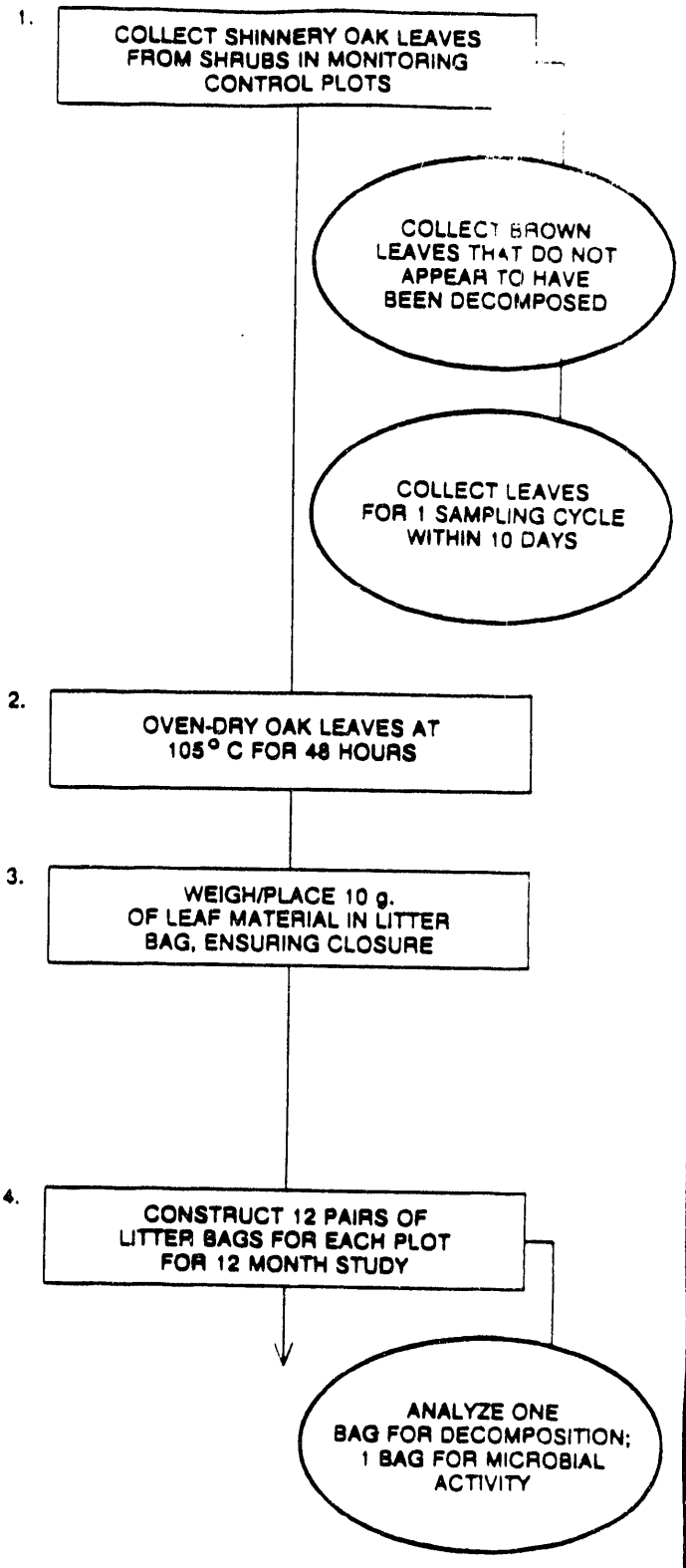
   NOTE: All leaves required for one sampling cycle (12 months) will be collected within 10 days.

2. Oak leaves shall be oven-dried at 105°C for at least 48 hours in a drying oven.

3. Weigh out 10 g of oven-dried leaf material and place in a litter bag. Fold the top of the bag down and staple it shut, using enough staples to ensure that the leaves cannot slip out of the bag.

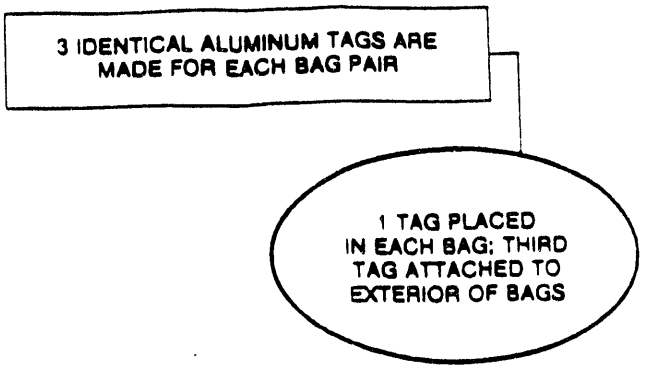
4. For a 12-month decomposition study, construct 12 pairs of litter bags for each Ecological Monitoring Plot. Pairs are emplaced together.

   NOTE: One bag of each pair will be analyzed for litter decomposition; the other will be analyzed for levels of microbial activity.



5. Three identical aluminum tags are made for each pair of litter bags. The tags shall include the Ecological Monitoring Plot identification and a letter identification for the bag (i.e., A, B) and the random location numbers.

NOTE: Place one tag inside each bag; the third tag will be attached to the outside of both bags.



5.2 Placement of Litter Bags

Each litter bag is approximately 20 cm x 20 cm and is made of a piece of mesh (1 mm) which has been folded and stapled to form a square envelope.

1. Twelve pairs of litter bags are randomly placed in each ecological monitoring plot, using the random site location procedure (Attachment 1).

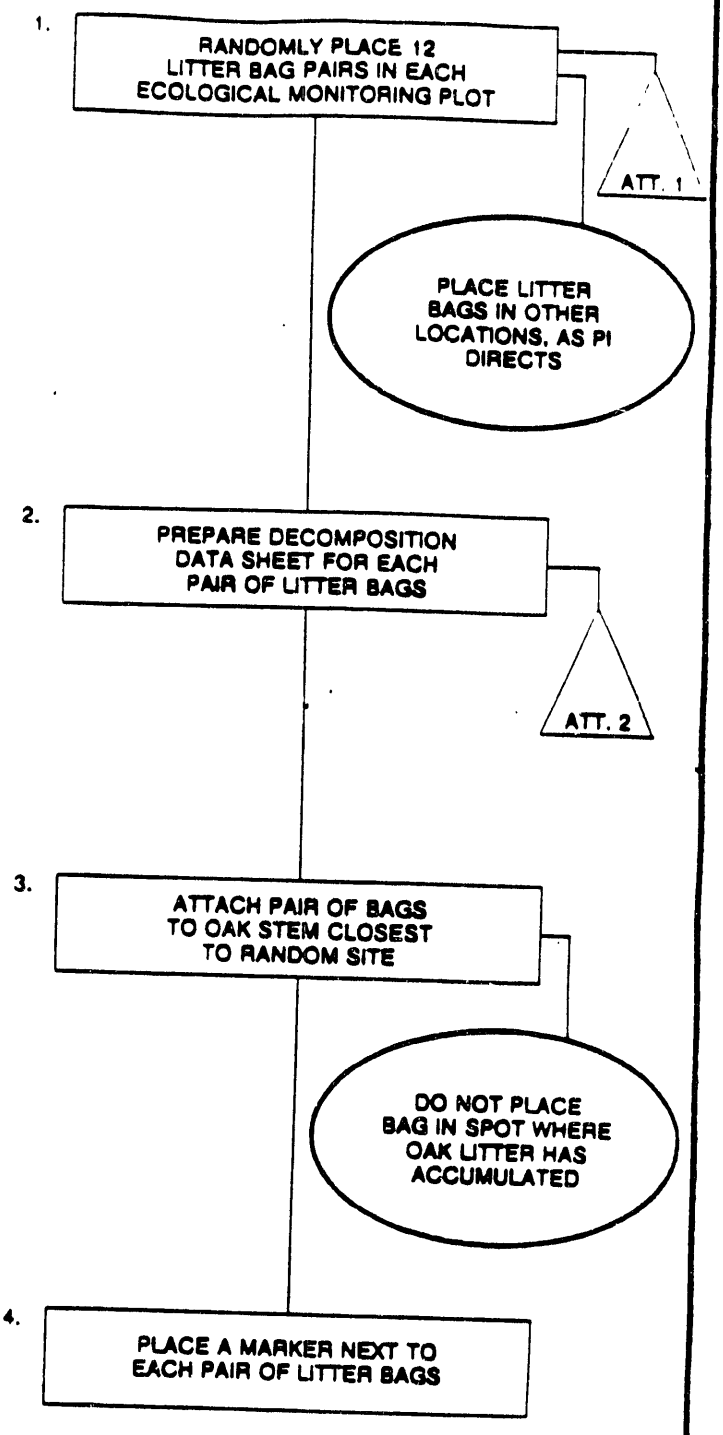
   NOTE: Litter bags may be placed in other locations as part of special research projects as directed by PI.

2. For each pair of litter bags, prepare a decomposition data sheet (Attachment 2) which will include the bag identification number and the random site location numbers for the bag pair.

3. At the random site, the pair of bags is attached to the oak stem which is closest to the random site.

   NOTE: The bag should be placed in a spot where oak litter has previously accumulated.

4. A marker is placed next to each pair of litter bags for tracking purposes.



5.3 Collection of the Litter Bags

At three-month intervals, three pairs of litter bags will be recovered from each monitoring plot. At three months, pairs A, B, and C will be collected; at six months, bags D, E, and F will be collected, and so forth, until the last three bags are collected at 12 months. If the bags cannot be collected in sequence (i.e., a bag has been destroyed or lost), another pair of bags may be collected. Note the collection date on the appropriate data sheet with an explanation of the action.

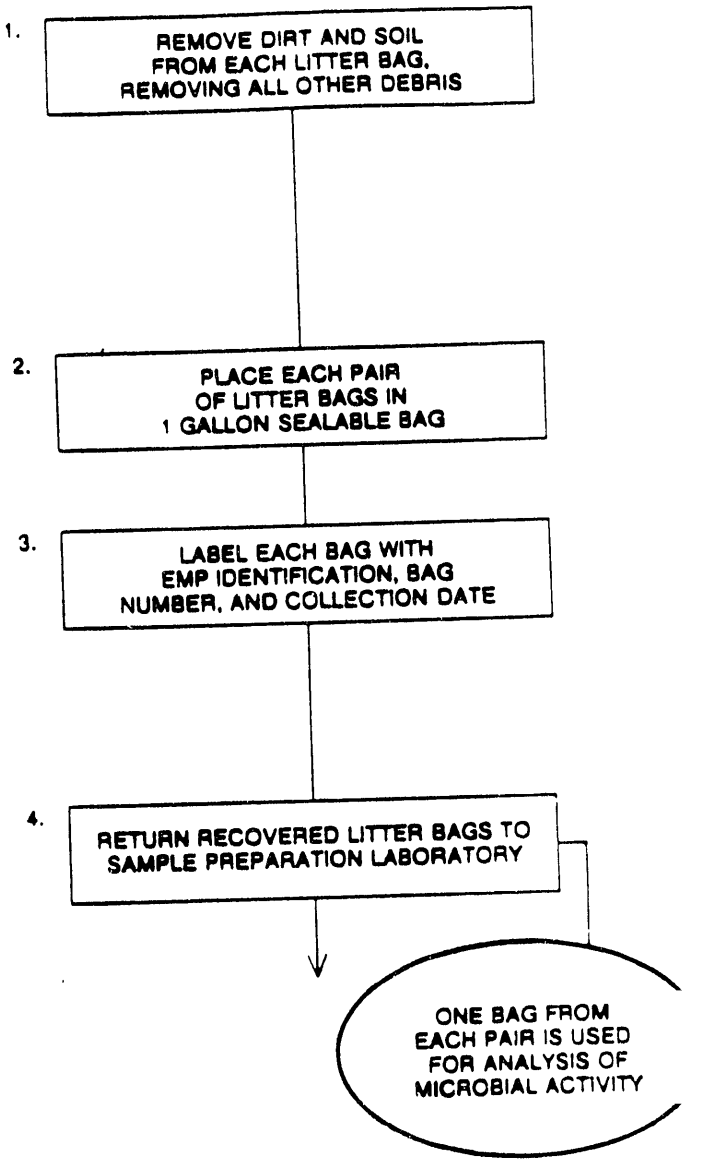
1. Gently remove as much soil as possible from the outside of each litter bag. Also remove any litter which is obviously not part of the original litter, e.g., grass or forb material which has fallen on or grown through the bags.

2. Place each pair of litter bags in a large (1 gallon) sealable bag.

3. The bag is labeled with the Ecological Monitoring Plot identification, the litter bag number, and the collection date.

4. Return all recovered litter bags to the sample preparation laboratory.

NOTE: One bag from each pair of litter bags is used for an analysis of microbial activity levels.

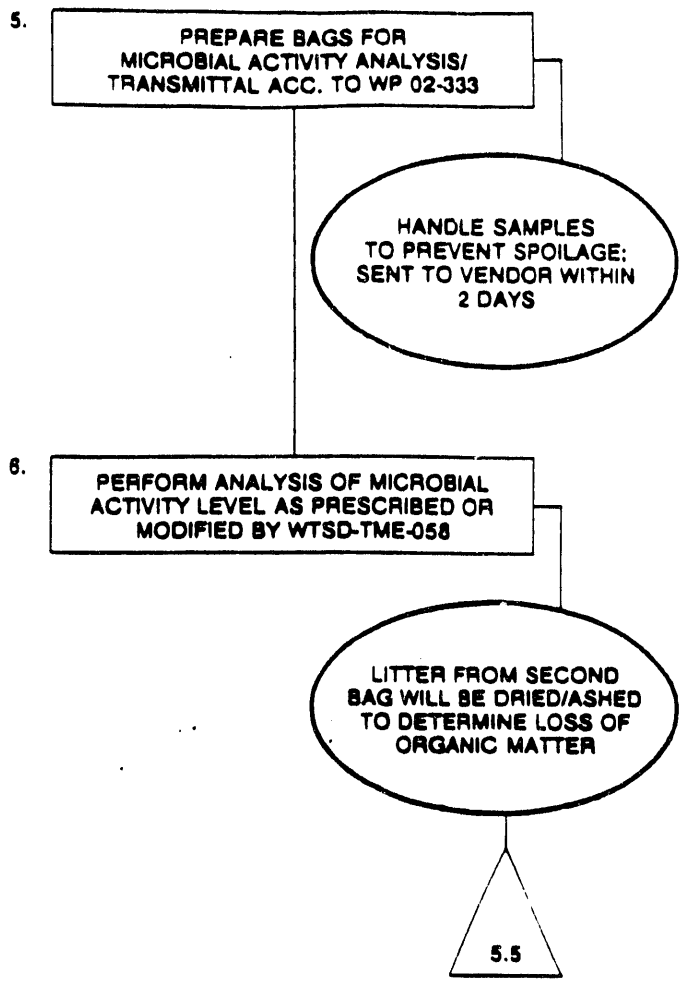


5. Prepare bags for analysis of microbial activity level for transmittal to the appropriate vendor according to procedures outlined in WP 02-333.

NOTE: The samples should be kept cool to prevent spoilage and shall be sent to the appropriate vendor within 2 days of collection.

6. The analysis of microbial activity level shall be according to the method described by Schnurer and Rosswall (1982) and modified by Dr. Elsa Taylor as described in WTSD-TME-058.

NOTE: The litter in the second bag from each pair will be dried and ashed as described in section 5.5 to determine the percentage of organic matter lost from the leaf material.



5.4 Processing Decomposition Samples

1. Air dry the litter in the lab for at least 72 hours, by propping the bags open.

2. Record on the decomposition data sheet (Attachment 2) for the corresponding litter sample the number of the pre-weighed metal can and its weight.

3. Place the litter into the can and reweigh, recording the total weight of the oven-dried can and the air-dried litter in the appropriate place on the data sheet (Attachment 2).

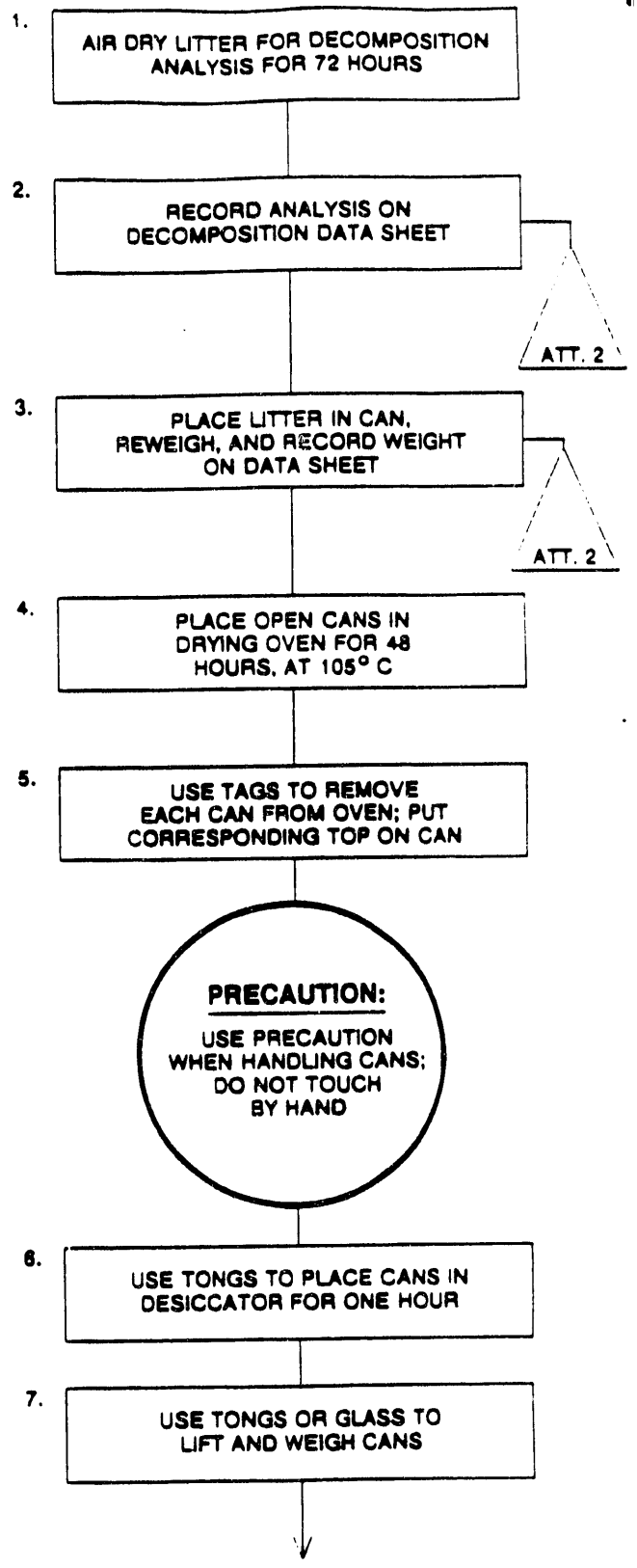
4. Place the open cans in the drying oven for at least 48 hours, at 105°C. The top of each can should be in the oven also.

5. At the end of the drying time, use tongs to remove each can from the drying oven and put the correct top on the corresponding can.

   PRECAUTION: Precaution shall be taken when handling the containers. It is important not to touch the cans, or their tops with your hands.

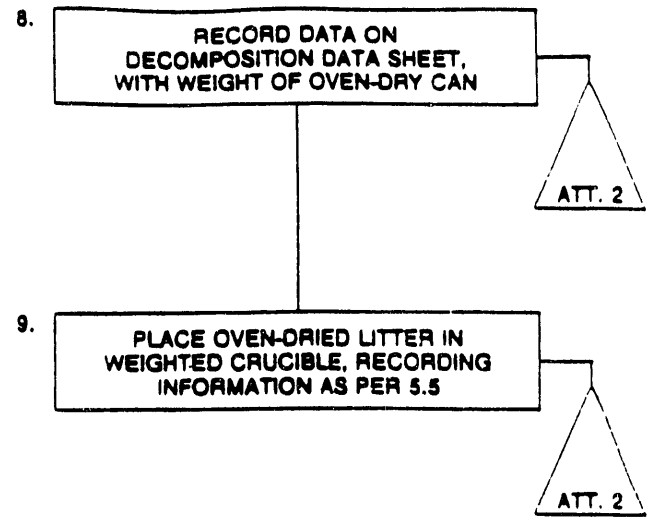
6. Using tongs, put the cans in the desiccator for one hour.

7. After one hour, using tongs or gloves, lift each can out of the desiccator and weigh it.



8. Record data in the appropriate block on the decomposition data sheet (Attachment 2), along with the weight of the oven-dry can containing the oven-dry litter.

9. The oven-dried litter shall be placed into a preweighed crucible. Record the crucible number and weight on the sample on sheet (Attachment 2). Record the weight of the oven-dried litter, following the procedures presented in 5.5.



5.5 Determining Ashed Weights

NOTE: To determine the ashed weight of each crucible, place each crucible in a muffle furnace for four hours at minimum 700°C. Allow the crucibles to cool (oven temperature should not go below 100°C) before placing them in the desiccator for one hour (use tongs). Weigh the crucibles. The weight shall be recorded for each crucible on the sample data sheet, along with the crucible number. At least once every litter field cycle (12 months), ashed weight will be determined for each crucible.

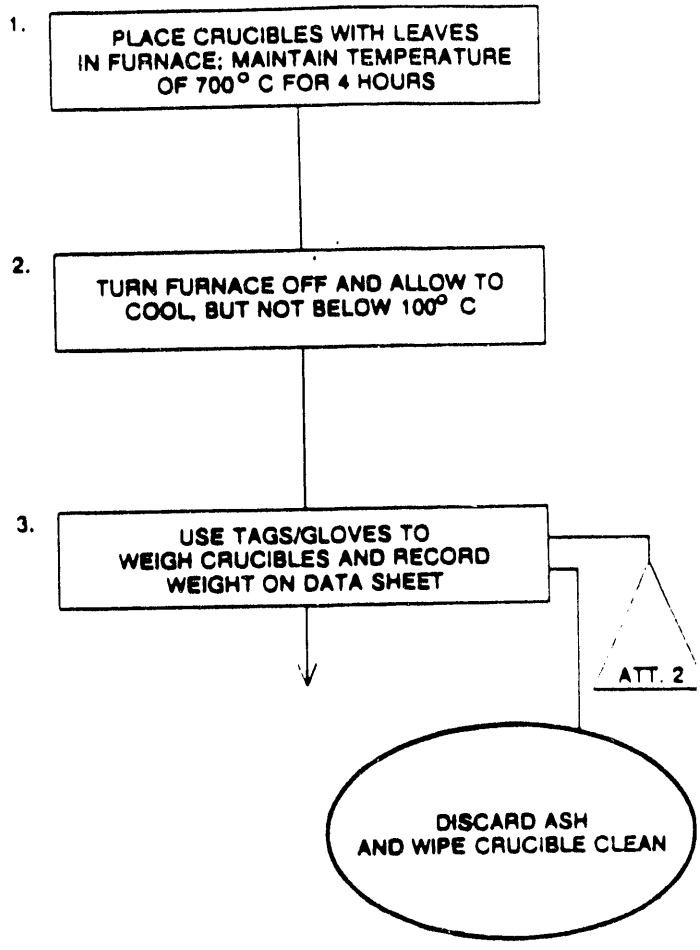
Specific procedural steps are as follows:

1. Place the crucibles with leaves in the muffle furnace; bring the furnace to at least 700°C and maintain that temperature for approximately 4 hours.

2. Turn off the furnace and allow to cool, but not below 100°C before placing the crucibles in the desiccator for one hour.

3. Using tongs or gloves, weigh each crucible and record the weight on the data sheet (Attachment 2).

NOTE: The ash can be discarded and the crucible wiped clean.



4. Using the Elkins and Whitford 1982 formula below or any algebraic variant thereof, determine the percentage of organic matter lost from the litter samples:

$$d = \frac{I + (A - Y)}{S} - F$$

where:

d = organic matter lost for each sample

I = initial dry weight of sample (10 g)

A = final inorganic weight (700°C for at least 4 hours)

Y = weight of initial organic content (a constant for each set of litter, determined when litter is collected)

S = inorganic content of soil = 99%

F = final dry weight of each sample

and:

$$\%d = \frac{d \times 100}{I - Y}$$

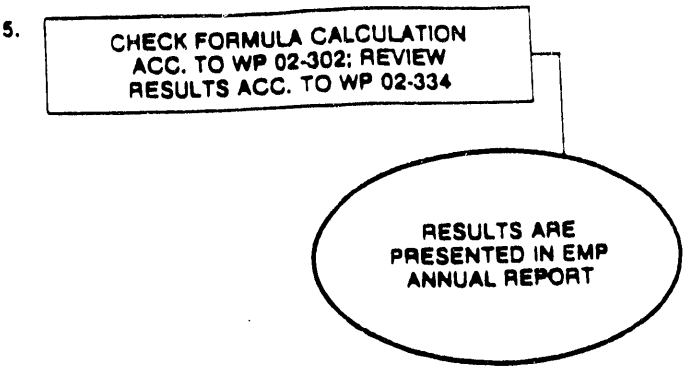
4. USING ELKINS/WHITFORD 1982 FORMULA, DETERMINE PERCENTAGE OF ORGANIC LOST MATTER



5. Formula calculation shall be checked according to WP 02-302. Results of the decomposition study and the microbial activity level assay will be reviewed according to the procedures outlined in WP 02-334.

NOTE: Results will be presented in the annual Ecological Monitoring Program Report.

171s



IDENTIFYING RANDOM LOCATIONS

1. SCOPE

This attachment describes the steps required to randomly locate sampling stations or points in the NES Program at the WIPP facility. These steps shall be followed to select a random location for collecting soil samples, placing litter bags, evaluating vegetation parameters, or other sampling activities where random locations within a rectangular area are required.

2. LOCATING A RANDOM SAMPLING STATION OR POINT

a. A starting point shall be defined at each sampling station for which these steps are used.

b. Draw a random number to represent one of the four major compass headings (N=1, S=2, E=3, and W=4) using a random number generator or a random number table. This will be the starting direction.

c. Draw a random number between 1 and a predetermined maximum value (integer) to represent the number of paces to proceed in the starting direction (see step a).

d. Draw a second random number between 1 and a predetermined maximum value (integer) to represent the number of paces to proceed in the second direction.

e. Enter these numbers in the appropriate blanks on the Sample Data Sheet for each sample.

3. IDENTIFICATION OF SAMPLING LOCATION IN THE FIELD

At the sampling station:

a. Proceed to the permanent marker or starting point.

b. Using a compass or the directional markers in place at the plots, find the starting direction indicated on the data sheet for the current sample or subsample.

c. Proceed in that direction for the number of paces determined by the first random number listed on the data sheet. Turn left 90 degrees and proceed in the second direction for the number of paces determined by the second random number listed on the data sheet.

d. If the selected location is inaccessible or inappropriate (e.g. man-made barrier), draw a new starting direction and proceed to the random location using the previously selected coordinates.

DECOMPOSITION DATA SHEET

_____ Quarter Decomposition Data _____

Plot _____ Sample _____ Random Location Coordinates _____

Date Litter Bag Emplaced: _____ Date Litter Bag Collected: _____

Can No. & Wt. (g)	Can + O.D. Lvs. (g)	O.D. Lvs. (g)	Crucible No. & Wt. (g)	Crucible + O.D. Lvs. (g)	O.D. Lvs. (g)	Crucible + Ash (g)	Ash (g)

Note: O.D. is Oven Dry Leaves

Formulas: $d = \frac{I + A - Y}{S} - F$ $\%d = \frac{d \times 100}{I - Y}$

Where: d = est. Organic Material lost from sample
I = initial Oven Dry wt. of sample (10.0 g)
A = inorganic Ash wt.
Y = initial Inorganic wt. of lvs. (constant for =)
S = estimated inorganic content of soil (constant = 99g)
F = final dry wt. of each sample

Calculations:

Done by _____ Date _____

Reviewed/Checked by _____ Date _____

WP Form 1430

LIST OF REVIEWERS

Procedure Number: WP 02-338

Revision Number: -0-

Procedure Title: NES Litter Bag Handling Procedures

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
R. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-340 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NES ENVIRONMENTAL PHOTOGRAPHY PROCEDURES

1.0 SCOPE

This describes the methods for aerial and surface photography of the WIPP facility for the nonradiological and environmental surveillance conducted by the Radiological and Environmental Programs Section (REPS). Results from the routine activities outlined in this procedure will be used as indicators of the impact of pre-operational, operational, and post-operational activities on observable ecological parameters in the area around the WIPP facility.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures

WP 02-330, Non-Radiological Environmental Surveillance (NES) Implementation

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedures

WP 02-333, NES Sample Tracking Procedures

WP 02-344, Stripchart Recorder Operation Procedures

American Institute of Biological Sciences Report on the WIPP Biology Program. 1979.

Department of Energy. 1980. Final Environmental Impact Statement, Waste Isolation Pilot Plant. Vol. 1 and 2.

4.0 GENERAL

Qualified personnel shall perform the task of this procedure as described in WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS Manager as specified in WP 02-302.

The taking of aerial and surface photographs for various programs conducted by the REPS shall be as specified in this procedure.

All photography taken as part of this program will be dated and labeled as necessary, and retained in the appropriate section of the Radiological and Environmental Programs file.

5.0 PROCEDURE

5.1 Aerial Photography

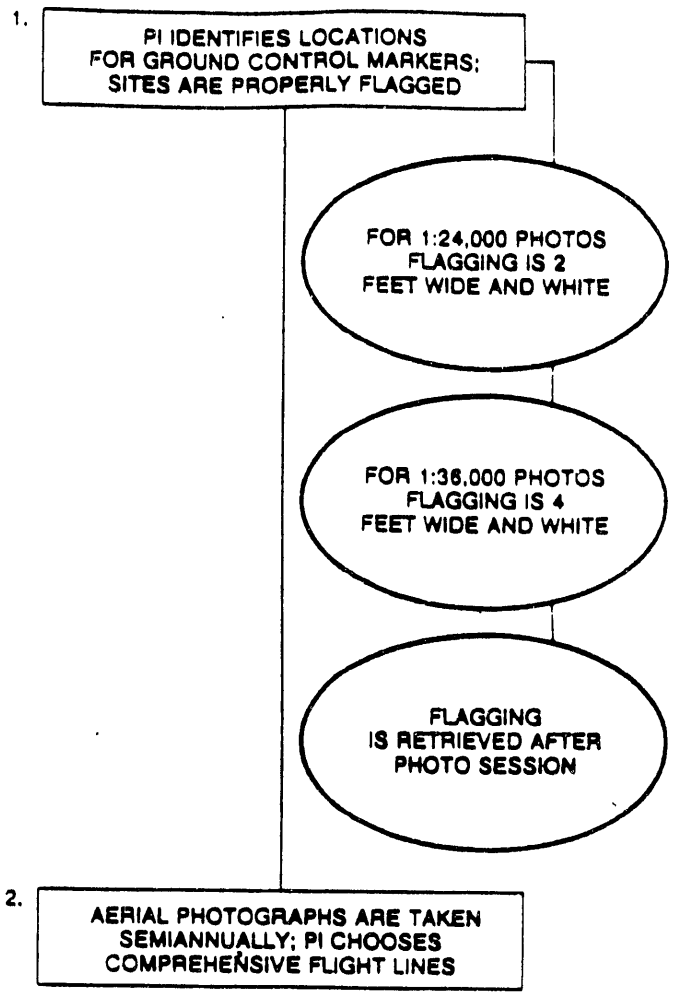
1. Prior to the photo session, the Principal Investigator (PI) will identify locations for ground control markers. These sites should be flagged accordingly for 1:24,000 or 1:36,000 air photos or higher elevation.

   NOTE: For 1:24,000 photos flagging must be at least 2 feet wide and white.

   NOTE: For 1:36,000 photos flagging must be at least 4 feet wide and white.

   NOTE: Flagging shall be retrieved after completion of the photo session.

2. Aerial photographs are taken semiannually. The flight lines shall be chosen by the PI to obtain coverage of the WIPP site including access roads, railroad, and other surface facilities.



5.2 Surface Photography

Surface photographs shall be taken semiannually, in late spring and late fall, at each ecological monitoring plot. In order to achieve consistent exposure quality, the cognizant environmental personnel (CEP) shall adhere to the follcwing procedures:

1. The CEP shall use a 35-mm single lens reflex camera with a wide angle lens. Kodacolor ASA 100 color print film shall be used.

2. A kodak color control chart shall be included in each surface photograph to establish a color control check.

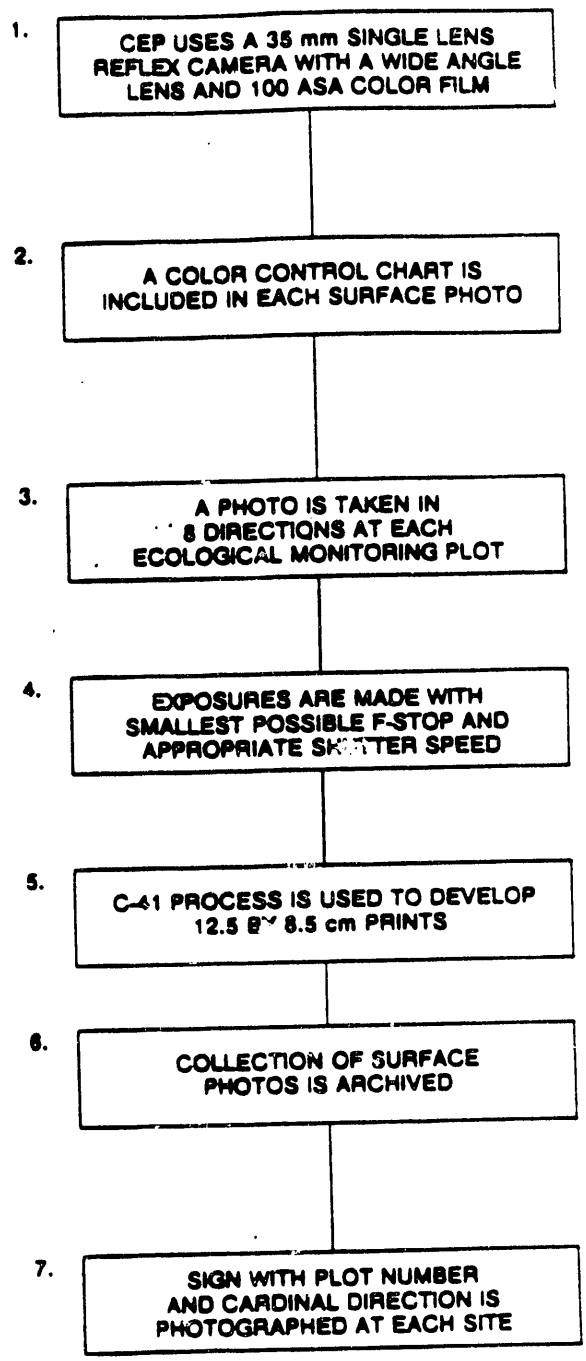
3. At each ecological monitoring plot photographs are taken at 45° angles in eight directions.

4. Film exposures are made with the smallest possible f-stop and appropriate shutter speed for weather/sky conditions.

5. The C-41 process is used to develop 12.5 by 8.5 cm prints.

6. The collection of surface photographs is archived and serves as an historical resource.

7. A sign indicating plot number and cardinal direction is photographed in each of the eight angles at each site. The date is recorded on the film automatically by the camera's data-back.



WIPP PHOTOGRAPHIC DATA SHEET

DATE OF PHOTOGRAPHY: _____

PHOTOGRAPHER (S): _____

AREA COVERED: _____

WEATHER/SKY CONDITIONS: _____

TIME OF DAY: _____ START: _____ FINISH: _____

AERIAL ☐		SURFACE ☐	
CAMERA		CAMERA	
SERIAL NO.		LENS FOCAL LN.	
LENS FOCAL LN.		HT. OF CAMERA ABOVE GROUND	
ALTITUDE		DIRECTIONS (VIEW)	
NEGATIVE SCALE		FILM TYPE	
FILM TYPE		FILTER TYPE	
FILTER TYPE		F-STOP	
F-STOP		SHUTTER SPEED	
SHUTTER SPEED		NO. OF FRAMES	
NO. OF FRAMES		COLOR CONTROL CHART	
% OVERLAP		PROCESSING	
GROUND CONTROL MARKERS		REMARKS	
PROCESSING			
REMARKS			

COMPLETED BY: _____ DATE: _____ REVIEWED BY: _____ DATE: _____

LIST OF REVIEWERS

Procedure Number: WP 02-340

Revision Number: 0

Procedure Title: NES ENVIRONMETAL PHOTOGRAPHY PROCEDURES

Reviewer's Name	Department
J. Cockman	REPS
B. Kehrman	REPS
R. Youngman	QA
T. Fischer	REPS

NO: 02-342 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NES WEATHERTRONICS STATION PROCEDURE

1.0 SCOPE

This document provides procedures for the operation of the General Weathertronics weather station. The station may be run for the Nonradiological Environmental Surveillance (NES) by the Radiological and Environmental Programs Section (REPS). The operation of the weather station, data reduction, and the disposition of strip charts will be conducted as described in this document.

This station simultaneously records air temperature, wind speed, and wind direction as functions of time on two recording strip charts. The Weathertronics station may be used as a backup system. The data collected by this system may be required only if a power-outage occurs at the site and data is not available from the primary monitoring system.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-301, Radiological Environmental Surveillance (RES) Implementation Procedure

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures

WP 02-343, Sierra-Misco Weather Station Operation Procedures

WP 02-344, Strip-Chart Recorder Operation Procedure

4.0 GENERAL

Qualified personnel shall perform the task of this procedure as described on WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS Manager as specified in WP 02-302. The following activities are included in this procedure:

5.1 Changing the Recorder Strip Chart
5.2 Labeling and Storing Strip Charts

5.0 PROCEDURE

5.1 Changing the Recorder Strip Chart

1. Turn off the switch for wind speed and wind direction. Unplug the temperature recorder before changing strip charts.

2. Open the record by rotating the knob on the upper left-hand side of the recorder front panel, so the front panel will rotate forward from the case. Flip down the plastic tab at the bottom right.

3. Push on the top of the two clips which hold the feed roller and the take-up roller, then lift up the chart rollers and remove both of them from the chassis.

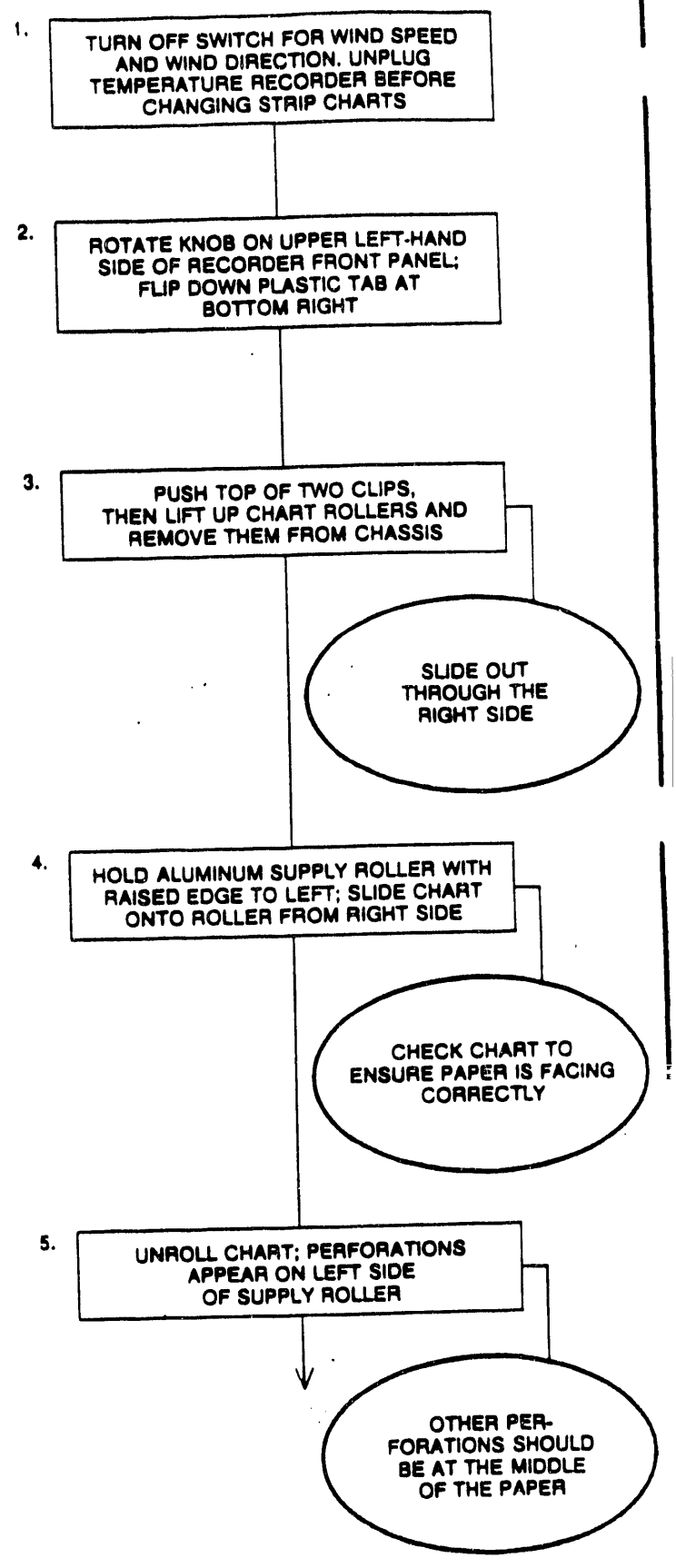
   NOTE: Slide out through the right side.

4. To install a new chart, hold the aluminum supply roller with the raised edge to the left, and slide the chart onto the roller from the right side.

   NOTE: Check the chart to be sure the paper is facing correctly.

5. Unroll a small portion of the chart; perforations should appear on the left side of the supply roller.

   NOTE: The other set of perforations should be at the middle of the paper.



6. Unroll about six inches of chart and slide the paper into the chassis via the chassis latch.

NOTE: Keep the paper taut to clear the stylus.

7. Slide the chart paper back and forth to engage the chart perforations in the drum sprockets.

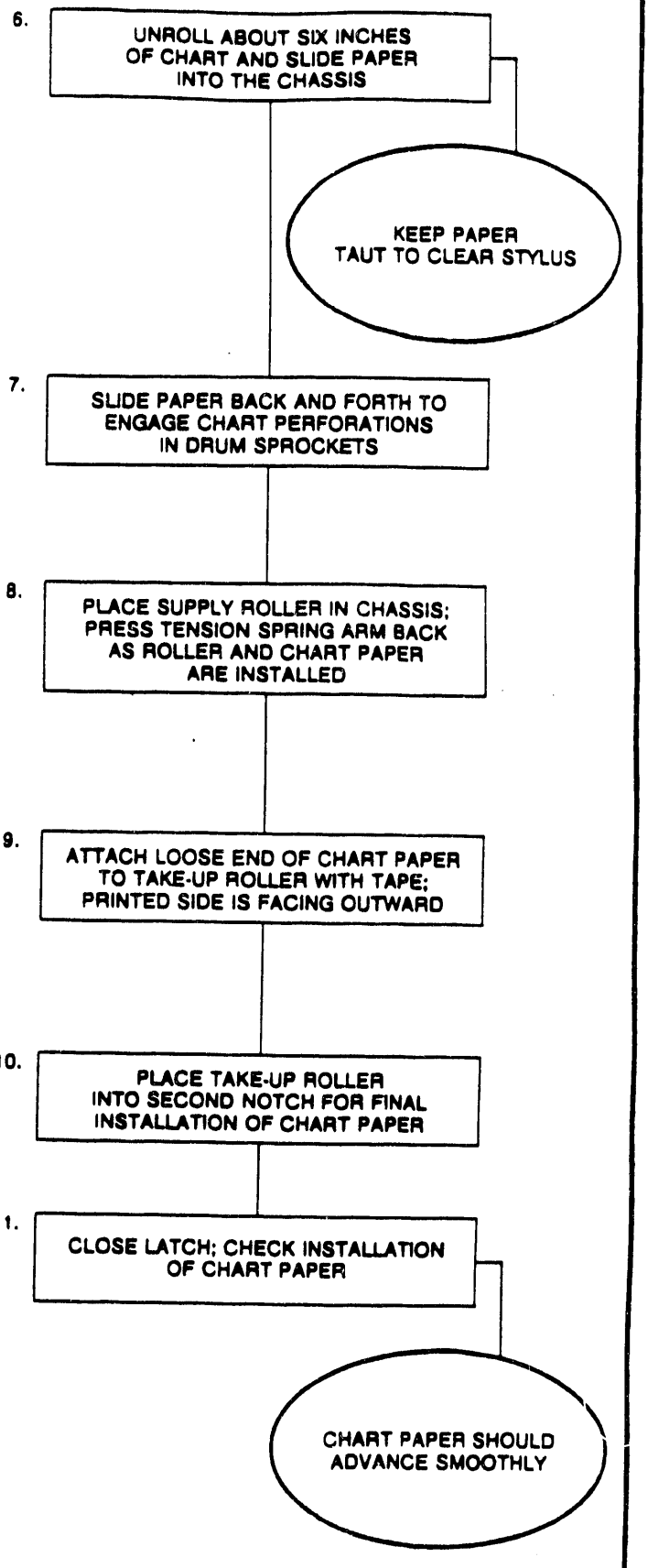
8. Place the supply roller in the chassis, pressing the tension spring arm back as the supply roller and chart paper are installed.

9. Attach the loose end of the chart paper to the take-up roller with a small piece of tape, and roll the take-up roller so the printed side is facing outward.

10. Place the take-up roller into the second notch for final installation of the chart paper.

11. Close the chassis latch; check the chart paper installation by simultaneously pressing and rolling downward the chart advance wheel on the left-hand side of the front panel.

NOTE: The chart paper should advance smoothly.



5.2 Labeling and Storing Strip Charts

Directions for labeling and filing strip charts are included in WP 02-344, Section 5.3.

180s

LIST OF REVIEWERS

Procedure Number: WP 02-342

Revision Number: 0

Procedure Title: NFS WEATHERTRONICS STATION PROCEDURE

Reviewer's Name	Department
J. Cockman	REPS
B. Kehrman	REPS
T. Fischer	REPS
R. Youngman	QA

NO: 02-343 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE:

PROCEDURE AUTHOR: J. Cockman

TITLE: NES SIERRA MISCO WEATHER STATION RECORDER STRIP CHART - MODEL 1048

1.0 SCOPE

This document establishes the procedures for operation of the Sierra Misco (SM) Mechanical Weather Station Model 1048 Recorder Strip Chart. The weather station is operated for Nonradiological Environmental Surveillance (NES), as conducted by the Radiological and Environmental Programs Section (REPS). The operation of the weather station, data reduction, and the disposition of strip charts will be conducted as described in this document.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-304, NES/RES Sample Tracking Procedure

WP 02-306, NES/RES Equipment Maintenance and Control Procedure

WP 02-330, Nonradiological Environmental Surveillance (NES) Implementation Procedure

WP 02-344, Strip-Chart Recorder Operation Procedure

WP 10-003, Instrumentation Control and Calibration

4.0 GENERAL

The station simultaneously records air temperature and relative humidity, wind speed and direction, and precipitation on a single chart as functions of time. The recording of the first four parameters is completely mechanical; ordinary dry batteries (voltage 1.5) are used to power the electric clock and to record precipitation. Calibration of the station during use shall be maintained in accordance with WP 10-003. Operability test procedures are described in WP 02-306, Section 5.5.

All activities associated with the monitoring and documentation of ambient weather conditions shall be as described in the procedure manual maintained by the Principal Investigator (PI) as per WP 02-330. Operation of the weather station shall be done by qualified personnel designated by the PI.

5.0 PROCEDURE

A strip chart records data for 60 days of continuous operation. To replace the used roll and/or install a new one, this procedure shall be followed:

1. Raise the lever and remove the take-up spool.

2. Remove the flange and take off the recorded chart roll.

3. Center a new roll on support and compress the spring on the right.

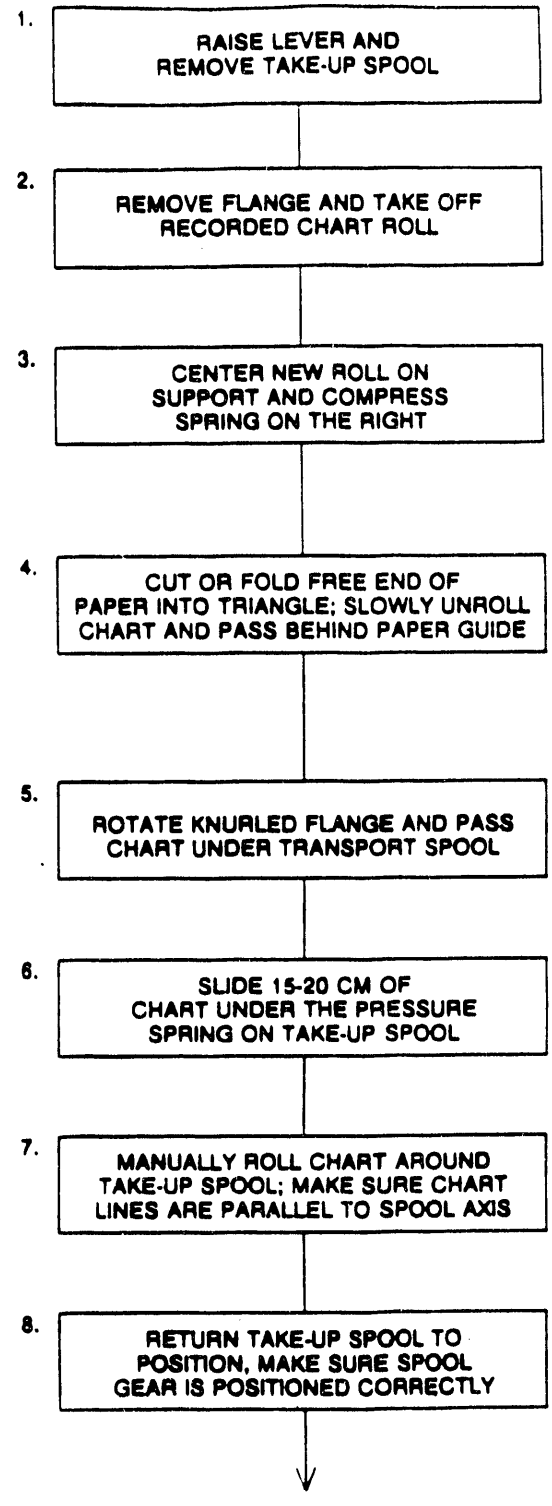
4. Cut or fold the free end of the chart roll into a triangle; slowly unroll the chart and pass it behind the paper guide.

5. Rotate knurled flange and pass chart under the transport spool. The holes in the chart should coincide with the sprockets on the transport spool.

6. Slide 15-20 cm of the chart under the pressure spring on the take-up spool.

7. Manually roll the chart around the take-up spool at least twice, making sure the horizontal chart lines are parallel to the axis of the spool.

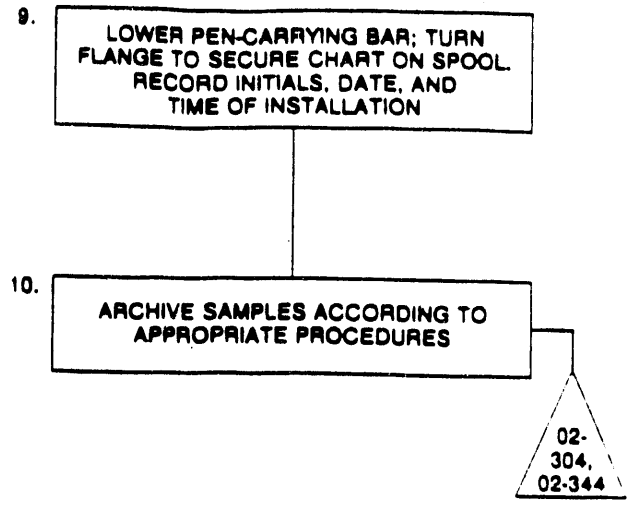
8. Return the take-up spool to its seat, making sure the gear on the spool is positioned correctly.



9. Lower the pen-carrying bar and manually turn the knurled flange several times to secure the chart on the spool. Record initials, the date, and the time the chart started onto the end of the paper.

10. Archive strip charts according to the Sample Tracking Procedure WP 02-304. Strip charts shall be labeled and stored according to Strip Chart Recorder Operation Procedure WP 02-344, Section 5.3.

181s



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LIST OF REVIEWERS

Procedure Number: wp 02-343

Revision Number: 0

Procedure Title: NES Sierra Misco Weather Station Recorder Strip Chart - Model 1048

Reviewer's Name	Department
R. Youngman	QA

NO: 02-344 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: STRIP-CHART RECORDER OPERATION PROCEDURE

1.0 SCOPE

This procedure establishes steps for using the Chessell Corporation Model 300 Servo strip-chart recorder in the Nonradiological Environmental Surveillance (NES) Program of the Radiological and Environmental Programs Section (REPS). The operation of the strip-chart recorder shall be conducted as described in this procedure.

2.0 DEFINITIONS

None

3.0 REFERENCES

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedure
WP 02-330, Non-Radiological Environmental Surveillance (NES) Implementation
WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedure
WP 02-333, NES Sample Tracking Procedure
WP 02-334, NES Data Management Procedure
WP 02-335, NES Equipment Maintenance and Control Procedure

4.0 GENERAL

Chessell Model 300 strip-chart recorders serve as secondary, or backup data recording devices to a primary data recording system (e.g., the SUM-X digital data logger). They may also be used as the primary system as needed in the NES program, or used for demonstration data display devices.

Qualified personnel shall perform the task of this procedure as described in WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS Manager as specified in WP 02-302.

A Chessell recorder is installed on a device with output compatible to the input specifications of the recorder. Maintenance of the recorders shall be as specified in WP 02-335, NES Equipment Maintenance and Control. When the Chessell recorder is used as a primary data recording device, or becomes the primary device due to inoperability of the primary system, NES data management and quality control procedures WP 02-334 and WP 02-302, respectively, shall be used in the reduction and control of the strip-chart data.

The following procedures are discussed in this document:

5.1 Changing the Strip Chart
5.2 Installing and Exchanging the Pen Cartridge
5.3 Labeling and Storing the Strip Charts

5.0 PROCEDURE

1 Changing the Strip Chart

1. Open the front window panel and switch both the "POWER" and "CHART" switches to the "off" position.

2. Record date and time of removal on the chart at the pen location; initial chart.

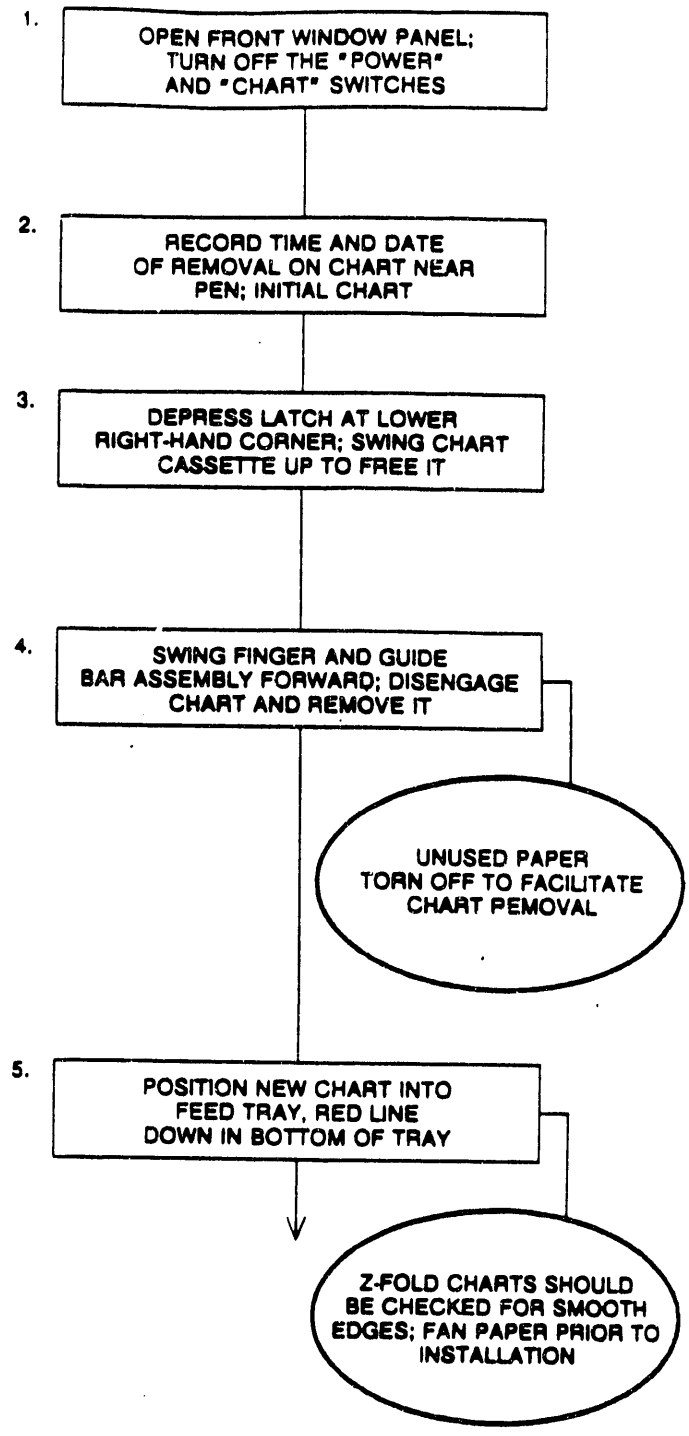
3. Depress the latch at the lower right-hand corner of the recorder and swing the chart cassette upward until it is free from the chassis forks.

4. Swing the finger and guide bar assembly forward and disengage chart from the sprockets; remove the chart.

   NOTE: The unused paper may be torn off to facilitate removal of the chart.

5. Position new chart paper into the feed tray with the red finishing line face down in the bottom of the tray. The printed side of the chart should be oriented to the outside when the paper is placed over the sprocket roller.

   NOTE: The Z-fold charts should be checked for square, smooth edges by aligning the new charts on a flat surface. Prior to installation, use thumb to fan the chart paper. This will ensure separation of the leaves.



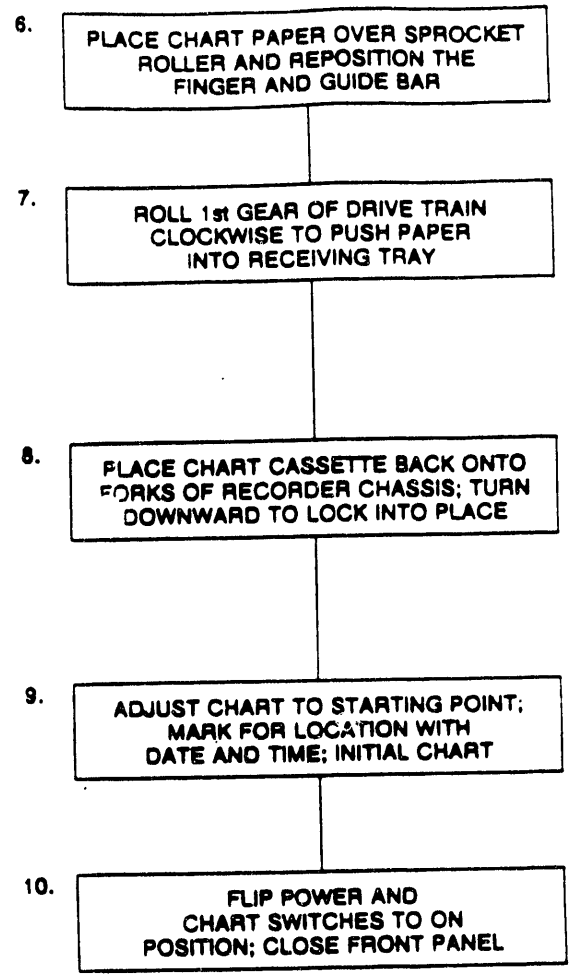
6. Place the chart paper over the sprocket roller and reposition the finger and guide bar.

7. Roll the first gear of the drive train clockwise to push the chart paper into the receiving tray. Continue to feed paper until proper folding of the paper in the receiving tray is ensured.

8. Place the chart cassette back onto the forks of the recorder chassis and turn downward until it locks into place. If the cassette does not lock easily, remove and check for obstructions or improper gear mesh.

9. Adjust the chart to the desired starting point and mark the pen location on the chart with the date and time; initial chart.

10. Flip the "POWER" and "CHART" switches to the "on" position and close the front panel.



5.2 Installing or Replacing Pen Cartridges

1. Open the front window panel and flip the "POWER" and "CHART" switches to the "off" position. Mark the pen location with the date and time; initial chart.

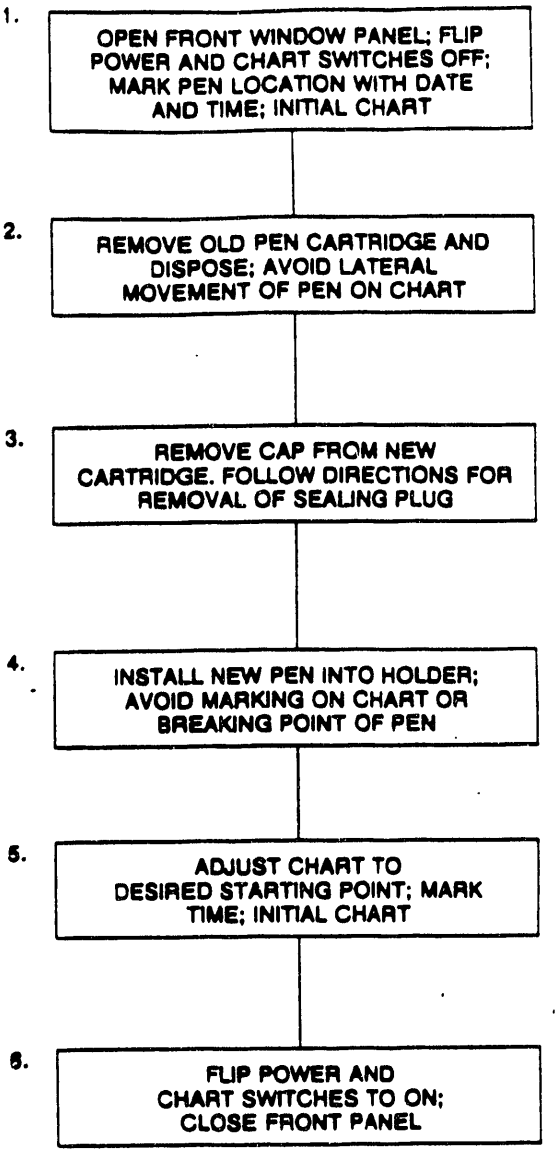
2. Carefully remove the old pen cartridge and dispose of it. Avoid lateral movement of the pen on the chart.

3. Remove the protective cap from the new pen cartridge. Follow the directions on the cartridge for removal of sealing plug; puncturing the cartridge may be necessary.

4. Carefully install the new cartridge into the holder, avoiding lateral movement of the pen or strong pressure on the point.

5. Adjust the chart to the desired starting point and mark it with the time; initial chart.

6. Flip the "POWER" and "CHART" switches to the "on" position and close the front panel.



5.3 Labeling and Storing Strip Charts

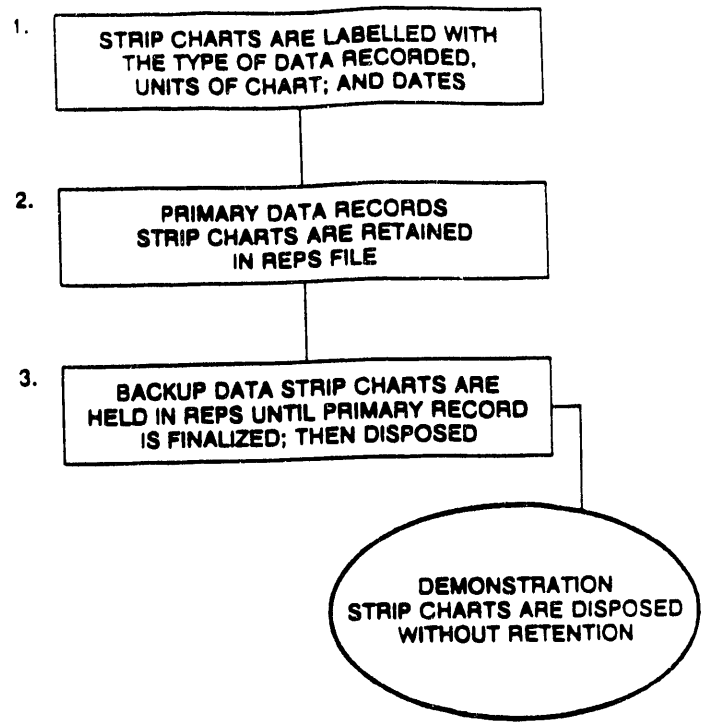
1. Strip charts are labeled with the type of data recorded, the units of the chart, and the dates included on the chart.

2. Strip charts used as primary data records are retained in the REPS file and final deposition will be determined by the REPS Manager.

3. Strip charts used as backup data are held in the REPS file until the primary record is reviewed and finalized. Backup data records may then be disposed.

NOTE: Only strip charts generated for demonstration purposes may be disposed without retention.

182s



LIST OF REVIEWERS

Procedure Number: WP 02-344

Revision Number: 0

Procedure Title: STRIP-CHART RECORDER OPERATION PROCEDURE

Reviewer's Name	Department
J. Cockman	REPS
R. Kehrman	REPS
T. Fischer	REPS
R. Youngman	QA

NO: 02-345 REV. 0 ISSUE DATE: 01/15/88

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NES SURFACE WATER AND SEDIMENT SAMPLING PROCEDURE

1.0 SCOPE

This document provides procedures for collecting surface water and sediment samples for chemical analysis, as part of the Nonradiological Environmental Surveillance (NES) Program conducted by the Radiological and Environmental Programs Section (REPS). Samples will be collected and prepared for storage or analysis as described in this document.

2.0 DEFINITIONS

None

3.0 REFERENCES

Prill, S. D. and G. R. Buckle, 1987, Guidance Manual: Surface Water and Sediment Sampling for the Environmental Monitoring Programs, Waste Isolation Pilot Plant, International Technology Corporation for Department of Energy

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures, Rev. 0

WP 02-303, RES Scheduling, Documentation, and Field Preparation Procedures, Rev. 0

WP 02-304, RES Sample Tracking Procedures

WP 02-305, RES Data Management Procedures

WP 02-306, RES Equipment Maintenance and Control Procedures

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedures, Rev. 0

WP 02-333, NES Sample Tracking Procedures, Rev. 0

WP 02-334, NES Data Management Procedures, Rev. 0

WP 02-335, NES Equipment Maintenance and Control Procedures, Rev. 0

4.0 GENERAL

All activities associated with the collection, handling, and transmittal of surface water and sediment samples shall be described in the Environmental Procedure (WP 02-3). Samples will be collected in accordance with schedules developed according to WP 02-303.

Qualified personnel shall perform the tasks of this procedure as described in Section 5.2 of WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS Manager as specified in WP 02-302.

Activities shall be documented on a Surface Water and Sediment Sampling Data Sheet (Form WP-1228). An example of a completed Surface Water and Sediment Sampling Data Sheet is provided as Attachment 1.

Data sheets and sample containers are prepared prior to sampling activities according to the procedures listed in WP 02-332.

When water samples are collected from the same location as sediment, the water samples must be collected first to avoid suspension of bottom sediments in water samples. The Principal Investigator (PI) will determine the required sample volumes prior to the sampling trip. The amount of sample collected at each station must be large enough to ensure that the appropriate number of aliquots is available for the required analyses. A minimum of two staff members will form the water/sediment sampling team. Non-swimmers shall wear a certified flotation device while performing sampling activities.

The following activities are described in this procedure:

5.1 Preparation for Field Sampling
5.2 Collection of Single Water Samples
5.3 Collection of Composite Water Sample
5.4 Collection of Sediment Sample
5.5 Field Observations
5.6 Post-Collection Activities
5.7 Post-Sampling Lab Activities

5.0 PROCEDURE

.1 Preparation for Surface Water and Sediment Sampling

1. The following listed equipment may be required and will be checked for availability and condition prior to sampling. The final list will be determined by the PI, according to the type and location of the sampling location.

Equipment Required for Surface Water and Sediment Sampling

- o Surface Water and Sediment Sampling Data Sheets/Instruction Completion Checklists (WP 1228, Attachment 1)
- o Sample labels
- o Anemometer
- o Thermometer (glass, range 0-40°C)
- o Camera and film
- o Boat, oars, and water safety gear
- o Rubber boots and/or hip waders
- o 20 feet of sounding line with terminal plumb
- o Conductivity meter and probe with standard solutions
- o Densitometer or hydrometer(s)
- o Paper towels

1. REQUIRED EQUIPMENT IS DETERMINED BY PI AND MADE AVAILABLE PRIOR TO SAMPLING

- o Indelible markers; pens; strong, waterproof tape
- o Containers for transport of samples

Equipment Required for Sediment Sampling

- o Widemouth amber bottles and VOA bottles
- o Eckman dredge and operation lines
- o Shovel
- o Spatula/scraping tool

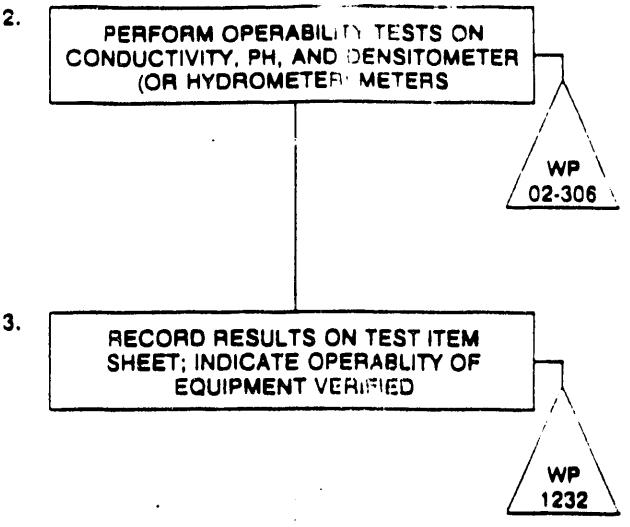
Equipment Required for Water Sampling

- o Water sample collector
- o Sample bottles as specified for specific sample type (Attachment 2)
- o pH meter with standard solutions
- o 500 ml deionized water (>14 mega Ohm conductivity)
- o Concentrated nitric acid
- o Concentrated sulfuric acid
- o Sodium hydroxide (as tablets or in solution)
- o Eyedropper
- o Litmus paper with range of pH 2.0-12.0

- o Filter paper for metals sample
- o Large mixing container for compositing
- o Large graduated cylinder

2. Verify the operability of the conductivity meter, pH meter, densitometer or hydrometer by performing an operability test as described in WP 02-306.

3. Record the results of each operability test on the appropriate Operability Test Item Sheet (Form WP-1232). Indicate on the data sheets that operability of equipment has been verified.



5.2 Collection of Single Water Samples

The following shall be performed at stations designated for the collection of a single water sample.

1. Record date and time on the Surface Water Sampling Data Sheet for that sampling station (WP 1228, Attachment 1).

2. Proceed to the sampling station as specified by the PI.

   NOTE: Boat or hip waders may be required.

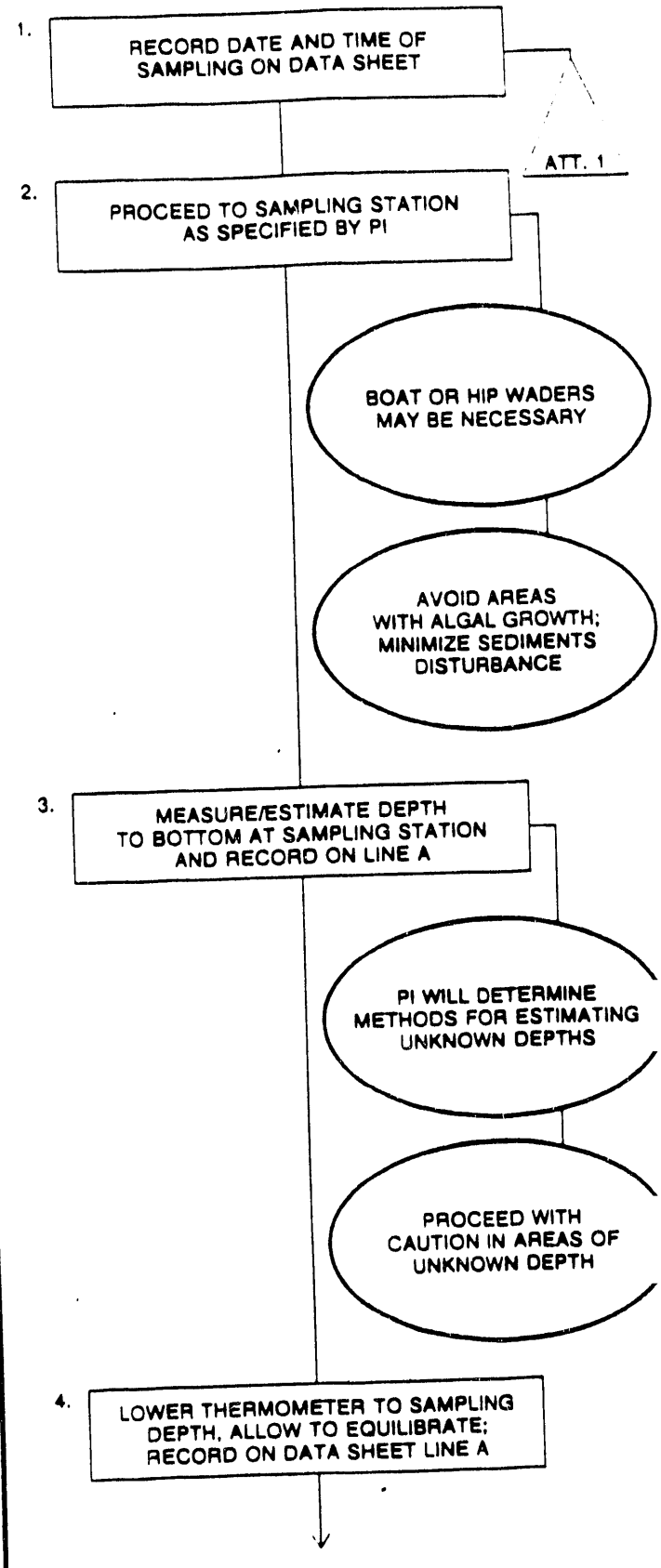
   NOTE: Avoid any areas with high algal growth on the water's surface. Minimize disturbance of bottom sediments with oars, anchor, or boots.

3. Measure or estimate depth to bottom at the sampling station and record on the data sheet on Line A.

   NOTE: Methods used to determine depth will be at the discretion of the PI.

   NOTE: Proceed with caution in areas of unknown depth, observing safety precautions.

4. Lower the thermometer to sampling depth, allow it to equilibrate, and record water temperature on the data sheet on Line A.



5. Rinse the collecting bottle at least three times prior to sampling by filling to approximately one-fourth capacity with the water to be sampled, then shaking the water out before re-rinsing.

NOTE: VOA sample bottles should not be rinsed.

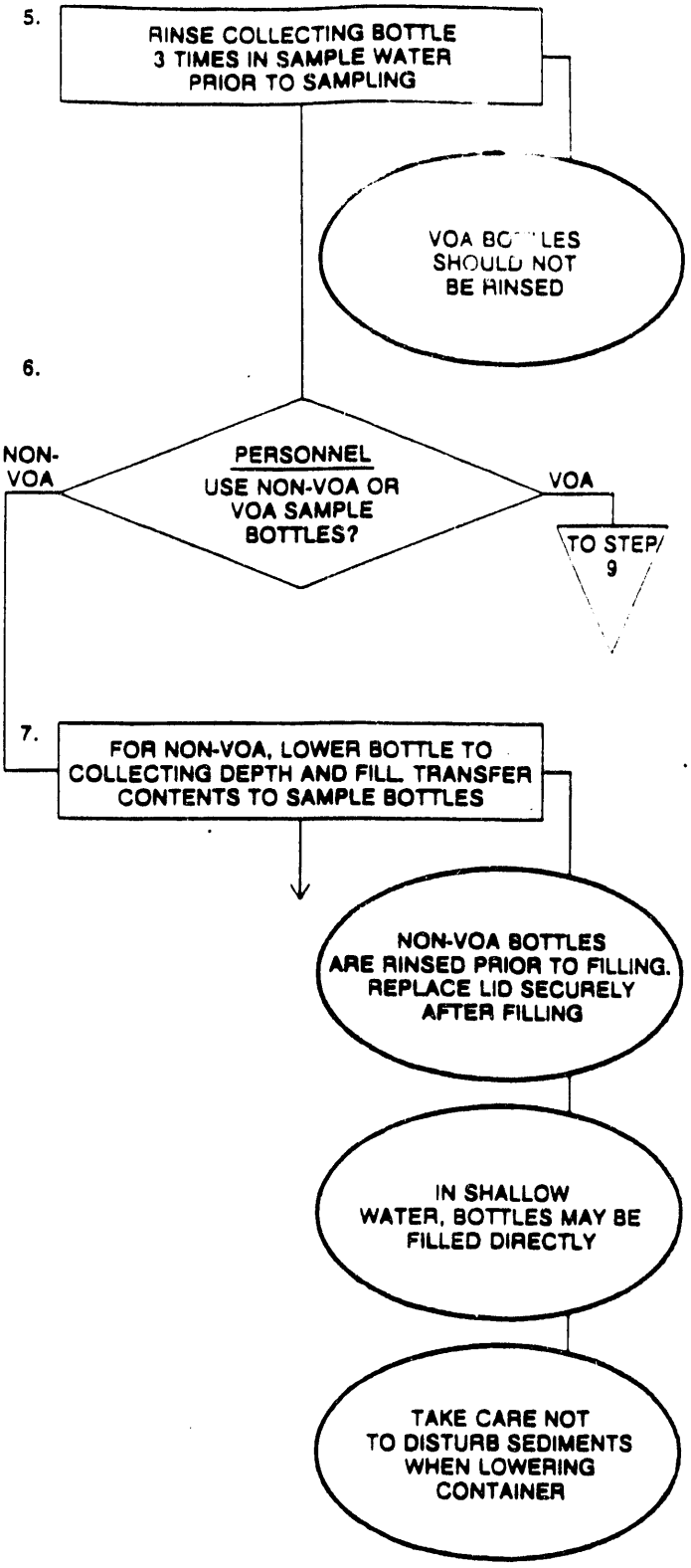
6. Personnel shall determine whether to use non-VOA or VOA sample bottles.

7. For non-VOA sample bottles, lower the collecting bottle to the sampling depth and fill. Bring it to the surface and transfer the contents to the sample bottles.

NOTE: Non-VOA sample bottles should be rinsed with small amounts of the sample water prior to filling. Replace sample bottle lid securely after filling with the sample.

NOTE: In shallow water, sample bottles may be filled directly, without the use of a separate collecting bottle.

NOTE: Care should be taken to prevent disturbing bottom sediments when lowering the container.



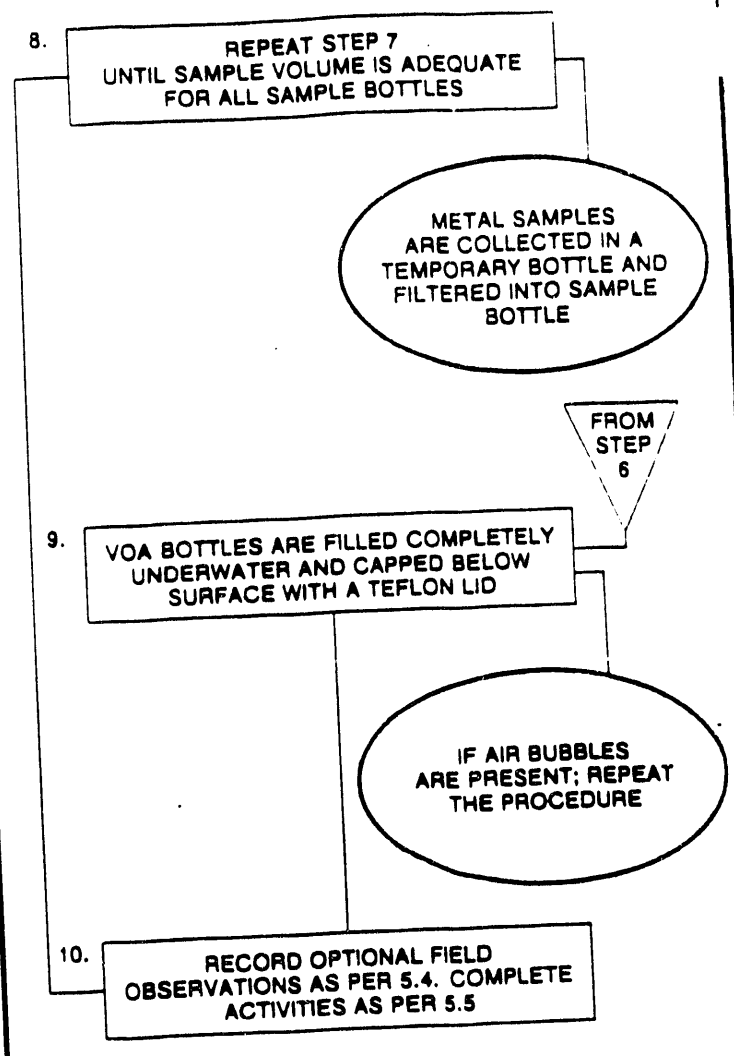
8. Repeat Step 7 until an adequate sample volume is obtained for all sample bottles specified for that station.

NOTE: Metals samples are collected as described above in a temporary sample bottle and must be filtered before being transferred to the final sample bottle.

9. VOA samples bottles must be filled completely underwater and capped with a teflon lid. No air bubbles can be in the bottle prior to capping.

NOTE: If air bubbles are present, repeat the procedure.

10. Record optional field observations as described in Section 5.4. Complete post-collection field activities as described in Section 5.5.



5.3 Collection of a Composite Water Sample

The following procedures shall be performed at stations designated for the collection of a composite water sample. The PI will decide on the number of locations and depths from which subsamples will be taken to form the composite water sample.

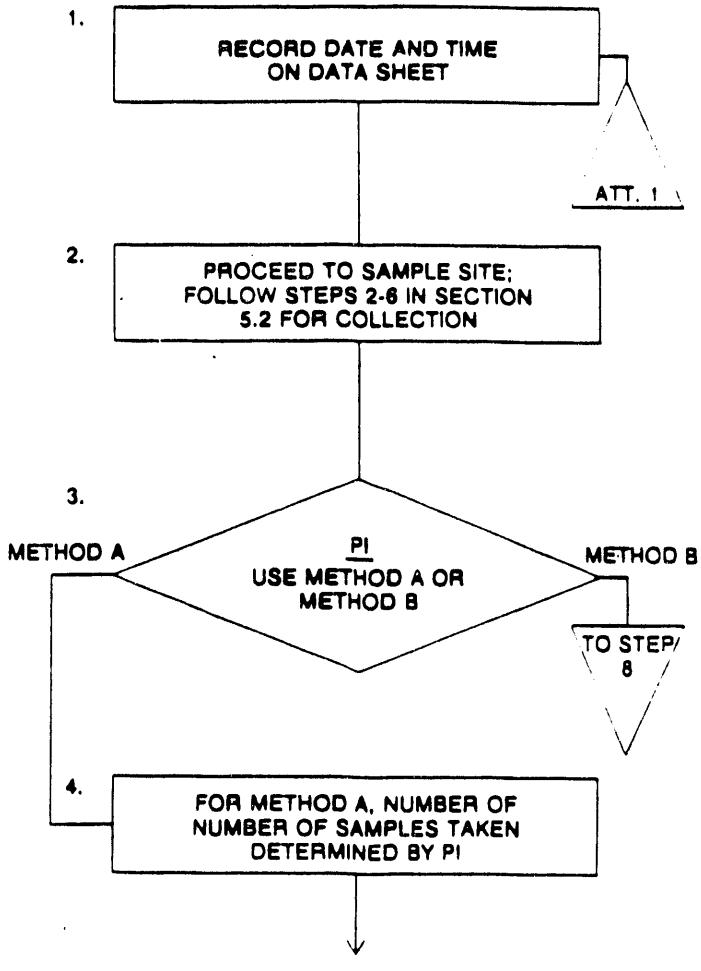
NOTE: VOA samples may not be composited. The PI will decide whether a single VOA sample will be taken from a single location or multiple samples will be taken from separate locations.

1. Record date and time on the Surface Water Sampling Data Sheet for that sampling station (WP 1228, Attachment 1).

2. Proceed to site of the first subsample and follow Steps 2-6 in Section 5.2 for collecting the subsample for each location.

3. The PI determines which of the two methods (A and B) may be used to composite the water sample.

4. For Method A, the number of subsamples to be taken is determined by the PI.



5. The volume of sample required from each subsample is determined for each sample bottle by dividing the sample bottle volume by the number of subsamples.

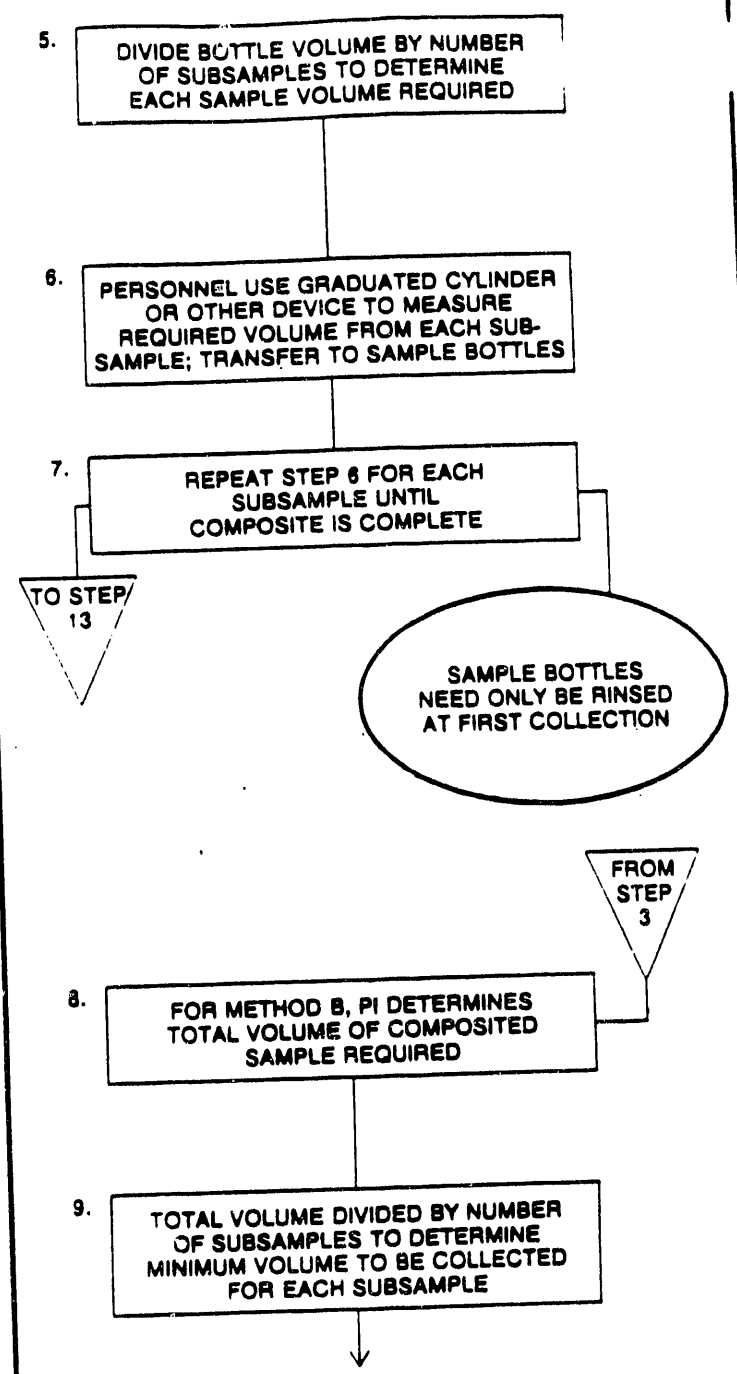
6. Personnel shall use a graduated cylinder or equivalent measuring device to measure the required volume from each subsample and transfer that quantity to each sample bottle.

7. Repeat Step 6 for each subsample until the composite sample is complete.

NOTE: Sample bottles need only be rinsed at the first subsample collection.

8. For Method B, the PI determines the total volume of composited sample required for all sample bottles.

9. The total volume is divided by the number of subsamples to determine the minimum volume to be collected for each subsample.



10. Personnel collect the same volume of water for each subsample (measure with a graduated cylinder or equivalent device) and transfer the subsamples to a mixing container.

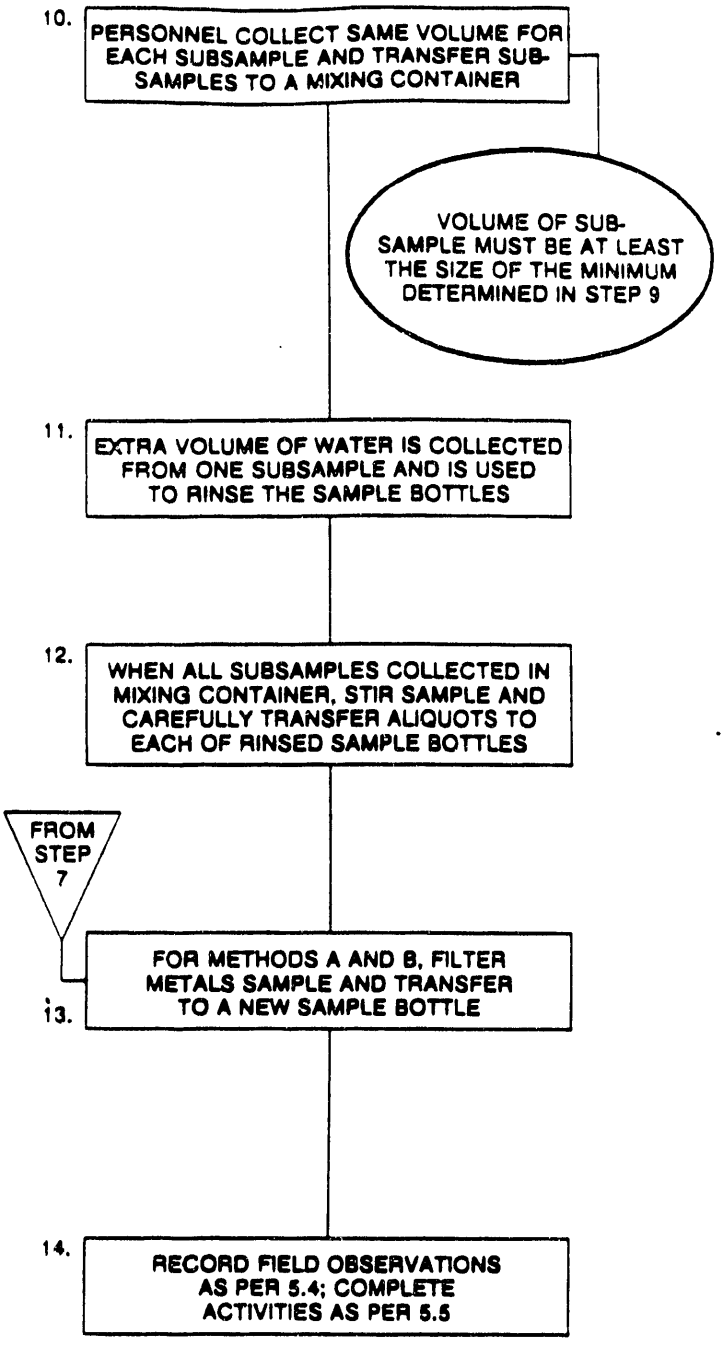
NOTE: The volume of the subsamples must be at least the size of the minimum determined in Step 9. The volume of the mixing container must be adequate to hold all subsamples.

11. An extra volume of water is collected from at least one of the subsamples, and is used for rinsing the sample bottles.

12. When all subsamples have been collected in the mixing container, stir the sample and carefully transfer aliquots to each of the rinsed sample bottles.

13. For both Methods A or B, filter metals sample and transfer to a new sample bottle.

14. Record field observations as described in Section 5.4. Complete post-collection activities according to Section 5.5.



5.4 Collection of Sediment Samples

1. Collect sediment samples after water samples have been collected and when both types of sampling are being performed at the same location.

   NOTE: If the water is shallow at the point of collection, a shovel may be used to collect the sediment sample. Otherwise, the Eckman dredge should be used.

2. Allow the material to drain after collection with either the shovel or dredge.

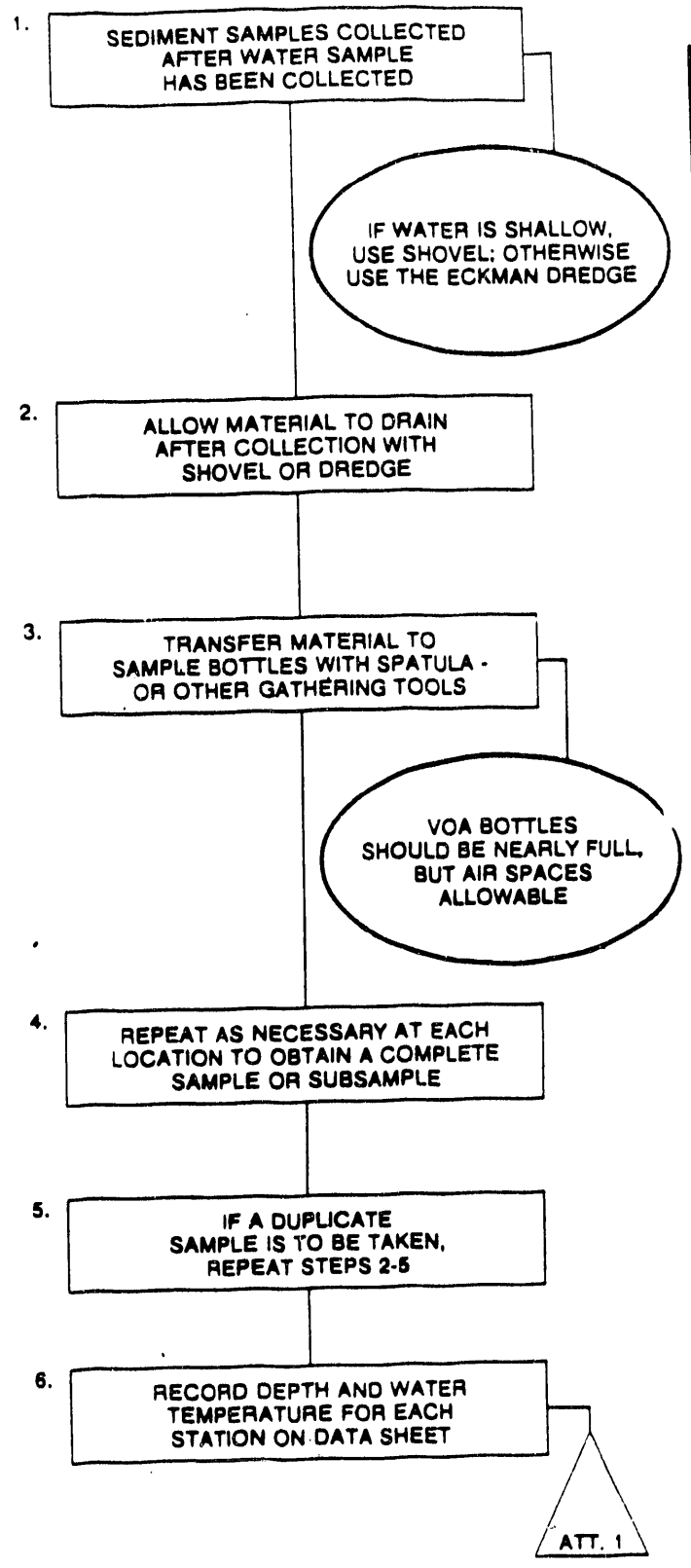
3. Transfer the material from either the shovel or dredge to the sample bottles with the spatula or other gathering tools.

   NOTE: VOA bottles should be nearly full. Air spaces are allowable.

4. Repeat, as necessary, for each location to obtain sufficient material for a complete sample or subsample.

5. If a duplicate sample is to be taken, repeat Steps 2 through 5 as necessary.

6. Record depth and water temperature on the data sheet (WP 1228, Attachment 1) for each station.



5.5 Optional Field Observations

The following optional observations are recommended but not required.

1. Prior to leaving the sampling location, observe the following weather and water quality parameters and record on the data sheet (WP 1228, Attachment 1):

    - o Air temperature: measured or estimated
    - o Wind speed: measured or estimated
    - o Water surface condition: smooth or calm, rippled, wavy whitecaps
    - o Clarity: Clear, turbid, very turbid (a Secchi disk may be used to quantify clarity)
    - o Relative water level: normal, above normal, below normal
    - o ph: measured with a portable meter or with litmus paper
    - o Conductivity: measured with a portable meter
    - o Temperature: measured on sample used for pH determination
    - o Density: measured with a densitometer or hydrometer

1. PRIOR TO LEAVING SAMPLING LOCATION, NOTE WEATHER AND WATER CONDITIONS AS NECESSARY

2. It is recommended that photographs be taken to document conditions at the time of sampling. Photographs should be labeled as to location, direction, and date and retained with the data sheets.

2. PHOTOGRAPHS ARE TAKEN TO DOCUMENT CONDITIONS AT TIME OF SAMPLING



5.6 Post-Collection Activities

This section applies to the preparation of samples for storage and shipment. Water samples requiring chemical preservation shall be processed in the field (as indicated below) as soon as possible after sample collection (or collection of the last subsample of a composite).

1. Begin post-collection activities by verifying data sheets (Attachment 1) and sample containers for completeness and accuracy of field information. Verify identification numbers and field observations.

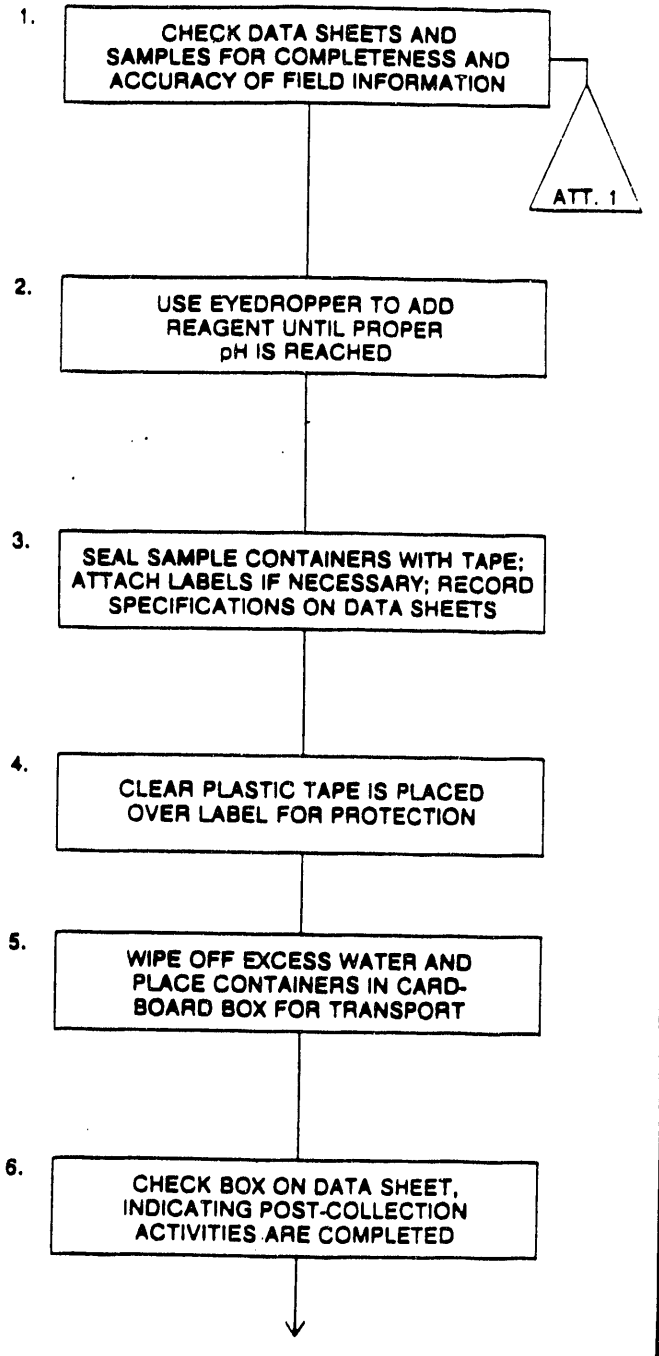
2. Using an eyedropper or appropriate dispenser, add concentrated reagent to the appropriate water samples until the pH is as required.

3. Seal the sample containers and secure with tape. Attach labels to sample bottles and record specifications on data sheets.

4. Clear plastic tape is placed over the label for protection.

5. Wipe off excess water and place containers in a cardboard box for transport to the sample preparation laboratory.

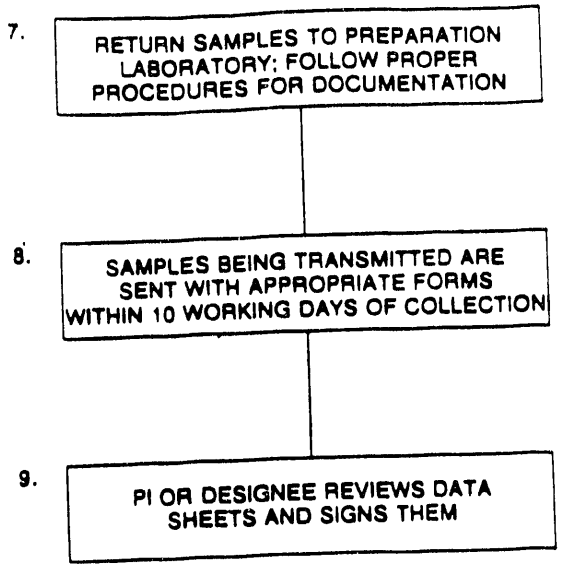
6. Check the data sheet, indicating that post-collection field activities have been performed.



7. Return samples to the sample preparation laboratory. Follow the procedures outlined in WP 02-304 for preparing documentation for transmitting or archiving samples.

8. Samples being transmitted are sent with appropriate forms within 10 working days of sample collection, or as otherwise directed by the PI.

9. The PI or a designee shall review the data sheets and sign.



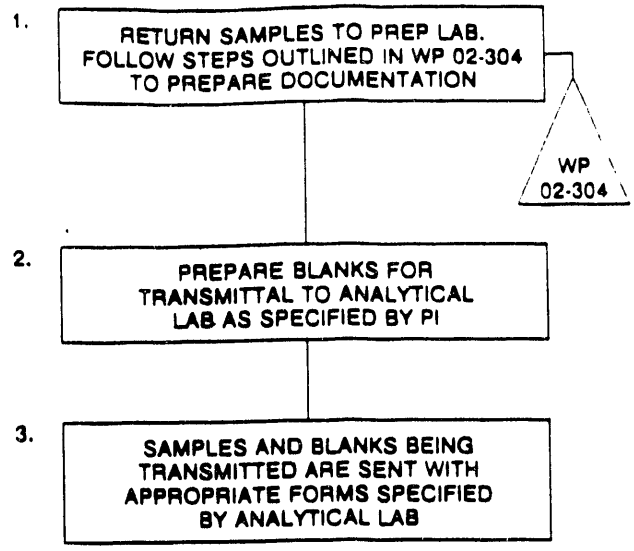
5.7 Post-Sampling Lab Activities

1. Return samples to sample prep lab. Follow the steps outlined in WP 02-304 and prepare the documentation for transmitting or archiving samples.

2. Prepare blanks for transmittal to the analytical lab as specified by the PI.

3. Samples and blanks being transmitted are sent with appropriate forms as specified by the analytical lab.

187s



DIRECTIONS FOR COMPLETING SURFACE WATER SAMPLING DATA SHEET

The following information applies to the completion of Surface Water Sampling Data Sheets (Form WP-1228) as specified in the RES Surface Water Sampling Procedures. An example of a completed Surface Water Sampling Data Sheet/Instruction Completion Checklist is provided on pages 4 and 5 of this attachment.

Item (Front of Sheet)	Description
Data Sheet No.	Unique data sheet number assigned and stamped according to WP 02-303.
Sampling Station	Accepted name of the location at which the sample is taken.
Equipment Operability Verified	Check the box to indicate operability tests have been performed on instruments being used to measure pH, conductivity, and density.
Unique Identity Code	List of identity codes of all samples being collected at the sampling station.
Specification/Comments	Description of the type of sample, type of container, type of preservation, and/or type of analysis to be performed on the sample referred to by the corresponding code.
Sample Collection:	
Date/Time	Month/day/year and time (24-hr. clock) that the samples are collected.
Depth to Bottom	Measured or estimated depth of the water at the point of sample collection.
Composite Sample	Check the box if the sample being collected is a composite.
Temp(s)	The water temperatures measured at each sampling depth at each sampling station (A, B, C).
Depth(s)	The depth at which the samples are collected at each sampling station (A, B, C).
Location and Comments	Description of sampling station and any pertinent information about the station.

Item (Front of Sheet)	Description
Field Measurements:	
Air temperature	Measured or estimated air temperature (shade) at the time of sample collection.
Wind speed	Measured or estimated wind speed (or wind speed range if the wind is variable) at the time of sample collection.
Water surface	Observed condition of the water surface (e.g., smooth, rippled, wavy, whitecaps).
Clarity	Observed or measured clarity of the water at the sampling location (e.g., clear, turbid, very turbid).
Relative water level	Observed water level with respect to previous observations (e.g., normal, above normal, below normal).
Sample temp.	Measured temperature of the water sample from which pH, conductivity, and density are measured.
pH	Measured pH of water sample.
Equipment	Equipment used in measuring pH.
Conductivity	
Measured	Measured electrical conductivity of the water sample.
Corrected	Conductivity value corrected for temperature variation from 25°C.
Equipment	Equipment used in measuring electrical conductivity.
Density	Measured density of the water sample.
Equipment	Equipment used to measure sample density.
Samples Acidified	Check the box to indicate that all samples requiring acid preservation have been acidified.
Sampling Completed By	Names or initials of the personnel involved in sample collection.

Item (Front of Sheet)	Description
Checked by/Date	Signature of PI or a designee who has reviewed the data sheet and the date of the review.

SURFACE WATER AND SEDIMENT SAMPLING DATA

RADIOLOGICAL/NONRADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

SAMPLING STATION: _____

UNIQUE IDENTITY CODE:

_____

_____

_____

_____

_____

SPECIFICATION/COMMENTS

GENERAL ANALYSIS _____ ACIDIFIED ☐

GENERAL ANALYSIS _____ ACIDIFIED ☐

TDS _____

TRITIUM _____

SEDIMENT _____

SAMPLE COLLECTION:

SURFACE WATER ☐ SEDIMENT ☐ SINGLE SAMPLE ☐ COMPOSITE SAMPLE ☐

DATE/TIME: _____ DEPTH TO BOTTOM: _____ m

STATION	DEPTH (m)	TEMP (C)	COMMENTS
A)			
B)			
C)			

FIELD OBSERVATIONS (OPTIONAL)

AIR TEMP: _____ SAMPLE TEMP: (C) _____ WIND SPEED: _____

WATER SURFACE: _____ CLARITY _____ RELATIVE WATER LEVEL: _____

pH: _____ INSTRUMENT NO. _____

CONDUCTIVITY (mMHOs/cm) MEASURED _____ INSTRUMENT NO. _____

CORRECTED _____

DENSITY (g/ml) _____ INSTRUMENT NO. _____

FIELD PERSONNEL _____
(List data recorder first)

CHECKED BY _____ DATE _____

WP Form 1228

Surface water sample bottles, as specified for specific sample type:

- Twelve 50-ml glass bottles (for analysis of tritium)
- Twenty-four 1-gallon polyethylene bottles (for analysis of the remaining radionuclides)
- Twelve 500-ml polyethylene bottles (for measurement of suspended solids concentrations)
- One 100-ml graduated cylinder
- One 1000-ml (1 liter) or 500 ml graduated cylinder
- One conductivity meter
- One pH meter
- A temperature probe or thermometer
- One densitometer
- A graduated line with weight attached
- Distilled water
- Six-foot pole, marked at one-foot intervals
- pH papers (pH scales 1-4 and 10-14)

The numbers of bottles given above assume that one 50-ml glass bottles, two 1-gallon polyethylene bottles, and one 500-ml polyethylene bottles will be needed at each site. The extra bottles on hand will be used for blanks, duplicates, of if bottle breakage or loss occurs. Samples will be collected and split with the Environmental Evaluation Group of the State of New Mexico at its request.

When water samples are to be collected for non-radiological analyses, the following additional bottles will be needed per sampling station:

- Two 40-ml glass vials with teflon-lined lids (for volatile organic compound analysis)
- One 1/2-gallon glass bottle (for base-neutral/acid extractable analysis)
- One 1/2-gallon glass bottle (for pesticide/PCB analysis) (NOTE: A 1-gallon glass bottle may be substituted for the two 1/2-gallon glass bottles.)
- Two 1-liter plastic bottles (for general chemistry)
- One 500-ml plastic bottle (for metals, with nitric acid used as a preservative to achieve pH < 2)

- One 500-ml plastic bottle (for nutrients, with sulfuric acid used as a preservative to achieve pH < 4)
- One 500-ml glass bottle (for phenols, with copper sulfate and phosphoric acid used as preservatives to achieve pH < 4)
- One 1-liter plastic bottle (for total cyanides analysis, with sodium hydroxide used as a preservative to achieve pH > 12)

187s

LIST OF REVIEWERS

Procedure Number: WP 02-345

Revision Number: 0

Procedure Title: NES Surface Water and Sediment Sampling Procedure

Reviewer's Name	Department
T. Fischer	REPS
J. Cockman	REPS
A. Rodriquez	REPS
R. Kehrman	REPS
R. Youngman	QA

NO: 02-346 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: PLANT SPECIMEN COLLECTION AND HERBARIUM MANAGEMENT

1.0 SCOPE

This document provides procedures for maintaining plant specimens that are collected as part of the Waste Isolation Pilot Plant (WIPP) Ecological Monitoring Program (EMP). The EMP is part of the Nonradiological Environmental Surveillance (NES) section of the Radiological and Environmental Programs Section (REPS). Procedures for collecting, handling, cataloging, and tracking of specimens are provided in this document.

2.0 DEFINITIONS

Annotate - A note that is added by way of comment or explanation. A second taxonomist may verify or alter the identification of a plant specimen. His comments and name should be noted on the herbarium label of that plant.

Associated Species - Plants that are found growing at the same location. When a particular plant is collected, the collector should note what other plants are growing with it.

Blotter - A piece of absorbent material that is placed between plant specimens while they are in a plant press. Blotters aid in drying.

Field Press - A small version of a plant press. A field press is easy to carry and open. It is easier to use than a plant press when frequent openings are required.

Genus - A major group of related plants. It marks the classification between family and species.

Herbarium - A cabinet where plant specimens are stored.

Herbarium Label - An identification tag included with a plant specimen. It is normally glued to the paper on which the plant specimen is mounted. It includes the name of the plant and the date of the collection as well as other information.

Key - A botanical key is a series of paired choices used in determining the identity of a plant.

Mounting Stock - The material on which plant specimens are glued before they are put in storage. An acid-free paper should be used and is available from commercial herbarium suppliers.

Plant Press - An apparatus for drying plants. A full-sized press is at least 12" x 18" in size. It consists of two 12" x 18" boards or lattice-work frames and a pair of straps to bind them together. Plants are layered between newsprint, blotters and ventilators, and placed between the frames. The straps are tightened as much as possible and the plants are left to dry.

Rhizome - An underground stem which functions as a type of root.

Species - An individual or kind capable of interbreeding. A genus is further divided into various species.

Stolon - A type of root. Stolons are comprised of stem material. They lay on top of the ground and send smaller roots into the soil at intervals along the stem.

Taxonomist - One who identifies plants by name.

Ventilator - A type of material used to aid in drying plants in a plant press. A ventilator resembles corrugated cardboard in appearance and functions in aiding air circulation through the plant press.

Voucher - A collected plant specimen. It is used as a piece of supporting evidence. Normally, voucher specimens are mounted on paper and housed in an herbarium.

3.0 REFERENCES

Harrington, H. D, How to Identify Grasses and Grasslike Plants (Sedges and Rushes), Swallow Press, Chicago, IL (1977).

Harrington, H. D. and L. W. Durrell, How to Identify Plants, Swallow Press, Chicago, IL (1957).

Hitchcock, A. S. and A. Chase, Manual of the Grasses of the United States, U.S. Government Printing Office, Washington, DC (1951).

Smith, James Payne Jr., Collection and Preparation of Vascular Plant Specimens, Department of Biology, Humboldt State University, Arcata, CA (1979).

4.0 GENERAL

Natural vegetation is monitored as part of both the Radiological and Nonradiological Environmental Surveillance Programs at WIPP. Exact identification of the species involved in these programs requires the collection of identified specimens for comparative purposes. The collection, preparation, and housing of herbarium specimens should follow certain guidelines contained in this document. Proper care shall be taken in the cataloging of herbarium specimens and their associated field notes. The advantages are as follows:

(1) Properly prepared specimens will last longer in storage.

(2) Properly documented specimens will provide accessible and reliable information.

(3) A properly developed herbarium may provide information that may be valuable to other interested parties which are not directly involved with the activities of WIPP.

(4) A properly developed herbarium provides a historical record of plant species that cannot be obtained in any other method.

Qualified personnel shall perform the task of this procedure as described in WP 02-301. WIPP Quality Assurance department will be notified of any nonconformance condition by the REPS section manager as specified in WP 02-302.

Cataloging/Journal

An Herbarium Journal shall be kept for all housed herbarium specimens. All plants shall be listed in numerical order. All label information will be cited in the journal. If a voucher is sent off for verification, or is otherwise removed from the herbarium cabinet, a note will be placed next to its number in the journal. The note should include the name and address of the person the voucher was sent to and a brief statement of why it was sent.

If a specimen is annotated and identified as a different species or variety, it shall be noted in the journal.

Indexing and Herbarium Emplacement

An index shall be maintained of each species collected. Each species shall have a separate index card. All collections of that species shall be listed on the card by voucher number.

If a specimen is reidentified, the voucher number shall be deleted from the index card for the old species identity. On the same card, an address of the new identity shall be included. The voucher number will not change, but the index card of the new identity will be updated with the voucher number.

Vouchers will be ordered alphabetically by family first and genus second. Each family will be collected into a separate genus folder. This folder protects the specimens and aids in keeping track of them. It shall be constructed of acid-free material.

Handling Vouchers in Transit

When vouchers are hand carried, they shall be placed in folders or envelopes to aid in protection. When mailed, vouchers shall be placed in padded envelopes with cardboard or other reinforcement to prevent bending of the specimen. Large numbers of vouchers may be shipped in boxes. Precautions shall be taken to prevent specimens from coming in contact with packing materials. For example, a flat piece of paper should separate the plant from the packing material.

Herbarium Label

The herbarium label should provide a comprehensive list of information about the respective plant specimen. The label should follow a predescribed format and should include the following information:

* Voucher collection number
* Collector's name
  Collector's personal identification number
* Taxonomist's name
* Annotator's name (if annotated)
* Date collected
* Location collected
  Field notes
    flower color
    abundance
    soil/geomorphology
    site notes
    associated species

NOTE: Items marked with an asterisk (*) are essential. If information about the plant is too lengthy to fit on the label, it should be recorded in the journal.

Herbarium Supplies

The following list identifies recommended supplies to aid in maintaining the herbarium collection:

- o Approved mounting stock, (e.g., University of California type herbarium paper)
- o Acid-free labels
- o Adhesives, e.g., clear craft glue for plants, glue stick for labels
- o Plant press and straps
- o Blotters and ventilators
- o Acid-free genus folders
- o Small envelopes to hold plant fragments
- o Weights to aid in preparing mounts, (i.e., heavy nuts and bolts)
- o Herbarium cabinet
- o Journal
- o Index cards and file

The following procedures are described in this document:

5.1 Plant Collecting
5.2 Plant Mounting
5.3 Plant Numbering

5.0 PROCEDURE

5.1 Plant Collecting

The method used for collecting plants is critical to the proper identification of that plant. Plants collected in fragments may not provide enough information for proper or complete identification.

Botanical keys frequently focus on different parts of the plant anatomy. So, a glossary developed from root morphology will not be helpful if the roots of a plant may have not been collected. It is therefore best to collect the whole plant (flowers, fruit, stems, leaves, roots) whenever possible.

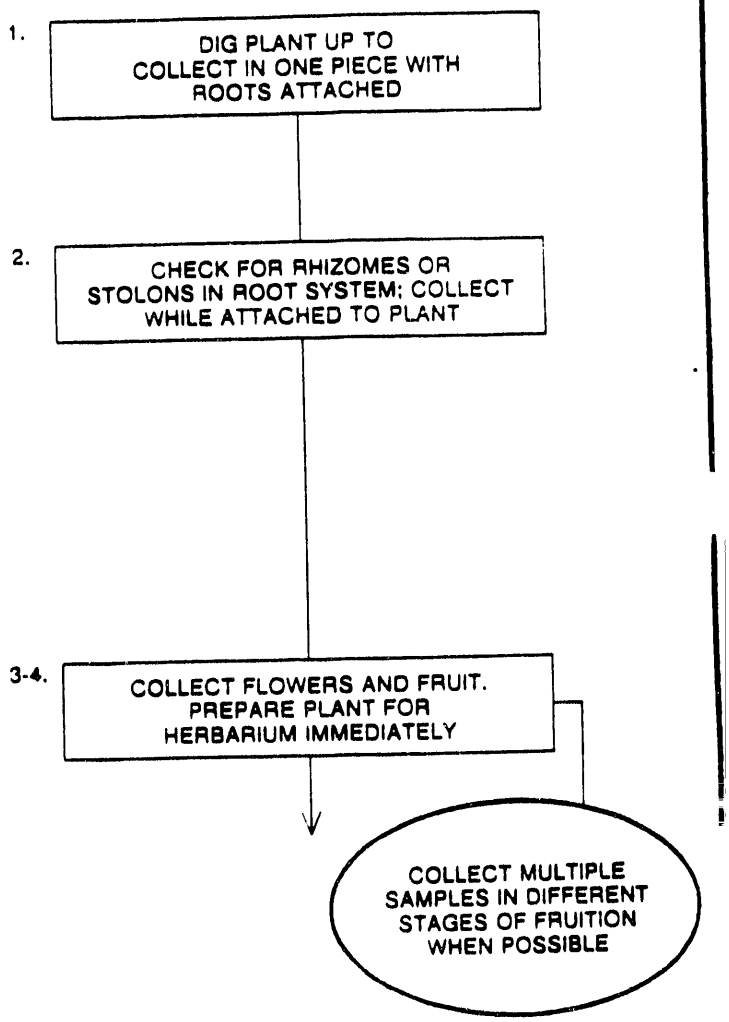
1. Dig the plant up to collect it in one piece with the roots attached.

2. Check to see if rhizomes or stolons are present in the root system, and collect these while they are still attached to the plant.

3. Collect flowers as well as fruit.

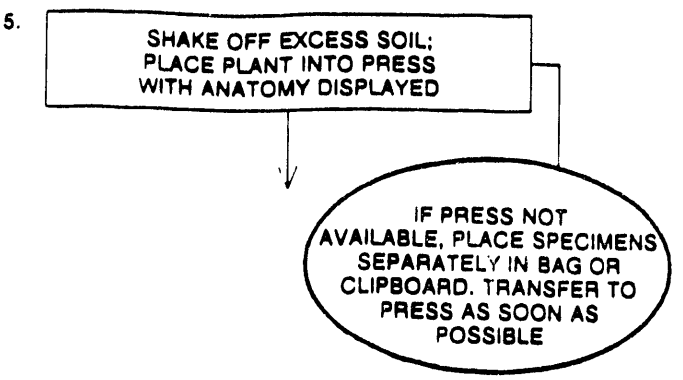
   NOTE: If the plant does not have flowers but does have fruit, and another plant of the same species does have fruit, collect them both.

4. Begin to prepare the plant for the herbarium as soon as it is collected.



5. Shake excess soil from the roots. Place the plant into a field press or plant press in a manner that will display its anatomy (i.e., arrange flower heads so they can be seen from both front and back).

NOTE: If a plant press is not available, place the specimens in a bag or clip board. Separate so they cannot be confused with other species collected. These plants must be transferred to a plant press.



6. Include field notes for each plant collected, including as much of the following information as possible:

NOTE: Field notes may be recorded in a Field Journal. They should, at a minimum, be written on the drying paper on which the plant is placed in the press.

- o Flower color - flower color may fade when the specimen is dry.
- o Abundance - indicate how much of the plant is located at the collection site; percent foliar cover or relative abundance may be noted.
- o Soil/Geology - if soil type is not known, describe it in generic terms.
- o Site notes - include notes on old fields, cattle tanks, salt licks, fence lines, etc.
- o Associated species - note the major dominant plants that the specimen is growing with at the collection site.

6. INCLUDE FIELD NOTES FOR EACH PLANT WITH ALL PERTINENT INFORMATION

NOTES MAY BE RECORDED IN FIELD JOURNAL OR ON PRESS PAPER

5.2 Plant Mounting

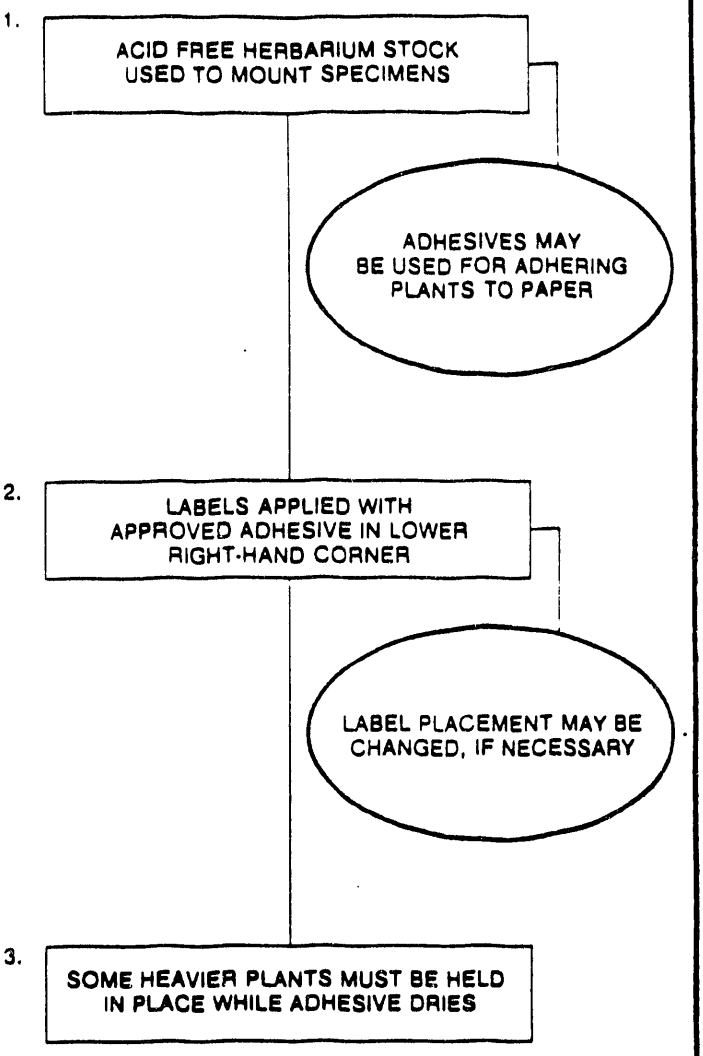
1. Acid-free herbarium stock shall be used to mount plant specimens.

   NOTE: Adhesives such as craft glue or herbarium glue/tape may be used for adhering plants onto the paper.

2. Labels are applied with an approved adhesive. Labels shall be affixed in the lower right-hand corner of the mount.

   NOTE: If the arrangement of a large specimen requires a different label placement, the label shall be placed at another point on the mount.

3. Some plants may need to be held down while the adhesive is drying to provide better attachment to the mount. Heavy items such as nuts and bolts may be used to accomplish this.



5.3 Plant Numbering

1. Completed voucher specimens shall be numbered chronologically according to the directions in Attachment 1.

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1. COMPLETE VOUCHER SPECIMENS ARE NUMBERED CHRONOLOGICALLY

ATT. 1

NUMBERING GUIDELINES

For completed voucher specimens, the number will be preceded by the year number in which that plant was collected. For example, the first complete voucher to go into the herbarium from plants collected in 1986 would be numbered 86-1. The second would be 86-2 and so on until all plants from the 1986 collection have been numbered. Plants collected in 1987 would be numbered 87-1, 87-2, and so on.

Separate collections of the same species will be treated with different collection numbers. The following guidelines should be used for collection numbers:

Plants of the same species collected on different days have separate collection numbers.

Plants of the same species collected from different locations have separate collection numbers.

Additional Guidelines

Plants of the same species collected at the same time and location have duplicate collection numbers. Three duplicates would be noted in the collection number, e.g., 86-1 (1/3) 86-1(2/3), 86-1(3/3).

A specimen that is too large to mount on one paper should be separated. Each piece should be lettered consecutively, e.g., 86-1A, 86-1B indicates that the two halves (A and B) are both from the same specimen 86-1.

208s

LIST OF REVIEWERS

Procedure Number: WP 02-346

Revision Number: 0

Procedure Title: PLANT SPECIMEN COLLECTION AND HERBARIUM MANAGEMENT.

Reviewer's Name	Department
J. Cockman	REPS.
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriguez	REPS
R. Youngman	QA

NO: 02-362 REV. 0 ISSUE DATE: 02/15/88

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NES BIRD CENSUS PROCEDURES

1.0 SCOPE

This procedure establishes the steps for measuring bird density for the Non-radiological Environmental Surveillance (NES) Program of the Radiological and Environmental Programs Section (REPS) at the Waste Isolation Pilot Plant (WIPP).

2.0 DEFINITIONS

Detection Point - Point where a bird was first observed or heard.

3.0 REFERENCES

WP 02-302, Radiological Environmental Surveillance (RES) Quality Assurance/ Quality Control Implementation Procedures

WP 02-330, Non-Radiological Environmental Surveillance (NES) Implementation Procedures

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedures

WP 02-333, NES Sample Tracking Procedures

WP 02-334, NES Data Management Procedures

John T. Emlen, Population Densities of Birds Derived from Transect Counts, Auk., vol 88, p. 323-343, April 1971.

N. T. Fischer, et al., Ecological Monitoring Program at the Waste Isolation Pilot Plant Second Semiannual Report, DOE/WIPP-85-002, 1986.

A. L. Gennaro and N. Jorgenson, Biotic Resources: Faunal Characteristics, submitted to Sandia National Laboratories, 1977.

D. J. Ligon, J. Haydock, and J. Bednarz, Avifauna Baseline Studies at the Los Medanos WIPP Site, Southeastern New Mexico, 1982.

4.0 GENERAL

The Emlen transect (Emlen, 1971) is used to determine bird densities. Emlen transects are each 2500 feet (760m) in length with perpendicular distance intervals of 0-50, 50-200, 200-400, and 400-800 feet (0-15, 15-61, 61-122, and 122-244m). This method of calculating bird densities has advantages over other methods in that it is more efficient in terms of area covered per unit of effort and is applicable during all seasons. This method is comparable in accuracy to the nest or territory count methods, but is less intensive in manpower requirements.

Qualified personnel shall perform the task of this procedure as described in WP 02-301. WIPP Quality Assurance department will be notified of any non-conformance condition by the REPS Manager as specified in WP 02-302.

Attachments 1 and 2 provide narrative instructions for completing Emlen data sheets and for determining bird census data.

5.0 PROCEDURE

5.1 Establishment of the Emlen Transect

Establishment of each transect shall be accomplished independently from the performance of surveys.

1. The starting point is selected and marked by flagging.

   NOTE: The starting point should be prominent and relatively permanent, i.e., a tall bush or fence post.

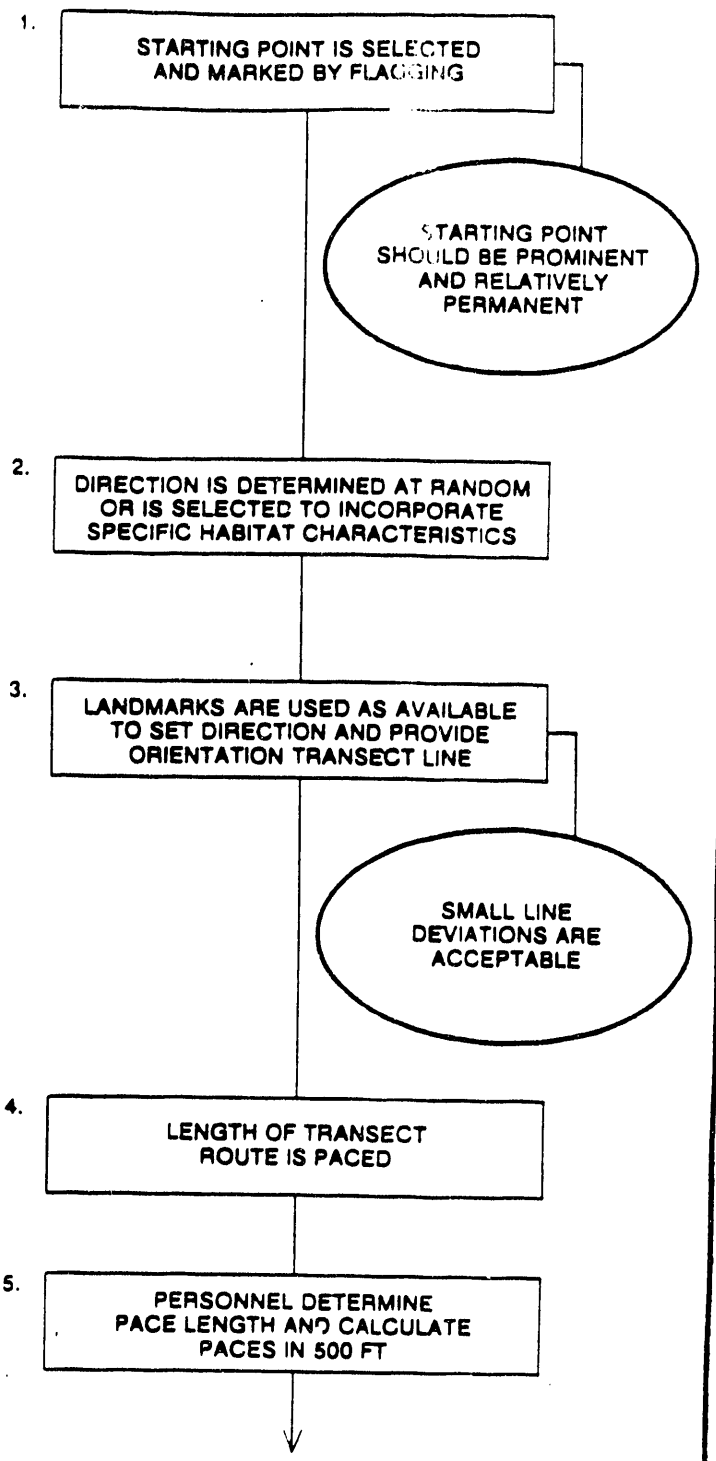
2. The direction shall be as determined at random or is selected to incorporate specific habitat characteristics.

3. When available, distant landmarks may be used to set the direction and provide line-of-sight orientation along the transect line. Otherwise, a compass should be used to maintain the direction of orientation.

   NOTE: Small deviations from a straight line are acceptable.

4. The length of the transect route is paced.

5. The field personnel shall determine personal average pace length and calculate the number of paces required to travel 500 feet.

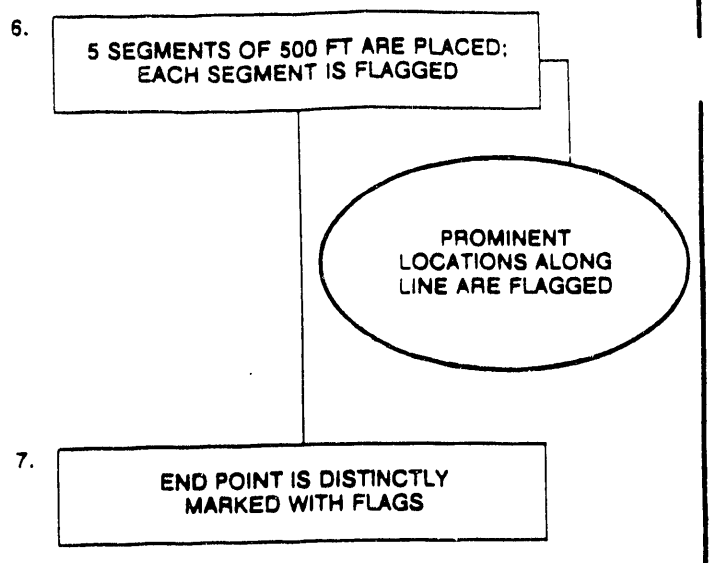


6. Beginning at the starting point, 5 segments of 500 feet are paced in a continuous line, and flagging used to mark the end of each segment.

NOTE: Prominent locations along the line are also flagged to provide continuous visual orientation along the line in both directions.

7. The end point is distinctly marked, using flags.

NOTE: A verbal description of the transect should be noted in the remarks section of the Emlen Census Data Sheet (Attachment 3).



5.2 Conducting the Survey

1. Surveys will begin within 1/2 hour after sunrise at each transect to maximize the comparability of results between transects.

   NOTE: Every natural means of detection, visual and auditory, may be used.

2. Emlen transects are performed by a single observer.

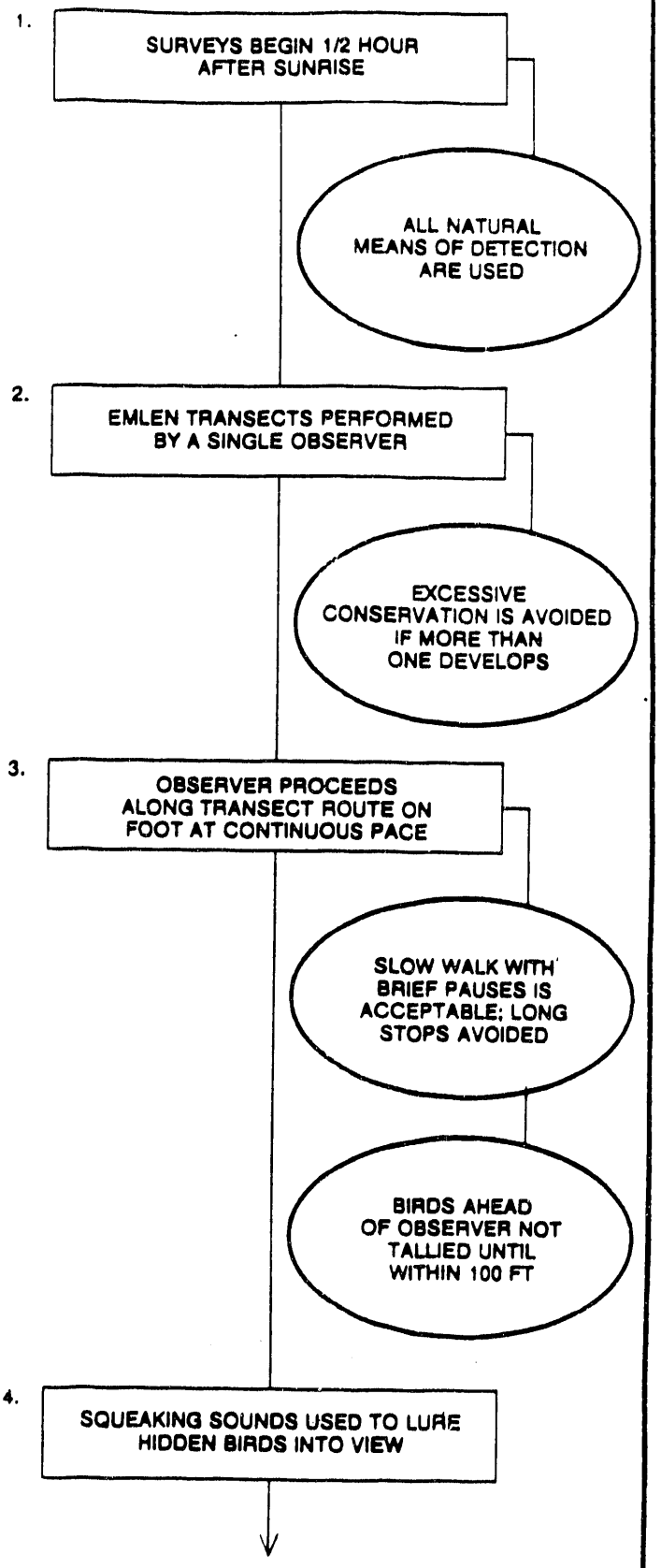
   NOTE: If another person accompanies the observer, excessive conversation should be avoided.

3. The observer proceeds along the transect route on foot at a continuous pace.

   NOTE: A slow walk may be alternated with brief pauses to look and listen. Long stops shall be avoided to reduce the possibility of double recording the same bird.

   NOTE: Birds ahead of an observer are not tallied until the observer has approached to within 100 feet of the bird's position along the transect. Birds that enter the survey tract after initial detection shall not be tallied.

4. Squeaking sounds may be used to lure hidden birds into view.



5. The point of detection is recorded at the bird's point of origin rather than the point at which the observer is able to identify the bird.

6. When the observer identifies a bird, the common name of the bird is recorded in the species column. The type of observation is then recorded in the appropriate distance interval column of the data sheet, WP-1435 (Attachment 3).

7. The type of detection shall be recorded with each observation.

NOTE: There are three classifications of observations. Each has a symbol:

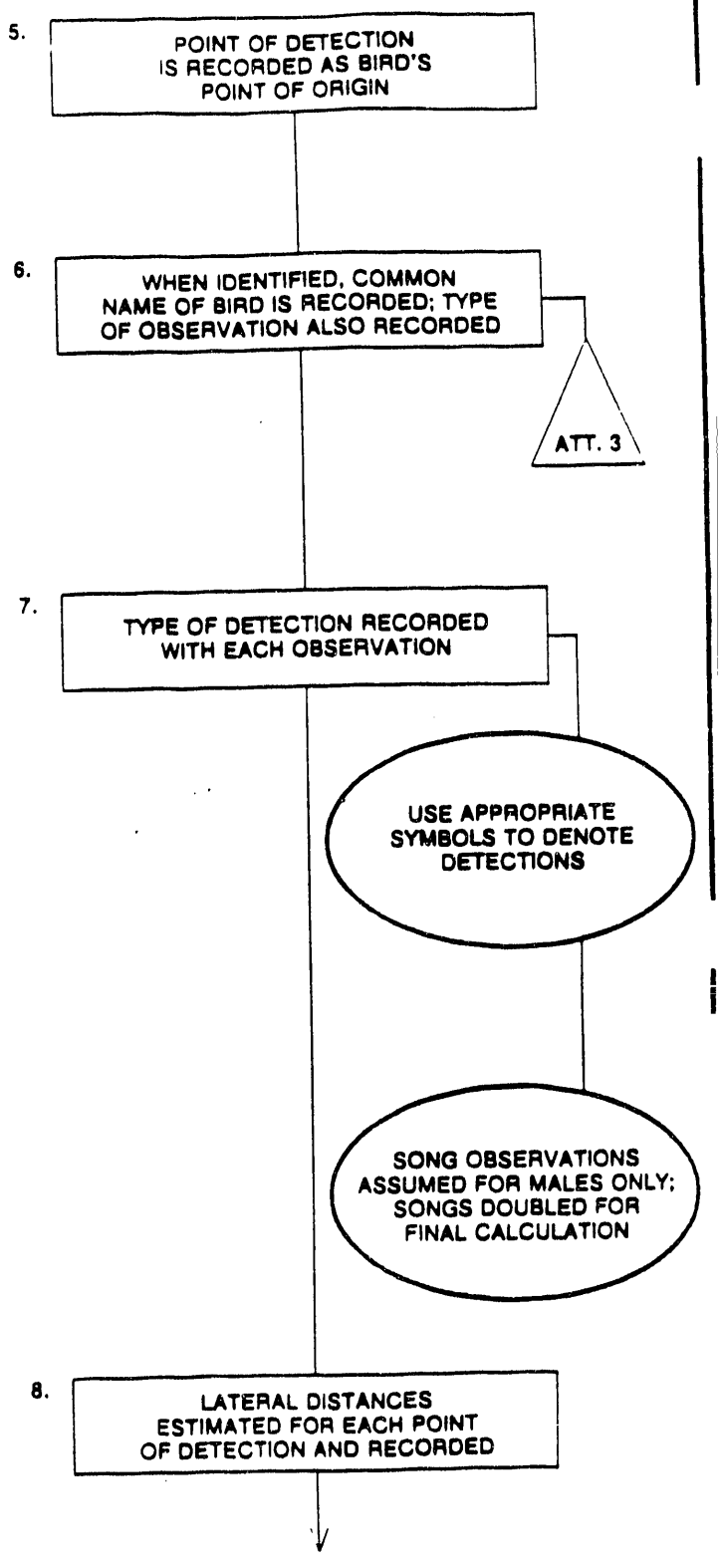
Sightings (the bird is observed) - O

Song (the male bird is heard singing) - S

Call (either sex is heard calling) - C.

NOTE: Song observations are assumed to be males only. The number of song observations will be doubled for the final density calculation.

8. Lateral distances (at right angles to the route of progress) are estimated for each point of detection and recorded in the appropriate column on the data sheet (0-50 feet, 50-200 feet, etc.) (Attachment 3).



9. When the observer reaches the end of the transect, 15 minutes are allowed for the birds to return to routine activity.

10. The observer shall proceed along the return route, using a new data sheet and shall repeat steps 1-9.

11. Interruptions to observe other items of special interest shall be postponed until the formal survey has been completed.

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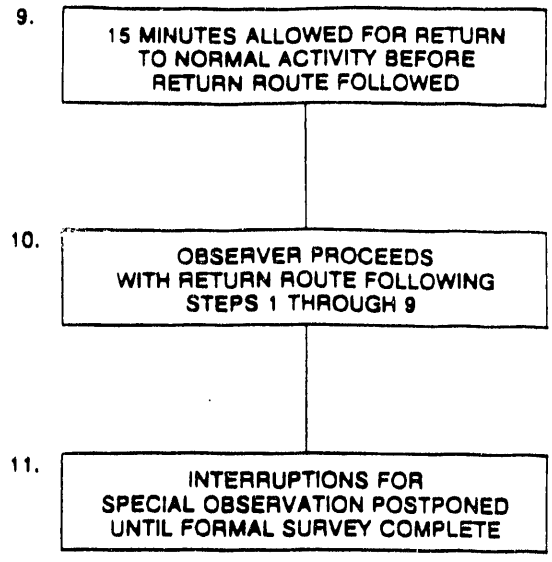


DATA SHEET INSTRUCTIONS

Out/Return: A separate data sheet should be used for each leg of the survey. Check the appropriate box.

Location: Record the transect number or identification code.

Date: Record the month, day, and year of the observations.

Time: Record the time using a 24-hour clock.

Observer: Record the first and last name of the observer.

Temperature, Wind, Sky: Notes on these parameters are optional. Use of approximations in vernacular terms are acceptable.

Remarks: The observer may include notes on any observation deemed noteworthy. Observations may include such things as species seen but not encountered within the transect, nest locations, presence of flocks or parent/offspring groups, etc.

If these observations are significant to the overall results, they may be reported in the EMP report with the data.

DETERMINING CENSUS FROM THE DATA SHEETS

Add up tick marks for each type of observation for each species in each distance interval column. (Do not add the columns together.) Multiply song observations by 2. For each column and species, sum the three types of observations for a total observations figure.

Convert the totals from each distance interval to a common unit area.

Perform the above steps from the starting point as well as the returning point. The transect is run twice per survey. From the starting point to the ending point (the "out" run) and then from the ending point back to the starting point (the "return" run). The data from each run are recorded separately and tallied separately. Identify the maximum density from among the converted densities for each of the four surveys. This figure can be used as an absolute value to compare with average densities from other locations.

EMLEN CENSUS DATA SHEET

EMLEN CENSUS DATA SHEET

LOCATION _____ OUT ☐ RETURN ☐

DATE _____ TIME _____ OBSERVER _____

SPECIES	0 - 50 FT			50 - 100 FT			100 - 200 FT			200 - 400 FT			400 - 800 FT		
	S	O	C	S	O	C	S	O	C	S	O	C	S	O	C

O: SEEN S: SONG C: CALL

TEMP: _____ WIND: _____ SKY: _____

REMARKS:

LIST OF REVIEWERS

Procedure Number: WP 02-362

Revision Number: 0

Procedure Title: NES Bird Census Procedures

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
A. Rodriquez	REPS
R. Youngman	QA

NO: 02-363 REV. 0 ISSUE DATE: 11/30/87

APPROVAL SIGNATURE: [signature]

PROCEDURE AUTHOR: J. Cockman

TITLE: NES SMALL MAMMAL CENSUS PROCEDURE

1.0 SCOPE

This procedure describes the methods for measuring the density of small nocturnal mammal populations. Small mammal densities are monitored as part of the Nonradiological Environmental Surveillance (NES) Program of the Radiological and Environmental Programs Section (REPS) at the Waste Isolation Pilot Plant (WIPP).

2.0 DEFINITIONS

None

3.0 REFERENCES

Price, M. V., N. M. Waser, and T. A. Bass; "Effects of Moonlight on Microhabitat Use by Desert Rodents"; 1984; Journal of Mammology 65(2):353-356.

WP 02-302, RES Quality Assurance/Quality Control Implementation Procedures

WP 02-330, Non-Radiological Environmental Surveillance (NES) Implementation

WP 02-332, NES Scheduling, Documentation, and Field Preparation Procedures

WP 02-333, NES Sample Tracking Procedures

WP 02-334, NES Data Management Procedures

4.0 GENERAL

Qualified personnel shall perform the tasks of this procedure as described in WP 02-301. WIPP Quality Assurance Department will be notified of any nonconformance condition by the REPS Manager as specified in WP 02-302.

Densities of small, nocturnal mammals are measured using a mark-and-recapture method. Two trapping sessions at each grid location are required to obtain a ratio to estimate population density. All trapping is done with live-traps in a 10 x 10 trap grid. Grid locations are determined by the Principal Investigator (PI) or designee.

The following equipment shall be utilized for this procedure:

- o bait (e.g., chicken scratch)
- o clip board
- o crimpers (for installing ear tags)
- o Small Mammal Data Sheet (Attachment 1, WP 1402)
- o ear tags (numbered fingerling tags)
- o field scale
- o gloves
- o plastic bags (large, heavy-duty to place animal in; small, clear to weigh animal in)
- o toe clipper (for P. flavus)
- o 100 Sherman live-traps or equivalent for each grid

The following methods are discussed in this document:

5.1 Trap Grid Set Up
5.2 Trapping Procedure
5.3 First Session Procedure for Captures
5.4 Second Session Procedure for Recaptures

5.0 PROCEDURE

5.1 Trap Grid Set Up

Small mammal surveys are conducted using live-traps in a grid pattern. The grid is composed of 10 rows (designated A-J) of 10 traps (numbered 1-10).

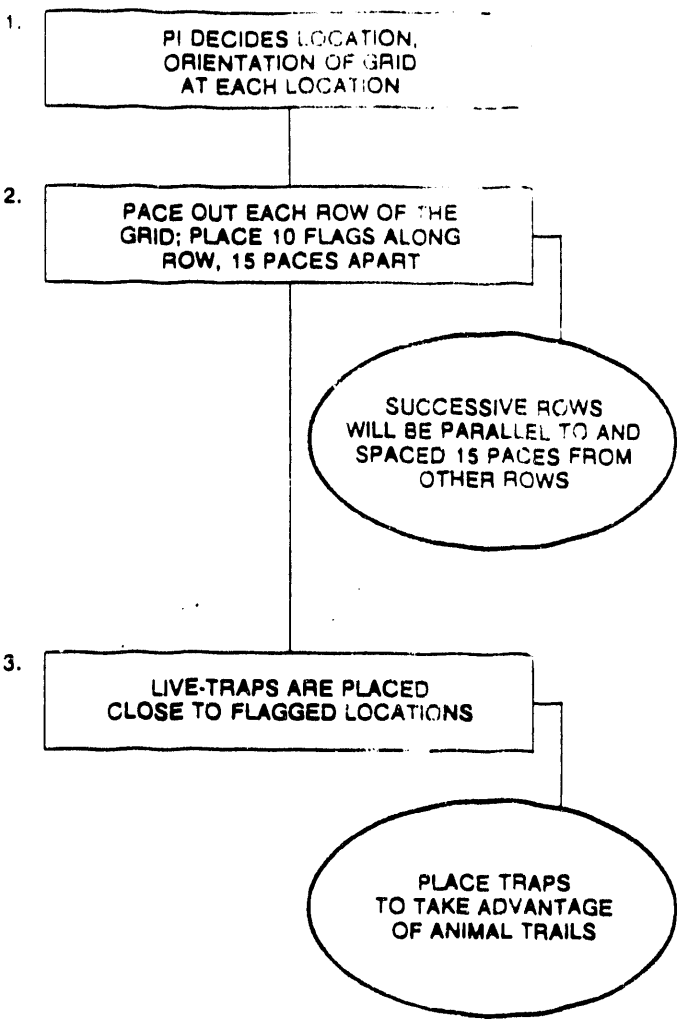
1. The PI decides the exact location and orientation of the grid at each location.

2. Using line of sight, pace out each row of the grid, placing 10 flags (pin flags or tape) along the row spaced 15 paces apart (approximately 10 m).

   NOTE: Successive rows will be parallel to and spaced 15 paces from the previous row.

3. Live-traps (Sherman Live-Trap or as designated by the PI) are placed as close to flagged locations as possible.

   NOTE: Place traps to take advantage of obvious small mammal runways and other sites which may increase the probability of capture.



5.2 Trapping Procedure

Two trapping sessions shall be conducted no more than two weeks apart, but not in the same week. There are 3 trap nights per session; trap nights are consecutive or as close together as possible.

NOTE: If inclement weather prevents consecutive trap running, run traps 3 nights in the same week.

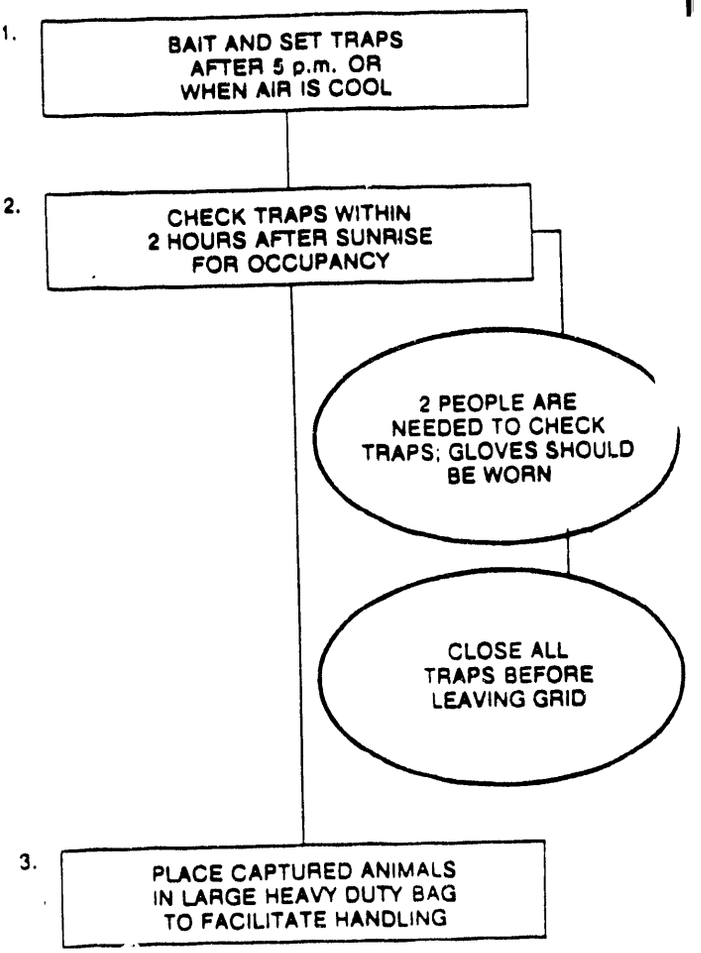
1. Bait and set traps after 5 p.m. or when air temperature is cool enough to prevent hyperthermia of trapped animals.

2. Check the traps within 2 hours after sunrise, examining closed traps for occupancy.

NOTE: At least 2 people are needed to check traps. Gloves should be worn to protect the handlers from animal bites.

NOTE: Close all traps before leaving the grid.

3. Place captured animals in a large, heavy duty bag to facilitate handling.



5.3 First Session Procedure for Captures

1. Record grid position and species on the data sheet (Attachment 1).

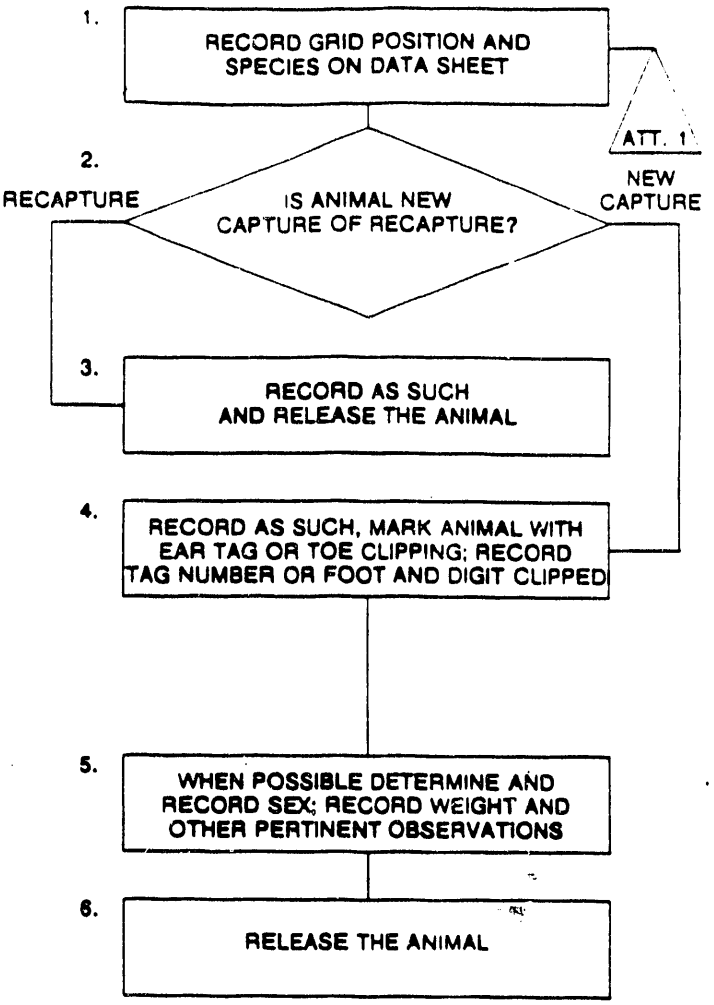
2. Determine whether the animal is a new capture or recapture.

3. If it is a recapture, record as such and release the animal.

4. If it is a new capture, record as such and mark the animal with an ear tag or toe clipping. Record the tag number or foot and digit clipped.

5. When possible, determine and record the sex; weigh the animal with the field scale and record; record any additional observations which may be pertinent on the data sheet (WP 1402).

6. Release the animal.



5.4 Second Session Procedure for Captures

1. Record grid position and species on the data sheet (Attachment 1).

2. Determine whether the animal is a new capture or recapture.

3. If it is a recapture, record as such and record the tag number or clipped toe on the data sheet.

4. If it is a new capture, record as such but do not mark the animal with ear tags or toe clips.

5. When possible, determine and record the sex; weigh the animal and record; record any additional observations which may be pertinent.

6. Release the animal.

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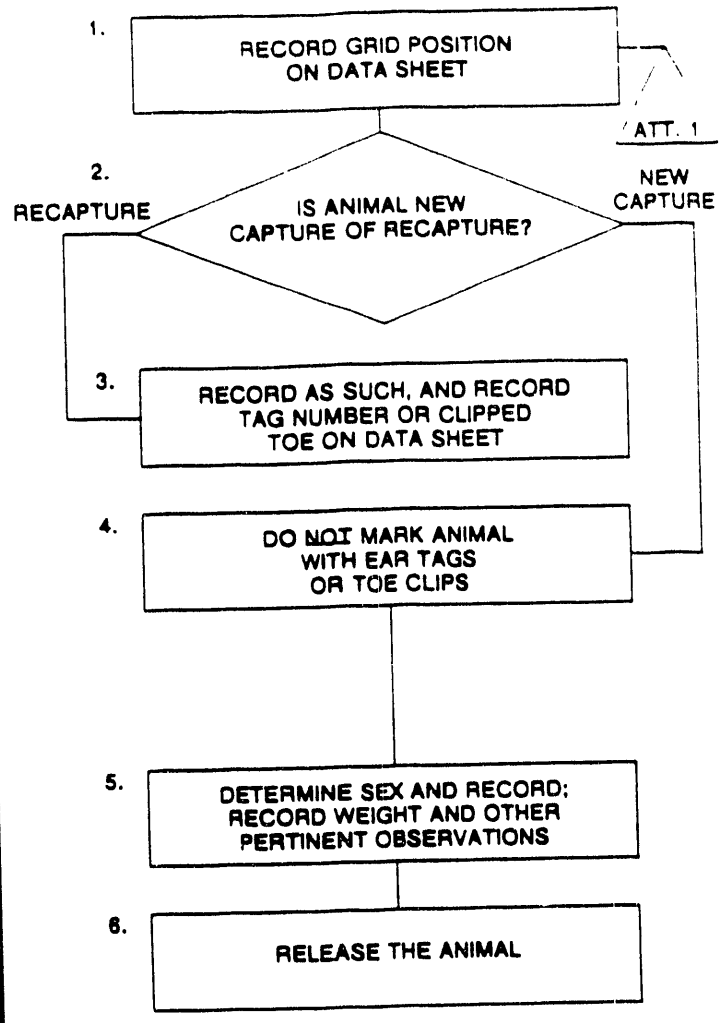

Small Mammal Data Sheet

NONRADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

Session	Night 1	2	3
First			
Second			

Location_____ Date_____ Time_____

Field Personnel_____
(List recorder's name first)

CONDITIONS: Approx. Temp._____ Wind_____ Sky_____ Ppt._____

GRID POSITION	D. ordii	N. micropus	O. leucogaster	P. flavus	OTHER	New Capture	Recapture	TAG #	SEX	WEIGHT(g)	COMMENTS

WP 1402 6-87

LIST OF REVIEWERS

Procedure Number: WP 02-363

Revision Number: 0

Procedure Title: NES SMALL MAMMAL CENSUS PROCEDURE

Reviewer's Name	Department
J. Cockman	REPS
T. Fischer	REPS
B. Kehrman	REPS
R. Youngman	QA

APPENDIX H

SAMPLE HANDLING AND LABORATORY PROCEDURES

Section 7.0 of the WIPP Operational Environmental Monitoring Plan (OEMP) discusses the quality assurance/quality control programs which ensure that samples collected and the resulting analytical data are representative of actual conditions at the WIPP site.

APPENDIX H

SAMPLE HANDLING AND LABORATORY PROCEDURES

Environmental sampling and analytical laboratory procedures to obtain quality results under the WIPP Environmental Monitoring Program are contained and/or described in the following documents:

- Environmental Procedures Manual (WEC, 1986a)
- Water Quality Sampling Manual (WEC, 1987)
- Ecological Monitoring Program Semiannual Report (Reith et al., 1985)
- Geotechnical and Geosciences Procedure Manual (WEC, 1988)
- Radiation Safety Manual (WP 12-5)
- Management and Operating Contractor WIPP Quality Program Manual (WEC, 1986b).

The WIPP has field analytical capabilities as well as contract analytical support from Westinghouse Advanced Energy Systems Division (WAESD), Eberline Analytical Corporation (Eberline), and IT Corporation Laboratory, Export, Pennsylvania. Each laboratory is responsible for maintaining an approved quality assurance program.

H.1 SAMPLE HANDLING

Sample Identification

The sample identity codes used in the Radiological Environmental Surveillance (RES) and the Ecological Monitoring programs (Nonradiological Environmental Surveillance - NES) are unique to each individual sample prepared for potential analyses. A four-tiered hierarchy of sample-specific information to accurately identify the sample type, the location of sampling, the data, and a sequence of the sampling event is recorded on the appropriate data sheets. A detailed description of the sample identification system is given in the RES Scheduling, Documentation, and Field Preparation Procedure (WP 02-303) and the NES Scheduling, Documentation, and Field Preparation Procedure (WP 02-332). These documents also describe the use of RADCOMP, a scheduling and data management software program used in sample identification and data tracking. Sample identification, calculations, computer inputs, and other applicable internal review procedures are implemented according to the NES/RES Quality Assurance/Quality Control Implementation Procedures (WP 02-302).

Environmental Activity Levels

Preoperational environmental samples collected for WIPP have contained only low levels of radioactivity. During operations, all wastes will arrive in sealed containers and will remain in an enclosed environment. Therefore, radionuclide levels should remain very low in the operational environmental samples. Samples at all locations are collected in accordance with accepted practices, widely recognized methodologies, and criteria for environmental monitoring (WP 02-3).

Packaging and Shipping of Samples Off Site

Environmental samples sent off site for analysis are packaged according to the specific sampling procedures (i.e., soil, water, vegetation, etc.) listed in the Environmental Procedures Manual (WP 02-3) and the Water Quality Sampling Manual (WEC, 1987). The NES/RES Sample Tracking Procedure (WP 02-304) outlines the chain-of-custody requirements to ensure the integrity of samples. WIPP does not

handle high-activity samples in the environmental monitoring programs. Contract laboratories are required to follow QA/QC procedures to ensure no cross-contamination of high and low-activity samples which they may process. The quality of the data from analytical contract laboratories are verified by 1) participation in interlaboratory cross-checks, 2) duplicate sample analysis, and 3) a comparison of results from sample splits provided to the New Mexico Environmental Evaluation Group (EEG) for analysis.

Quality Assurance

A comprehensive QA program (WP 02-302) has been implemented to assure that the data collected are representative of actual concentrations in the environment. Each contract laboratory is responsible for maintaining an approved quality assurance program detailing: (1) routine calibration of counting instruments, (2) frequent source and background counts (as appropriate), (3) routine yield determinations of radiochemical procedures, (4) replicate/ duplicate analyses to check precision, and (5) analyses of reagents to ensure chemical purity that could affect the results of the radiochemical analytical process. The accuracy of radionuclide determination is ensured through the use of standards traceable to the National Bureau of Standards, participation in the Environmental Protection Agency Cross-check Interlaboratory Comparison Program, and other interlaboratory analytical assessment programs, when available.

H.2 ENVIRONMENTAL SURVEILLANCE

External Radiation

From 1984 through 1989, thermoluminescent dosimeters (TLDs) were used at WIPP to measure penetrating (gamma) radiation levels around the WIPP site. TLD packages containing five lithium fluoride (LiF) chips were collected and evaluated quarterly. Dosimeters were provided, read, and annealed by Eberline Corporation in Albuquerque, New Mexico, but are being replaced by a WIPP-operated system. Field dosimeters were accompanied during shipment and installation by control dosimeters, which were kept in a copper-lined lead cave during the field cycle (quarterly) exposure period. These control dosimeters enable data to be corrected for transient exposure during shipment and distribution. Detailed procedures for handling TLD packages are given in the Thermoluminescent Dosimeter (TLD) Handling Procedures (WP 02-308). The Environmental Radiation Monitoring Procedure (WP 02-313) provides instructions for obtaining measurements of ambient gamma radiation using the Reuter-Stokes RSS-1012, Environmental Monitoring System.

Airborne Particulates

The model CMP-14CV samplers (HiQ Environmental Products) are used at WIPP for particulate collection. These samplers have a regulated flow rate of 950 ml per second (two cubic feet per minute) of air through a 47-mm (1.9 inch) glass fiber filter. Filters are collected weekly and sent to the analytical laboratory in accordance with the Low-Volume Airborne Particulate Sampling Procedures (WP 02-312). A gross alpha and gross beta count of each weekly filter is completed prior to compositing filters from each location for each sampling quarter. The quarterly composite is then analyzed using gamma spectrometry for representative gamma-emitting radionuclides typically present in the environment or expected to occur in the waste received at WIPP. Finally, the composite sample undergoes destructive chemical analysis for the specific alpha and beta emitters of concern. High volume airborne particulate samplers are also maintained and available in the event of an accidental release. Sampling procedures for the high volume airborne particulate equipment are given in WP 02-311. Laboratory methods for analyses of radionuclides are given in Table H-1.

Airborne Gases

The Atmospheric Monitoring Station (AMS) manufactured by ThermoElectron, Inc., is used to monitor potential pollutant gas concentrations continuously. The AMS is composed of seven analyzers which monitor SO_2, H_2S, O_3, CO, NO, NO_2, and NO_x gases. A detailed description of the AMS is given in the

TABLE H-1

METHODS USED FOR RADIOLOGICAL ANALYSIS OF AIRBORNE PARTICULATE SAMPLES

METHOD TITLE	REFERENCE
Gross Alpha Gross Beta	Procedure number OI-86-2, Rev. 0, Gross Alpha and Beta Activity on WIPP and Other Environmental Air Filters, Westinghouse Electric Corporation Advanced Energy Systems Division (WAESD).
Cesium 137, Cobalt 60, Radium 226, Thorium 228	Procedure number A-524, Determination of Gamma Emitting Isotopes in Environmental Samples, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.
Neptunium 237	Procedure number A-508, Determination of Np 237 in Environmental Samples, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239/240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix C, WAESD
Uranium 238 Uranium 234/233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix A, WAESD.
Americium 241, Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Polonium 210, Lead 210	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix J, WAESD.

Ecological Monitoring Program At The Waste Isolation Pilot Plant Annual Report for FY 1986 (Fischer, 1987). The AMS operation procedures are followed in accordance with the Ambient Air Quality Monitoring Procedure (WP 02-341). Calibration and maintenance of monitoring equipment are performed in accordance with the NES/RES Equipment Maintenance and Control Procedures (WP 02-306) to ensure accuracy of results.

Biological Materials

Samples of native mammals, birds, sport fish, locally-produced beef and vegetation are collected and prepared for analyses as described in the Biotic Sampling Procedures (WP 02-310). Samples, other than vegetation, are transported in ice to the sample preparation laboratory. Samples are either oven-dried between 105°C and 135°C for 24 hours or ashed at 700°C, depending on the requirements of the contract laboratory. Methods of analyses are given in Table H-2.

Soil Sampling

Soil sampling procedures used at WIPP are given in the RES Soil Sampling Procedures (WP 02-307). A template insert allows the collection of samples at three depths for each location: 0 to 2 cm (0 to 0.8 in), 2 to 5 cm (0.8 to 2.0 in), and 5 to 10 cm (2.0 to 3.9 in). Every sample is a composite of 10 randomly located subsamples, each delineated by a 10x10 cm (3.9x3.9 in) stainless steel template. Soil samples are poured through a splitter to remove organic debris and gravel. Soil samples are air-dried prior to shipment to the contract laboratory. Methods of analyses for radionuclides are given in Table H-3.

Surface Water and Sediments

Surface water and sediment samples for radionuclides are collected and handled according to the RES Surface Water and Sediment Sampling Procedures (WP 02-309). This procedure describes methods for collecting, preserving and packaging representative water and sediment samples. Laboratory methods for analyses of radionuclides are given in Table H-4.

Surface water and sediment sampling and handling procedures for nonradionuclide analyses are conducted according to the NES Surface Water and Sediment Sampling Procedure (WP 02-345) and the Guidance Manual: Surface Water and Sediment Sampling for the Environmental Monitoring Program at WIPP (DOE-WIPP-88-007). During the preoperational environmental monitoring program a wide range of analyses were conducted to establish background concentrations for constituents of potential environmental concern. The parameters and methods of analysis are given in Table H-4.

Ground Water

Ground water sampling for radiological analyses is conducted according to the Water Quality Sampling Manual (WEC, 1987), except for the private wells which are obtained in accordance with the Geotechnical and Geosciences Procedure Manual (WEC, 1988). This sampling plan includes detailed procedures on collecting a representative sample by measurement of field parameters to determine a chemical steady-state with respect to those constituents. Included in this plan are the procedures associated with the pumping of ground water, the serial sampling and analysis program, and the final sample collection and preparation for shipment to contract laboratories. The Water Quality Sampling Program is conducted by Westinghouse in coordination with Sandia National Laboratories. The methods of analyses for various radionuclides are listed in Table H-4.

The Water Quality Sampling Manual (WEC, 1987), Section 4.0, includes the field laboratory analytical procedures, a summary of methods and modifications, techniques for calibration of equipment and the precision and accuracy expected for each procedure. Field parameters for nonradiological analyses

TABLE H-2

BIOTIC SAMPLING AND ANALYTICAL PROCEDURES

PARAMETER	REFERENCE METHOD
Cesium 137, Cobalt 60, Radium 226, Thorium 228	Procedure number A-524, Determination of Gamma Emmiting Isotopes in Environmental Samples, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.
Neptunium 237	Procedure number A-508, Determination of Np 237 in Environmental Samples, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239/240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix C, WAESD.
Uranium 238, Uranium 234/233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix A, WAESD.
Americium 241 Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Litter Decomposition	Elkins, N. Z., and W. G. Whitford, 1982, "The Role of Microarthropods and Nematodes in Decomposition in a Semiarid Ecosystem," Oecologia, Vol. 55, pp. 303-310. Santos, P. F., E. Depree, and W. G. Whitford, 1978, "Spatial Distribution of Litter and Microarthropods in a Chihuahuan Desert Ecosystem, J. of Arid Environments, Vol. 1, pp. 41-48. Santos, P. F., N. Z. Elkins, Y. Steinberger, and W. G. Whitford, 1984, "A Comparison of Surface and Buried Larrera Tridentata Leaf Litter Decomposition in a North American Hot Desert," Ecology, Vol. 65, pp. 278-284. Whitford, W. G., D. W. Freckman, N. Z. Elkins, C. W. Pardu, R. Parmelee, J. Phillips, and S. Tucker, 1981, "Diurnal Migration and Responses to Simulated Rainfall in Desert Soil Microarthropods and Nematodes," Soil Biol. Biochem., Vol. 13, pp. 417-425.
Bird Density	Emlen, J. T., 1971, "Population Densities of Birds Derived from Transect Counts," Auk, Vol. 88, pp. 323-342.
Mammal Survey	Hayne, D. W., 1949, "Two Methods for Estimating Populations from Trapping Records," J. Mammal, Vol. 30, pp. 399-411.

TABLE H-2

BIOTIC SAMPLING AND ANALYTICAL PROCEDURES
(CONTINUED)

PARAMETER	REFERENCE METHOD
Microbial Activity Levels	Schnurer, J., and T. Rosswall, 1982, "Fluorescein Diacetate Hydrolyses as a Measure of Total Microbial Activity in Soil and Litter," Applied and Environmental Microbiology, Vol. 43, (6), pp. 1251-1256.
Vegetation Foliar Cover Species Richness Density of Animals Seedling Emergence	Cain, S.A., and G.M. Castro, 1959, Manual of Vegetation Analysis, Harper and Brothers, New York.

TABLE H-3

METHODS OF SOIL ANALYSIS

Cesium 137, Cobalt 60, Radium 226, Thorium 228	Procedure number A-524, Determination of Gamma Emitting Isotopes in Environmental Samples, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.
Neptunium 237	Procedure number A-508, Determination of NP 237 in Environmental Samples, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239-240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix H, WAESD.
Uranium 238, Uranium 234-233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix G, WAESD.
Americium 241, Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Water Soluble Extraction of Anions	Soil Extraction for Common Anions, ITAS-Pittsburgh Laboratory Methodology, 1985.
Chloride, Titrimetric	Method 325.3 Method for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
pH on Saturation Paste, Conductivity on Extract, Sodium	A. Sobeck, W. Schuller, J. Freeman, R. Smith, Field and Laboratory Methods Applicable to Overburdens and Minesoils, United States Environmental Protection Agency - 600/2-78-054, p. 95, March 1978.
Calcium, Direct Aspiration	Method 215.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Magnesium, Direct Aspiration	Method 242.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Potassium, Direct Aspiration	Method 258.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Sodium, Direct Aspiration	Method 273.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.

TABLE H-4

METHODS USED FOR GROUND WATER AND SURFACE WATER ANALYSIS

METHOD TITLE	REFERENCE
Alkalinity	Method 403, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Bromide, Titrimetric	Method 320.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Chloride, Potentiometric Method	Method 407C, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Cyanide Determination by Flow Injection Analysis	Quick Chem Method No. 10-204-00-1-A, Lachat Instruments-1987
Fluoride (Potentiometric) Ion Selective Electrode)	Method 340.2, Method for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Nitrate/Nitrite Determination by Flow Injection Analysis	Quick Chem Method No. 10-107-04-1-A, Lachat Instruments-1987
Nitrogen/Nitrate (Colorimetric, Brucine)	Method 352.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
pH (electrometric)	Method 150.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Phenol Determination by Flow Injection Analysis	Quick Chem Method No. 10-210-00-1-A, Lachat Instruments-1987.
Phosphorus, All Forms (Colorimetric; Ascorbic Acid; Single Reagent)	Method 365.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Residue, Nonfilterable	Method 160.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Residue, Filterable	Method 160.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.

TABLE H-4

METHODS USED FOR GROUND WATER AND SURFACE WATER ANALYSIS
(CONTINUED)

METHOD TITLE	REFERENCE
Conductance (Specific Conductance, μmhos at 25°C)	Method 120.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Sulfate (Turbidimetric)	Method 375.4, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Total Organic Halides	Method 9020, Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency SW-846, 3rd Ed., 1986.
Total Organic Carbon	Method 9060, Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency SW-846, 3rd Ed., 1986.
Inductively Coupled Plasma-Atomic Emission Spectrometric Method for Trace Element Analysis Of Water and Waste	Method 200.7, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Arsenic (Atomic Absorption, Furnace Technique)	Method 206.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Molybdenum (Atomic Absorption, Direct Aspiration)	Method 246.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Selenium (Atomic Absorption, Furnace Technique)	Method 270.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Titanium, Direct Aspiration	Method 283.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.
Mercury, Manual Cold Vapor	Method 7470, Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, SW-846, 3rd Ed., 1986.
Strontium, Direct Aspiration	Method 303A, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Thallium (Atomic Absorption, Furnace Technique	Method 279.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/ 4-79-020, 1983 Revision.

TABLE H-4

METHODS USED FOR GROUND WATER AND SURFACE WATER ANALYSIS
(CONTINUED)

METHOD TITLE	REFERENCE
Lithium, Aspiration	Method 317B, Standard Methods for the Direct Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Cesium, Direct Aspiration	Method 303A, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Base-Neutral and Acid Extractables	Method 625, Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, U.S. Environmental Protection Agency 600/14-82-057, 1982.
Gas Chromatography/Mass Spectrometry for Semi-volatile Organics Capillary Column Technique volatile Organics Capillary Column Technique	Method 8240, Test Method for Evaluating Solid Waste, U.S. Environmental Protection Agency, SW-846, 3rd Ed., 1986.
Gas Chromatography/Mass Spectrometry for Semi-Volatile Organics Capillary Column Technique	Method 8270, Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, SW-846, 3rd Ed., 1986.
ITWC 007 Silica	Quick Chem Method No. 10-114-27-1A, Lachat Instruments - 1988.
Iodide, Tetrimetric	Method 345.1, Method for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Pesticides and PCBs	Method 608, Method for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/14-82-057, July 1982. Method 8080, Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency SW-846, 3rd Ed., 1986.
Cesium 137, Cobalt 60	Procedure number A-524, Determination of Gamma Emitting Isotopes in Environmental Samples, WAESD.
Radium 226, Thorium 228	Procedure OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix E, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.

TABLE H-4

METHODS USED FOR GROUND WATER AND SURFACE WATER ANALYSIS
(CONTINUED)

METHOD TITLE	REFERENCE
Neptunium 237	Procedure number A-508, Determination of Np 237 in Environmental Samples, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Uranium 238, Uranium 234, Uranium 233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of of WIPP Samples, Appendix A, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239/240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix C, WAESD.
Americium 241, Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Hydrogen 3 (Tritium)	Procedure number A-531, Rev. 0, Determination of Beta Emitting Radionuclides by Liquid Scintillation Counting, WAESD.

include pH, EC, specific gravity, specific conductance, temperature, flow volumes and rates, chloride, calcium, magnesium, total sulfide as H_2S, alkalinity, and dissolved iron. Samples are also collected and sent to the contract laboratory for more extensive analyses. Parameters and reference methods to be used for ground water analyses are given in Table H-4.

H.3 ECOLOGICAL MONITORING

Soil Sampling

Soil sampling and handling procedures are given in the NES Soil Sampling Procedures (WP 02-336). Six surface samples at 0-2 cm (0-0.8 in.) are collected at random locations from each ecological study plot. Each sample is a composite of ten subsamples collected by using a 10x10 cm (3.9x3.9 in.) template inserted into the soil. Soils are sifted through a No. 0.20 mesh screen to remove large organic matter and gravel. Soil samples are air-dried for a minimum of 48 hours. The parameters and methods of analyses are given in Table H-3.

Biological Materials

Biotic sampling and handling procedures for the Ecological Monitoring Program are given in the NES Vegetation Sampling Procedure (WP 02-337) and the NES Litter Bag Handling Procedure (WP 02-338). Details of methods and modifications are given in Reith et al. (1985). Methods and references for various studies are given in Table H-2.

REFERENCES

Fischer, N. T. (editor), 1987, "Ecological Monitoring Program, Annual Report, FY 1986," DOE/WIPP 87-003, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

Reith, C. C., E. T. Louderbough, R. J. Eastmond, and A. L. Rodriguez, 1985, "Ecological Monitoring Program for the Waste Isolation Pilot Plant, Semi-Annual Report: July - December 1984," WTSD-TME-058, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

WEC (Westinghouse Electric Corporation), 1986a, "Environmental Procedures Manual," WIPP 02-03, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

WEC (Westinghouse Electric Corporation), 1986b, "Management and Operating Contractor-WIPP Quality Program Manual," Waste Isolation Pilot Plant, Carlsbad, New Mexico.

WEC (Westinghouse Electric Corporation), 1987, "Water Quality Sampling Manual," WIPP 07-02, Revision 1, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

WEC (Westinghouse Electric Corporation), 1988, "Geotechnical and Geosciences Procedure Manual," WIPP 07-001, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

APPENDIX I

DATA ANALYSIS

Section 8.0 of the WIPP Operational Environmental Monitoring Plan (OEMP) describes the criteria and methods to be used for statistically analyzing data collected for the OEMP. Accuracy, temporal and spatial analysis, distributions and descriptive statistics, and data anomalies are covered.

APPENDIX I

DATA ANALYSES

This section describes the criteria and methods to be used for statistically analyzing data collected in the Operational Environmental Monitoring Plan (OEMP). The goal of statistical data analyses is to provide an objective and reliable means for interpreting data in relation to the stated objects of the data collection program. For the OEMP, the principal goal of data analyses will be the comparison of a data point or data set to equivalent data collected at another location and time (such as preoperational baseline data or data collected at a control location) or to a fixed standard. The basic requirements and recommendations for data analyses are stated in DOE/EH-0023 and DOE/EH-XXX.

For each parameter, several levels of analyses are required before statistically valid interpretation can be achieved. The type of analysis used at each level will vary among parameters due to the particular characteristics of the parameter and the specific objectives of monitoring each parameter. Five general levels of data analyses are described here. Analyses at each of these levels will be considered for each parameter. The levels are:

1. Determination of the accuracy of each point measurement by means of the quantification and control of precision and bias.

2. Evaluation of the effects of auto-correlation due to the location and time of sampling on the expected value of the point measurement.

3. Identification of an appropriate model of variability (i.e., a probability density distribution) for each point measurement and the calculation of descriptive statistics based on that model.

4. Treatment of data anomalies, such as values below the limit of detection, negative values, missing data, and outliers.

5. Interpretation of the data through statistically valid comparisons (tests) of data groups and trend analysis.

In the following sections, each of these levels of data analyses are described and the requirements for application to the OEMP are presented.

I.1 ACCURACY

Accuracy is the closeness of a measurement to its actual, or true, value. Since the true value cannot be determined independently of measurement, accuracy cannot be determined absolutely. However, accuracy is controlled by two basic elements, bias, or the consistent over- or underestimation of the true value, and precision, or the concentration of repeated measurements around a central (expected) value. Accuracy is maximized when bias is minimized and precision is maximized (Gilbert, 1987).

To some extent, precision and bias are controlled by strict adherence to sample collection, handling, and measurement protocols. In the OEMP, procedures are in place which specify the protocols for those functions performed at WIPP (WEC 1986) and quality control procedures establish control on precision and bias for contractors.

The remaining elements of precision and bias will be quantitatively estimated through periodic performance of the following types of measurements:

- Measurement of replicate samples (two or more separate samples taken at the same time, from the same location, and with the same procedures)

- Measurement of duplicate samples (two or more aliquots of one sample) or the repeated measurement of the same sample (as in two or more counts of a single air filter)

- Measurement of blank samples

- Measurement of standard pseudo-samples (samples of an equivalent medium containing a known amount of the target species).

The measurement of replicate samples is used to estimate the amount of imprecision incurred through the entire process of sample collection, handling, and measurement. The measurement of duplicates and repeated measurements are used to estimate the amount of imprecision attributable to measurement. Blanks and pseudo-samples are used to evaluate bias incurred through measurement processes. Measurements of replicate samples and repeated measurements have been made in the RBP, particularly in the low-volume air sampling program. Results of the EPA cross-check Interlaboratory Comparison Program have always indicated to date that WIPP values for gross alpha and gross beta analyses are within specified control limits.

The methods used for satisfying these requirements will be dependent upon the sampling and measurement characteristics of each parameter. Generally, the following specifications will be followed: one replicate sample will be collected for each ten samples collected; at least one duplicate or one repeated measurement will be made for each discrete set of samples analyzed, or for each tenth sample analyzed; one blank sample will be analyzed for each discrete set of samples analyzed (for radioactivity counts, the background count is not considered a blank); and measurements of pseudo-samples will be performed once per year. Variations from these specifications may be required due to peculiarities of the individual parameters and will be stated in the procedure for that parameter.

I.2 TEMPORAL AND SPATIAL ANALYSIS

Environmental parameters vary with space and time. The effect of one or both of these two factors on the expected value of a point measurement can be statistically evaluated through spatial analysis and time series analysis; however, these methods often require extensive sampling efforts which are in excess of the practical requirements of the WIPP OEMP. The application of these methods to a particular parameter must, therefore, be limited by consideration of its significance in the final interpretation of the data.

In particular, spatial analysis will have very limited use in this program, although the effect of spatial auto-correlation on the interpretation of the data will be considered for each parameter. Spatial variability will be accounted for by the use of predetermined key sampling locations. Data analysis will be performed on a location-specific basis, or data from different locations may be combined only when the data have been determined to be statistically homogeneous.

Time series analysis, on the other hand, plays a more important role in data analysis for the OEMP. Parameters will be reported as time series, either in tabular form or as time plots. For key time series parameters, these plots will be in the form of control charts on which control levels will be identified based on preoperational databases, fixed standards, control location databases, or other standard for comparison. Where significant seasonal changes in the expected value of the parameter are identified in the preoperational database or in the control locations, corrections in the control levels which reflect the season change will be made.

I.3 DISTRIBUTIONS AND DESCRIPTIVE STATISTICS

For data sets which include more than 10 data points that are homogeneous in space and time (including seasonal homogeneity) and which have less than 10 percent missing data, a test for conformance to the normal distribution will be performed. A probability plot is an accepted method for performing this test;

however, more powerful tests of normality, such as the W Test or D'Agostino's Test (Gilbert, 1987), are more accurate. Any standard goodness-of-fit test is acceptable, provided the assumptions of the test are met.

If normality is not met, the data will be log-transformed and retested for normality. If the transformed data fit the normal distribution, the original data will be accepted as having a log-normal distribution. If normality is still not found, two courses may be taken. One is to continue to test the fit to standard families of distributions, such as the gamma, beta, and Weibull, with proper modifications to subsequent analyses based on the these results. The other course is to use nonparametric methods of data analysis.

For data sets smaller than 10, but homogeneous and complete, the log-normal distribution will be assumed. Data sets with more than 10 percent missing data will be analyzed using nonparametric methods. Nonhomogeneous data sets will be subdivided into homogeneous sets and each of these analyzed individually.

Descriptive statistics will be calculated for each homogeneous data set. At a minimum, these will include a central value and a range of variation. The central value will be the arithmetic mean of the untransformed data if the data are not censored at either end. If the data are censored, either a trimmed mean or the median will be used as the central value (which may be within the censored range). If the data set is greater than 10 and is uncensored, the standard deviation will be calculated and used as a basis for the reported range in variation. If these criteria are not met, the range between the 0.25 and 0.75 quartiles will be used.

I.4 DATA ANOMALIES

Data anomalies include data points reported as being below the limit of detection (LD) or otherwise censored over a specific range of values, missing data points occurring randomly in the data set, and outliers which cannot be ascribed to a known source of variation. Treatment of data anomalies requires specific, a priori guidelines and standards.

Whenever possible, values which are below detection limits will be obtained and incorporated into the database for statistical analysis. When no value is available, alternative methods of analysis, as described in previous sections, will be used. In particular, the use of nonparametric statistics may be required.

Missing data points comprising less than 10 percent of the data set will not affect data analyses. Results based on data in which more than 10 percent is missing will be identified as such at the time of reporting. In particular, consideration of the potential effect of missing data must be made when the majority of the data are missing from a discrete time span.

An outlier will be defined as any data point occurring in either extreme range (or tail) of the data distribution for which there is less than 0.01 probability of occurrence. For normally distributed data, this is roughly 2.3 or more standard deviations above or below the mean. When no probability model is identified, however, outliers may only be found through visual inspection of the data.

If no outside source of variation is identified to account for an outlier in a data set, it will be included in the data set and all subsequent analyses. If the inclusion of such outliers is found to affect the final results of the analyses significantly, both results (with and without outliers) will be reported.

I.5 COMPARISONS AND REPORTING

Comparisons between data sets will be performed using standard statistical tests. The selection of the specific test will be dependent upon the relative power of the test and the degree to which the underlying requirements of the test are met. In addition to tests comparing data from distinct locations and times,

trend analyses will be performed on time series where sufficient data exist. As a general standard, a 95 percent confidence level will be used for the final interpretation of results.

Citation of the source of the test method or the software used to perform the test will be made when the results are reported. Data and subsequent calculated values will be reported in accordance with standard rules for significant figures.

REFERENCES

Gilbert, R. O., 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand, Reinhold, New York, New York.

Westinghouse Electric Corporation (WEC), 1986, "Environmental Procedures Manual," WIPP 02-03, Waste Isolation Pilot Plant, Carlsbad, New Mexico.

APPENDIX J

ANNUAL SITE ENVIRONMENTAL MONITORING REPORT FOR THE WASTE ISOLATION PILOT PLANT

The Annual Site Environmental Report for the Waste Isolation Pilot Plant (DOE/WIPP-89-005) is prepared in accordance with DOE Order 5400.1. This report documents annual monitoring of the Radiological Baseline Program (RBP) and the Ecological Monitoring Program (EMP) during the preoperational phase.

DOE/WIPP-89-005

ANNUAL SITE ENVIRONMENTAL REPORT FOR THE WASTE ISOLATION PILOT PLANT CALENDAR YEAR 1988

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This report was prepared for the U.S. Department of Energy
by the Safety, Security and Environmental Protection Department
of the Management and Operating Contractor, Waste Isolation Pilot Plant
Under Contract No. DE-AC04-86AL31950

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1.0 INTRODUCTION

This is the fourth annual preoperational Site Environmental Report for the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. The WIPP project is operated by Westinghouse Electric Corporation for the U.S. Department of Energy (DOE). The purpose of the WIPP is to provide a research and development facility to demonstrate the safe disposal of transuranic (TRU) wastes generated by the defense activities of the U.S. government. This document is prepared in accordance with the guidance contained in DOE Order 5400.1 (DOE, 1988a) which requires DOE facilities to "submit an Annual Site Environmental Report to the Office of Operational Safety." The report provides a comprehensive description of environmental activities at the WIPP during calendar year 1988, including:

- A description of the WIPP project and its mission
- A description of the local environment, including demographics
- A summary of environmental program information, including an update on the status of environmental permits and compliance activities
- A presentation of the data of the Radiological Baseline Program (RBP), which is a program to characterize background radionuclide concentrations in the environment around the WIPP site
- A summary of findings of the Ecological Monitoring Program (EMP), which examines nonradiological impacts of WIPP construction on the surrounding ecosystem.

The WIPP facility is under construction and will not receive waste before September 1989. Therefore, this report describes the status of the preoperational activities of the Radiological Environmental Surveillance (RES) program, which are outlined in the Radiological Baseline Program for the Waste Isolation Pilot Plant: Program Plan (Reith and Daer, 1985). Since the program is in a preoperational phase, certain elements of DOE Order 5400.1 are not presented in this report. For example, no discussion of radionuclide emissions with subsequent estimates of doses to the public is included.

During March 1989, the monitoring activities of the RBP and the EMP were combined into the Operational Environmental Monitoring Program (OEMP). This program is described in the Operational Environmental Monitoring Plan for the

Waste Isolation Pilot Plant (DOE, 1989). This plan defines the scope and extent of the WIPP effluent and environmental monitoring programs during the facility's operational life. It also discusses the quality assurance/quality control programs which ensure that samples collected and the resulting analytical data are representative of actual conditions at the WIPP site. The Operational Environmental Monitoring Plan was prepared in accordance with the guidance contained in DOE Order 5400.1 and draft Order 5400.xx (DOE, 1988b). This plan also responds to the requirements and guidelines presented in DOE Order 5400.xy, "Radiological Effluent Monitoring and Environmental Surveillance for U.S. DOE Operations" (DOE, 1988c).

1.1 DESCRIPTION OF THE WIPP PROJECT

The transuranic (TRU) wastes to be received at WIPP beginning in September 1989 are composed of materials which are contaminated with alpha-emitting radionuclides with atomic numbers greater than 92 and half-lives greater than 20 years. Activities of these radionuclides in TRU wastes exceed 100 nCi/g. General criteria defining the various categories of radioactive waste, including TRU waste, appear in DOE Order 5820.2A (DOE, 1988d) and DOE Order 5820.2 (DOE, 1985). Isotopes of plutonium, americium, and curium will be the predominant radionuclides contaminating TRU waste. Table 1-1 lists these and other radionuclides which may be present in the various wastes to be received for emplacement.

TRU waste will be delivered to the WIPP Waste Handling Building via trucks and rail cars. Contact-handled transuranic (CH-TRU) wastes will arrive in shipping containers known as TRUPACT II's (TRansUranic PACkage Transporters). TRUPACT II's are durable, Type B, Department of Transportation (DOT) transport containers, accommodating drums and other waste containers. Remote-handled transuranic (RH-TRU) wastes will be packaged in waste canisters and shipped to WIPP in special transportation casks.

Once in the Waste Handling Building, waste containers will be removed from their shipping container, placed on the waste-handling hoist, and lowered to the repository horizon at a depth of 655 m (2,150 feet). Waste containers will then be removed from the hoist and emplaced in excavated storage rooms in the Salado Formation, a thick sequence of salt beds deposited approximately

TABLE 1-1

RADIONUCLIDE CONTENT OF WIPP WASTES

RADIONUCLIDES IN WIPP WASTES	TOTAL ACTIVITY DRUMS (Ci)	TOTAL ACTIVITY BOXES (Ci)	TOTAL ACTIVITY (Ci)	TOTAL MASS DRUMS (gm)	TOTAL MASS BOXES (gm)	TOTAL MASS (gm)	PERCENT TOTAL ACTIVITY	PERCENT TOTAL MASS
Th-232	2.43E-01	3.06E-02	2.74E-01	2.23E+06	2.81E+05	2.51E+06	0.00	15.89
U-233	6.24E+03	1.48E+03	7.72E+03	6.58E+05	1.56E+05	8.14E+05	0.08	5.15
U-235	3.23E-01	4.72E-02	3.70E-01	1.51E+05	2.21E+04	1.73E+05	0.00	1.10
U-238	1.28E+00	1.89E-01	1.47E+00	3.84E+06	5.68E+05	4.41E+06	0.00	27.91
Np-237	8.01E+00	7.11E-03	8.02E+00	1.14E+04	1.01E+01	1.14E+04	0.00	0.07
Pu-238	3.87E+06	1.65E+04	3.89E+06	2.22E+05	9.48E+02	2.23E+05	42.51	1.41
Pu-239	3.13E+05	1.12E+05	4.25E+05	5.11E+06	1.83E+06	6.94E+06	4.65	43.92
Pu-240	7.12E+04	3.40E+04	1.05E+05	3.14E+05	1.50E+05	4.64E+05	1.15	2.94
Pu-241	2.51E+06	1.57E+06	4.08E+06	2.24E+04	1.40E+04	3.64E+04	44.59	0.23
Pu-242	1.13E+01	6.68E+00	1.80E+01	2.90E+03	1.71E+03	4.61E+03	0.00	0.03
Am-241	6.20E+05	1.66E+04	6.32E+05	1.91E+05	5.12E+03	1.96E+05	6.96	1.24
Cm-244	1.25E+04	1.58E+02	1.27E+04	1.50E+02	1.90E+00	1.52E+02	0.14	0.00
Cf-252	2.00E+03	2.53E+01	2.03E+03	3.72E+00	4.71E-02	3.77E+00	0.02	0.00
			9.15E+06			1.58E+07		

TOTAL NUMBER OF DRUMS 3.69E+05
TOTAL NUMBER OF BOXES 2.28E+04

Source: DOE, 1988e.

250 million years ago (Permian Age). Specially designed seals and plugs will be placed in the excavated storage rooms and in the shafts. The plastic nature of the salt formation will result in gradual creep closure, causing encapsulation and isolation of the waste within the Salado Formation. The first five years of WIPP operations will be a demonstration period, during which time wastes will be emplaced so that they remain retrievable.

Once operational, the underground area will be ventilated by air which enters the Air Intake Shaft and the Construction and Salt Handling Shaft, and exits through the Exhaust Shaft. In the event of an underground accident, exhaust air will be circulated at a reduced flow rate through the Exhaust Filter Building, which contains banks of high efficiency particulate (HEPA) filters, in order to remove potentially contaminated particulates. Exhaust ventilation from the Waste Handling Building is continuously HEPA filtered, and is not expected to represent a significant effluent release point.

1.2 DESCRIPTION OF THE ENVIRONMENT

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 1-1). The site is approximately 40 kilometers (25 miles) east-southeast of Carlsbad in an area known as Los Medaños (the dunes), which is a sparsely inhabited plateau with little water and limited land uses. Most of the land is owned by the Federal Government or the State of New Mexico and is used for grazing. Other land uses in the general area include mining for potash, and exploration for or extraction of hydrocarbons.

The WIPP site consists of 16 sections of federal land in Township 22 South, Range 31 East. Except for the 2.75 square kilometers (1 square mile) encompassing the facility (known as the DOE Exclusive Use Area), surface land uses remain largely unchanged. Mining and drilling for purposes other than support of the WIPP project are restricted within this 16 section area.

The WIPP site is divided into zones as represented in Figure 1-1. Zone I, surrounded by a chain-link fence, includes all major surface facilities. The Secured Area Boundary, bounded by a barbed wire fence, includes other facilities associated with construction. Zone II indicates the maximum extent of underground development. The WIPP Site Boundary extends at least 1.6

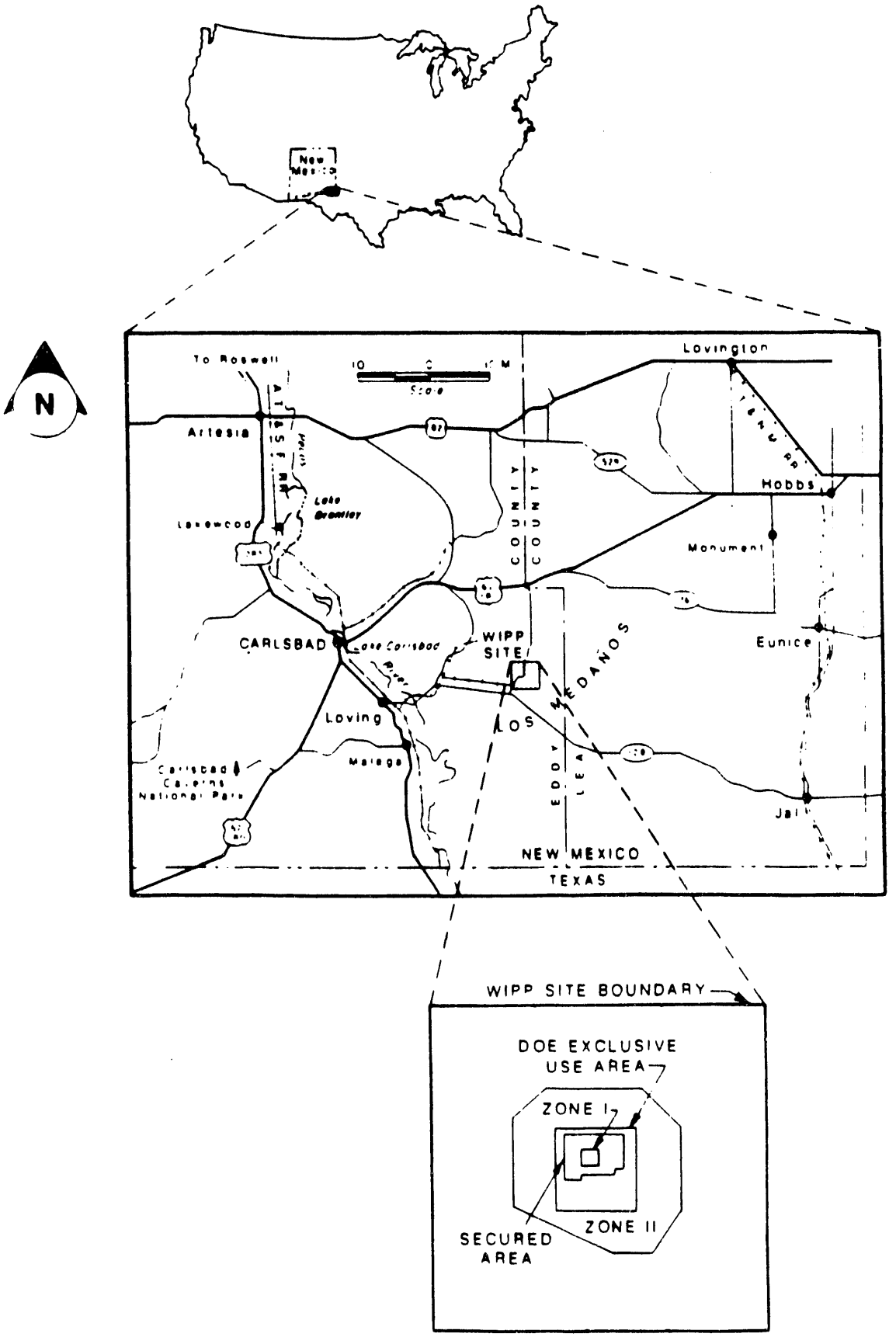


FIGURE 1-1 LOCATION OF THE WIPP SITE

kilometers (1 mile) beyond any underground development and is defined on the surface by the 16 section land withdrawal area. This boundary provides a functional barrier of intact salt between the underground region defined by Zone II and the accessible environment.

The approximate distribution of the local 1985 population within 80 kilometers (50 miles) of the WIPP site is illustrated in Figure 1-2. The nearest residents to the site include eight individuals living at the Mills Ranch, 5.8 kilometers (3.5 miles) south-southwest of the site and 13 individuals living at the Smith Ranch, 10 kilometers (6 miles) west-northwest of the site. Both neighboring ranches have been and will continue to be monitored as part of WIPP's environmental surveillance program. Detailed demographic summaries and projections are in the WIPP Final Environmental Impact Statement (FEIS) (DOE, 1980) and Final Safety Analysis Report (FSAR) (DOE, 1988e).

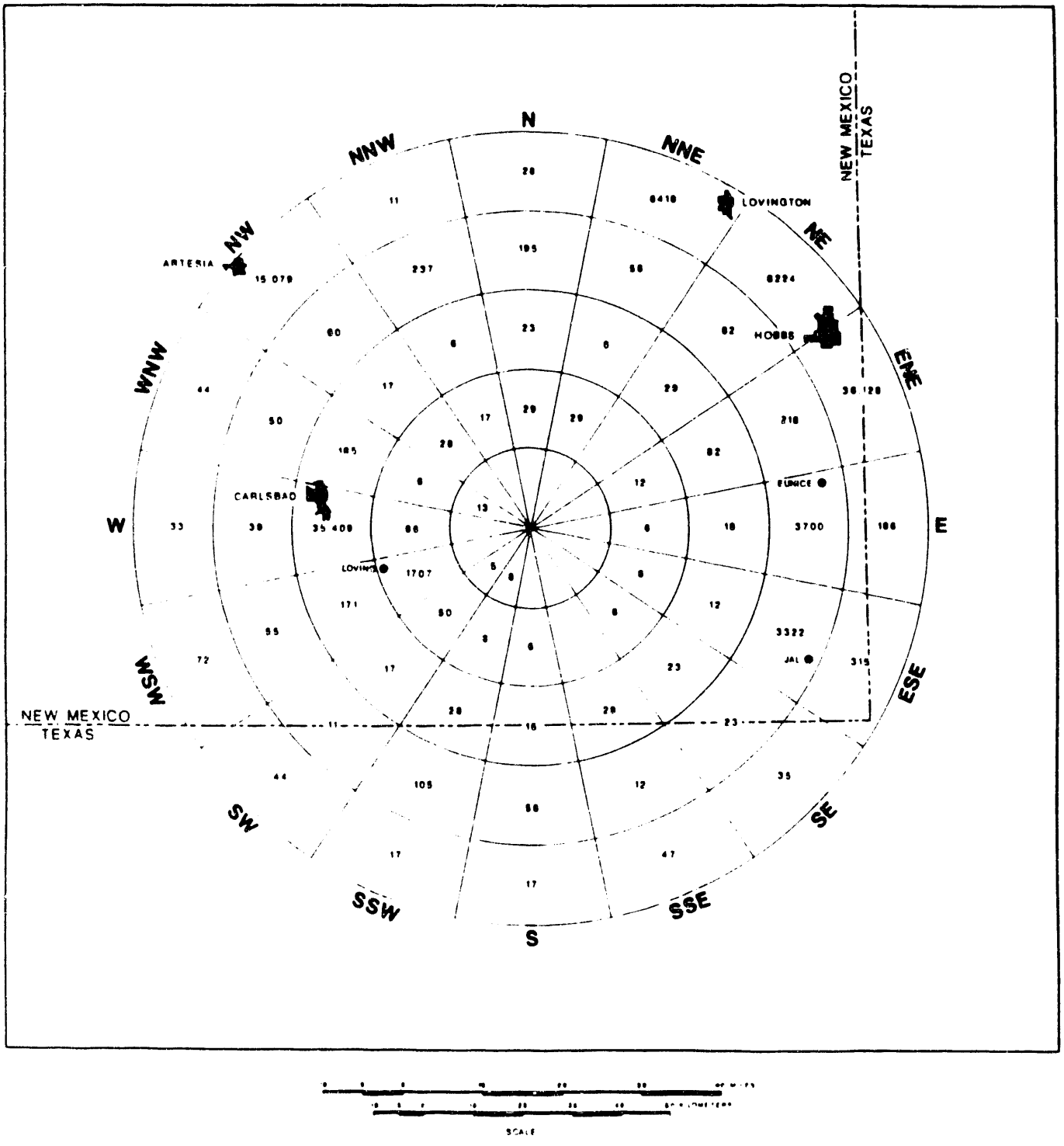


FIGURE 1-2 1985 POPULATION WITHIN 50 MILES OF WIPP

2.0 SUMMARY OF ENVIRONMENTAL ACTIVITIES AT WIPP

The WIPP environmental program monitors a comprehensive set of parameters in order to detect and quantify any present or future environmental impacts. Measurements are taken of background radiation, meteorological conditions, water and air quality, soil properties, and the status of the local biological community. Ecological studies focus upon the immediate area surrounding the site, whereas baseline radiological surveillance covers a broader geographic area including nearby ranches, villages, and cities.

An important environmental activity which commenced in 1985 was the preoperational phase of the radiological environmental surveillance program. This activity, the Radiological Baseline Program (RBP), is described in Reith and Daer (1985). The primary goal of the RBP is to establish a preoperational database of radiological data against which operational radiation measurements will be assessed. The RBP consists of five subprograms: 1) the atmospheric radiation baseline, which includes eight stations where airborne particulates are continuously collected and analyzed for radioactivity; 2) the ambient radiation baseline, which includes 44 stations with thermoluminescent dosimeters (TLDs) to monitor penetrating radiation on a quarterly basis, and a pressurized ionization chamber instrument located on the site for continuous monitoring of penetrating radiation; 3) the terrestrial radiation baseline, which includes 28 stations where soil samples are collected; 4) the hydrologic radiation baseline, which includes 10 stations where surface water and at 5 of these, sediments are collected as well as 23 wells where groundwater is collected; and 5) the biotic baseline, which includes the sampling of vegetation, rabbits, quail, beef, and fish. The RBP was replaced by the Operational Environmental Monitoring Program in March 1989.

All materials (airborne particulates, water, sediments, soils, and biota) collected are analyzed for activities of naturally occurring and transuranic radionuclides by a contract analytical laboratory. This laboratory and the vendor analyzing the thermoluminescent dosimeters for penetrating radiation undergo periodic review of their performance and adherence to quality standards and specifications.

The surveillance results for 1988 are summarized in this report; selected pre-1988 results are included in Appendix A because additional data were received subsequent to the issuing of the third annual report (Flynn, 1988). Compilations of radiological data are presented in Section 5.0.

Measurements made and reported to date represent values within the expected ranges of environmental radioactivity as presented in documents prepared by national consensus organizations, such as the National Council on Radiation Protection and Measurement (NCRP, 1975; NCRP, 1976), and federal agencies (DOE, 1980, EPA, 1977).

Section 6.0 of this report summarizes the nonradiological environmental activities associated with the WIPP project. Species surveyed at the site (small mammal, bird, and vegetation) generally indicate small shifts in composition as a result of area-wide factors such as precipitation. Surface water quality is similar to results obtained in previous monitoring years. Air quality in the immediate area of the facility has been affected to some extent by site activities such as paving and traffic.

3.0 COMPLIANCE SUMMARY

The WIPP project is subject to environmental compliance requirements from a variety of sources. This section summarizes the status of the project in complying with the various programs.

3.1 COMPLIANCE WITH ENVIRONMENTAL MONITORING

Environmental monitoring procedures were set up to track site impacts from construction and operation of the facility. The Ecological Monitoring Program, Radiological Baseline Program, and Water Quality Sampling Program (WQSP) were developed for that purpose.

Detailed manuals are used in the RBP, EMP and WQSP to assure the highest standards of quality control from sample collection and handling, through laboratory analysis, and on to data evaluation (Geotechnical and Geosciences Procedure Manual, WP 07-2) and Environmental Procedures Manual, WP 02-03). Quality Assurance and Quality Control standards are discussed in Section 8, Quality Assurance. The RBP, EMP and WQSP sampling frequencies and parameters also are established in the procedures manuals. Table 3-1 lists the sampling frequency goals for 1988 and the actual 1988 frequency rate. Occasional flawed or lost samples or equipment malfunctions account for any difference between the number of samples scheduled for collection and analysis and the number actually collected and analyzed. The schedule for 1988 went beyond the minimum requirement.

3.2 COMPLIANCE WITH AGREEMENT FOR CONSULTATION AND COOPERATION

Compliance with terms of the Agreement for Consultation and Cooperation established in 1981 with the State of New Mexico is part of WIPP procedures. This agreement, required by the federal legislation which authorized the WIPP project (Public Law 96-164, 1980), specifies that DOE notify the State of New Mexico prior to the commencement of key events. There were no key events in 1988 that necessitated formal notification of the State of New Mexico under the terms of the Agreement.

The Supplemental Stipulated Agreement specifies that DOE provide the state with sufficient information to conduct an independent review of all WIPP

TABLE 3-1

ADHERENCE TO 1988 SAMPLING SCHEDULE

	LOCATIONS (OR OTHER UNITS) SAMPLED EACH PERIOD	SAMPLING PERIODS IN 1988	SAMPLES SCHEDULED IN 1988[1]	SAMPLES COLLECTED	SAMPLES ANALYZED AND/OR REPORTED	REMARKS
RBP:						
Liquid Influent (twice prior to operations)	1	0	0	0	0	Samples collected prior to 1988
Liquid Effluent (twice prior to operations)	2	0	0	0	0	Samples collected prior to 1988
Aerial Gamma Survey (once prior to operations)	1	1	1	1	1	
Thermoluminescent Dosimeters	44	4	176	172	172	4 lost in field
Exposure Rate Meter	1	C[2]	C	C	C	
Atmospheric Particulate (Lo-Vol)	8	52	416	409	409	5 samples lost due to sampler malfunction. 2 samples not collected after WNW location discontinued on December 14.
Native Vegetation - Radioanalysis (three times prior to operations)	3	1	3	3	0	
Beef (once prior to operations)	2	0	0	0	0	Beef samples collected in previous years.
Game Birds (twice prior to operations)	1	1	1	1	1	
Rabbits (twice prior to operations)	2	1	2	2	2	

TABLE 3-1
ADHERENCE TO 1988 SAMPLING SCHEDULE
(CONTINUED)

	LOCATIONS (OR OTHER UNITS) SAMPLED EACH PERIOD	SAMPLING PERIODS IN 1988	SAMPLES SCHEDULED IN 1988[1]	SAMPLES COLLECTED	SAMPLES ANALYZED AND/OR REPORTED	REMARKS
RBP: (Continued)						
Soil - Radioanalysis (three depths at 37 locations) (twice prior to operations)	111	0	0	111	0	Samples archived
Surface Water - Radioanalysis	10	1	10	10	10	
Ground Water - Radioanalysis (three times prior to operations)						
- WIPP Wells[3]						
• WQSP (not scheduled for 1988)	7	0	0	0	0	
• WQSP (annual sampling)	13	1	13	13	13	
• WQSP (biennial sampling)	3	2	6	6	6	
• extras	2	1	2	2	2	
- Private Wells (annual sampling)	9	1	9	9	9	
- Private Wells (biennial sampling)	1	2	2	2	2	
Fish (twice prior to operations)	1	1	1	1	1	
Sediment	4	1	4	4	4	
General Environmental Monitoring:						
Meteorology						
- Temperature at 2 meters	1	C	C	C	C	
- Wind Speed at 10 meters	1	C	C	C	C	
- Wind Direction	1	C	C	C	C	
- Precipitation	1	daily	daily	as needed	as needed	
- Barometric Pressure	1	C	C	C	C	
- Relative Humidity	1	C	C	C	C	
Aerial Photography	1	2	2	2	2	

TABLE 3-1
ADHERENCE TO 1988 SAMPLING SCHEDULE
(CONTINUED)

	LOCATIONS (OR OTHER UNITS) SAMPLED EACH PERIOD	SAMPLING PERIODS IN 1988	SAMPLES SCHEDULED IN 1988[1]	SAMPLES COLLECTED	SAMPLES ANALYZED AND/OR REPORTED	REMARKS
General Environmental Monitoring: (Continued)						
Air Quality						
- Pollutant Gas Concentration	1	C	C	C	C	
- Total Suspended Particulates	1	52	52	52	47	5 collected samples were flawed
Water Quality						
- Surface Water and Sediments	4	1	4	4	4	
- Ground Water						
• WIPP Wells[4]						
- WQSP (not scheduled for 1988)	4	0	0	0	0	
- WQSP (annual sampling)	16	1	16	16	16	
- WQSP (biennial sampling)	3	2	6	6	6	
• Private Wells (annual sampling)	9	1	9	9	9	
• Private Wells (biennial sampling)	1	2	2	2	2	
Wildlife Populations						
- Breeding Bird Density	4	1	4	4	4	
- Small Mammal Density	4	1	4	4	4	
Salt Impact Studies:						
Soil Chemistry						
- Surface Collection (six samples per location)	42	4	168	168	168	
- Subsurface Collection (six samples per location)	42	1	42	42	42	
Soil Microbiota						
- Microbial Activity (three samples per location)	21	4	84	84	81	3 samples lost in field

TABLE 3-1
ADHERENCE TO 1988 SAMPLING SCHEDULE
(CONTINUED)

	LOCATIONS (OR OTHER UNITS) SAMPLED EACH PERIOD	SAMPLING PERIODS IN 1988	SAMPLES SCHEDULED IN 1988[1]	SAMPLES COLLECTED	SAMPLES ANALYZED AND/OR REPORTED	REMARKS
Salt Impact Studies: (Continued)						
- Leaf Litter Decomposition (three samples per location)	21	4	84	84	42	Analysis of 3rd and 4th quarter pending equipment availability
Vegetation						
- Foliar Coverage	7	2	14	14	14	
- Annual Plant Density	7	2	14	14	14	
- Species Richness	7	1	7	7	7	
Surface Photography						
- Visual Impacts (eight photos per location)	56	2	112	112	112	

[1] (Number of sampling locations) X (number of sampling periods) = (number of samples scheduled)
[2] C = Continuous Sampling
[3] Water Quality Sampling Program (WQSP) Wells and two extra wells (Air Intake Shaft, H-18)
[4] Same wells as in (3), plus H-01.

activities. This review, performed by the New Mexico Environmental Evaluation Group (EEG), allows for an independent program of radiological surveillance conducted in parallel with the RES program at the WIPP. The EEG received split water, soil and biotic samples supplied by WIPP Environmental Programs during routine collections, and from air sampling instruments located side-by-side with the WIPP instruments.

3.3 COMPLIANCE WITH FEDERAL AND STATE ENVIRONMENTAL CONTROLS

The WIPP is required by Executive Order 12088, "Federal Compliance with Pollution Control Standards", and DOE policy of January 1, 1986 (DOE, 1986), to comply with applicable pollution control standards, regulations, and statutes. This applies to existing environmental activities and problems, and to potential environmental impacts.

Records are maintained of all federal, state or local permits, notices, and approvals which apply to the WIPP project. Section 4.2, Environmental Permits, contains a discussion and current listing of these permits. In 1988, WIPP remained in compliance with current environmental activities that require permits, notices or approvals.

The air quality monitoring program initiated in 1986 has found that the air quality in the area of the WIPP meets state and federal standards with some short-term exceptions. During a four-month period in the summer, H_2S levels in the afternoon hours were high, causing state standards for a one-hour average to be exceeded. In addition, in December 1988, O_3 levels exceeded standards. A detailed discussion of these situations and the probable causes is contained in Section 6, Nonradiological Environmental Program Data.

The WIPP is currently permitted as a generator of hazardous waste under the Resource Conservation and Recovery Act (RCRA) as a result of both research and construction activities. As such, it must comply with regulations that primarily address day-to-day waste management, and which are included in 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste, and the equivalent New Mexico Hazardous Waste Management Regulation 204. Westinghouse Electric Corporation arranged with a contractor to have a comprehensive environmental audit performed at the WIPP site from May 18-20, 1988. A few

minor violations were noted and subsequently corrected. At this time, the facility can be considered in full compliance with all applicable hazardous waste regulations.

The Salt Impact Studies of the EMP are specifically conducted to determine if adverse environmental impacts are occurring from salt transport away from the surface storage piles. The 1988 results of this study are found in Section 6, Nonradiological Environmental Program Data, and indicate that no such adverse impacts were observed in 1988.

A number of provisions to mitigate potential environmental impacts appear in Statements of Work issued to all construction contractors at the WIPP. These include:

- Protection of environmental resources, including the avoidance of unnecessary damage to vegetation, wildlife, and soil by controlling traffic, minimizing disturbance zones, and cleaning up spills.
- Protection of air resources, including the control of hydrocarbon emissions by using proper fuels, the suppression of dust by spraying with water, and the monitoring and control of noise.
- Protection of water resources, including the use of retention ponds for controlling suspended materials, solutes, and other pollutants.
- Preservation and recovery of historical, archaeological, and cultural resources, including the interruption of construction activities as necessary to investigate and mitigate any finds of unusual or potentially valuable items.
- Post-construction cleanup, including the obliteration of temporary construction facilities such as haul roads, stockpiles, and work areas, as well as the restoration of all damaged landscape features outside the limits of approved work areas.

All construction contractors have complied with these terms of their contracts.

4.0 ENVIRONMENTAL PROGRAM INFORMATION

Since its inception, the WIPP project has included a comprehensive set of environmental programs. The combined goals of these programs are to characterize the local environment, to quantify environmental impacts of the facility and, above all, to assure the protection of the public. Two comprehensive overviews of environmental activities at WIPP were published in 1985 (Reith, 1985; Reith et al., 1985).

4.1 ENVIRONMENTAL MONITORING PROGRAMS

Subsequent sections of this report outline the environmental sampling programs such as: 1) the Radiological Baseline Program, which measures baseline radiological parameters; 2) the Ecological Monitoring Program, which tracks nonradiological impacts of construction; 3) the Operational Environmental Monitoring Program, which succedes the RBP and the EMP during the operational phase; and 4) the Water Quality Sampling Program, which provides data for site characterization, performance assessment, the RBP and the EMP.

4.1.1 The Radiological Baseline Program

Data acquisition for the RBP began on June 30, 1985 according to the RBP program plan (Reith and Daer, 1985). In addition to the program plan, the RBP is supported by several other programmatic documents, including:

- Compilation of Historical Radiological Data Collected in the Vicinity of the WIPP Site (Bradshaw and Louderbough, 1987)
- Guidance Manual: Surface Water and Sediment Sampling for the Environmental Monitoring Program (Prill and Buckle, 1987)
- "WIPP Water Quality Sampling Manual" (WP 07-2 of the Geotechnical and Geosciences Procedure Manual)
- Environmental Procedures Manual (02-03).

These documents are revised and updated as necessary based on experience gained during sampling environmental media, compilation of radiological data, and the impact of changing regulatory requirements.

The principal guideline for RBP sampling strategy is the pathway analysis described in the WIPP Final Safety Analysis Report (FSAR) (DOE, 1988e). Figure 4-1 indicates that each of the critical pathways to man is being monitored by at least one of the five RBP subprograms.

The minimum RBP sampling schedule prior to receipt of waste is presented in Table 4-1. Compliance with the 1988 sampling schedule is listed in Table 3-1. Sampling and related activities (logging, packaging, and shipping) are conducted in accordance with the procedures described in Section 8.0, Quality Assurance. Sample splits are made available to the New Mexico Environmental Evaluation Group (EEG) and selected samples and splits are archived.

4.1.2 The Ecological Monitoring Program

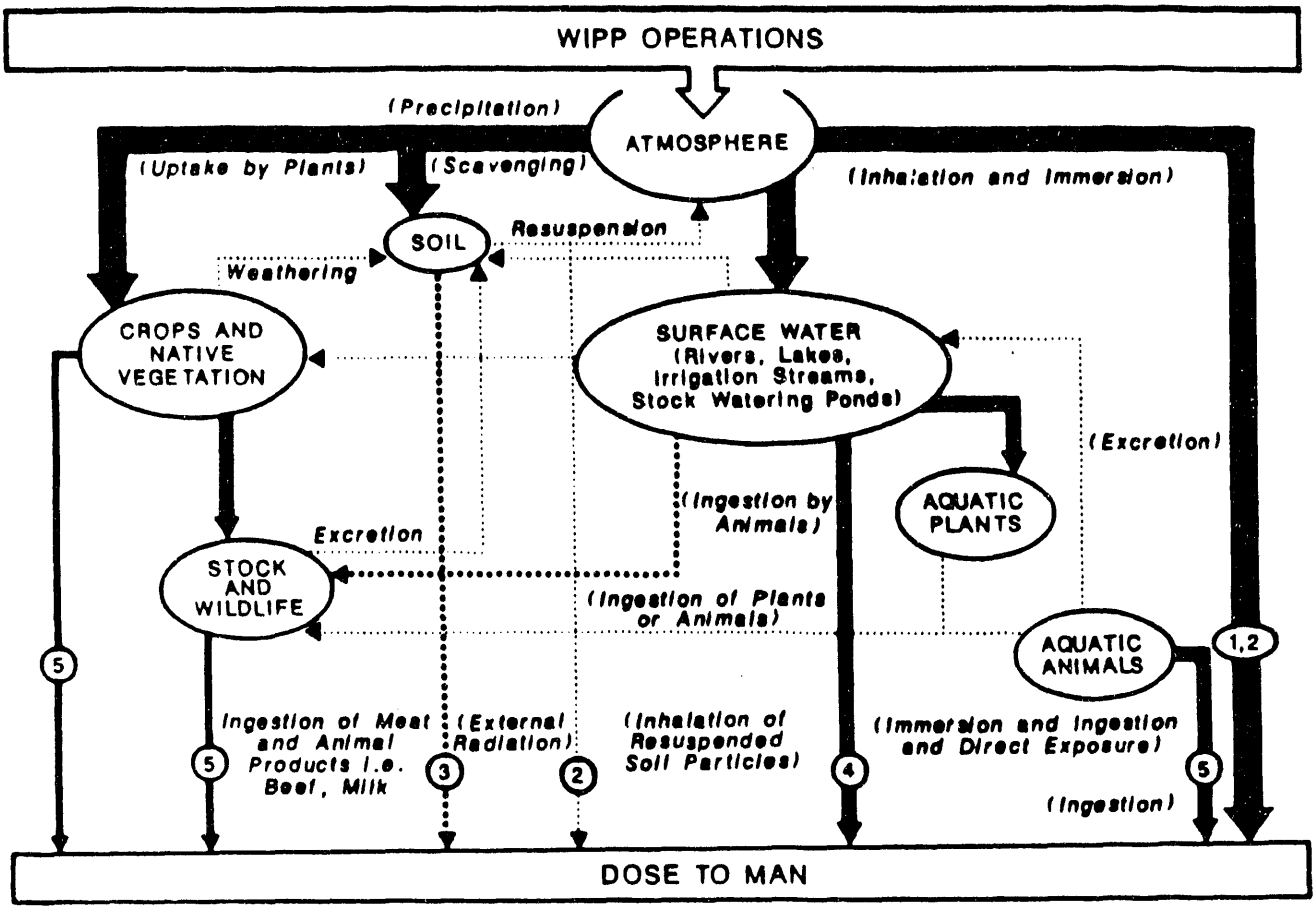
The EMP was initiated in 1984. This program was preceded by the WIPP Biology Program (1975-1982), which combined scientific and technical expertise from six universities to develop an extensive baseline of information describing the major components of the Los Medaños ecosystem prior to the initiation of the WIPP construction activities (see Reith et al., 1985, for a summary of this program). The principal functions of the EMP are:

- To detect and quantify the impacts of construction and operational activities at the WIPP on the surrounding ecosystem
- To continue the development of the ecological database for the Los Medaños area initiated by the WIPP Biology Program
- To investigate unusual and unexpected elements in the ecological and radiological databases
- To provide environmental data which are important to the mission of the WIPP project, but which have not or will not be acquired by other programs.

Table 4-2 contains the parameters and minimum measurement frequencies of EMP sampling. Figure 4-2 shows the location of the ecological monitoring plots.

4.1.3 Operational Environmental Monitoring Program

Because of the research and development aspects of the WIPP mission, and because of the commitments discussed in the Final Environmental Impact Statement (FEIS) (DOE, 1980) to the State of New Mexico, the public, and the



POSSIBLE RADIONUCLIDE PATHWAYS LEADING FROM THE WIPP SITE TO MAN:

THE WIDTH OF EACH LINE IS PROPORTIONAL TO THE IMPORTANCE OF THE PATHWAY IN THE LOS MEDANOS ECOSYSTEM. THE NUMBERS IN THE PATHWAYS LEADING TO MAN INDICATE WHICH MONITORING PROGRAMS WILL INTERCEPT THAT PATHWAY.

1. EXTERNAL RADIATION MONITORING
2. AIRBORNE PARTICULATE AND EFFLUENT MONITORING
3. SOIL AND SEDIMENT SAMPLING
4. SURFACE WATER AND GROUNDWATER MONITORING
5. VEGETATION, BEEF, GAME ANIMAL AND AQUATIC FOODSTUFFS SAMPLING

FIGURE 4-1 PRIMARY EXPOSURE PATHWAYS

TABLE 4-1

MINIMUM RBP SAMPLING SCHEDULE
PRIOR TO RECEIPT OF WASTE

TYPE OF SAMPLE[1]	SAMPLING LOCATIONS	SAMPLING FREQUENCY
Liquid Influent	1	Once
Liquid Effluent	1	Once
Aerial Gamma Survey	1	Once
Thermoluminescent Dosimeters	44	Quarterly
Exposure Rate Meter	1	Continuous
Atmospheric Particulate (LoVol)	8	Weekly
Vegetation	3	Annually
Beef	2	Once
Game Birds	1	Twice
Rabbits	1	Twice
Soil	28 (3 depths)	Twice
Surface Water	10	Annually
Groundwater	23	Twice
Fish	1	Twice
Sediment	5	Annually

[1] Specific Radionuclides Tested = ^{3}H, ^{7}Be, ^{40}K, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, ^{244}Cm

TABLE 4-2

ECOLOGICAL MONITORING PROGRAM PARAMETERS AND MINIMUM FREQUENCY

TYPE	PARAMETER(S)	MEASUREMENT FREQUENCY
General Environmental Monitoring		
Meteorology	Temperature (at 2 m)(1)	Continuous
	Wind Speed (at 10 m)	Continuous
	Wind Direction (at 10 m)	Continuous
	Precipitation	Daily
	Barometric Pressure	Continuous
	Relative Humidity	Continuous
Aerial Photography	Area of Land Disturbed	Annually
Air Quality	Pollutant Gas Concentration (O_3, CO, H_2S, SO_2, NO_x)	Continuous
	Total Suspended Particulates	Weekly
Water Quality	General Chemistry and Pollutants (Chemical Constituents)(2)	Annually
Wildlife Populations	Breeding Bird Density	Annually
	Small Mammal Density	Annually
Salt Impact Studies		
Soil Chemistry	pH, EC, Na, Cl, Mg, Ca, K	Quarterly
Soil Microbiota	Microbial Activity Level	Quarterly
	Leaf Litter Decomposition	Quarterly
Vegetation	Foliar Coverage	Biannually
	Annual Plant Density	Biannually
	Species Richness	Annually
Surface Photography	Visual Impacts	Biannually

(1) Height expressed in meters above ground level.

(2) Chemical Constituents = Chloride, iron, manganese, phenols, sodium, sulfate, pH, specific conductance, total organic carbon, total organic halogen, arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nitrate, selenium, silver, volatile hazardous substances, semi-volatile hazardous substances, PCBs.

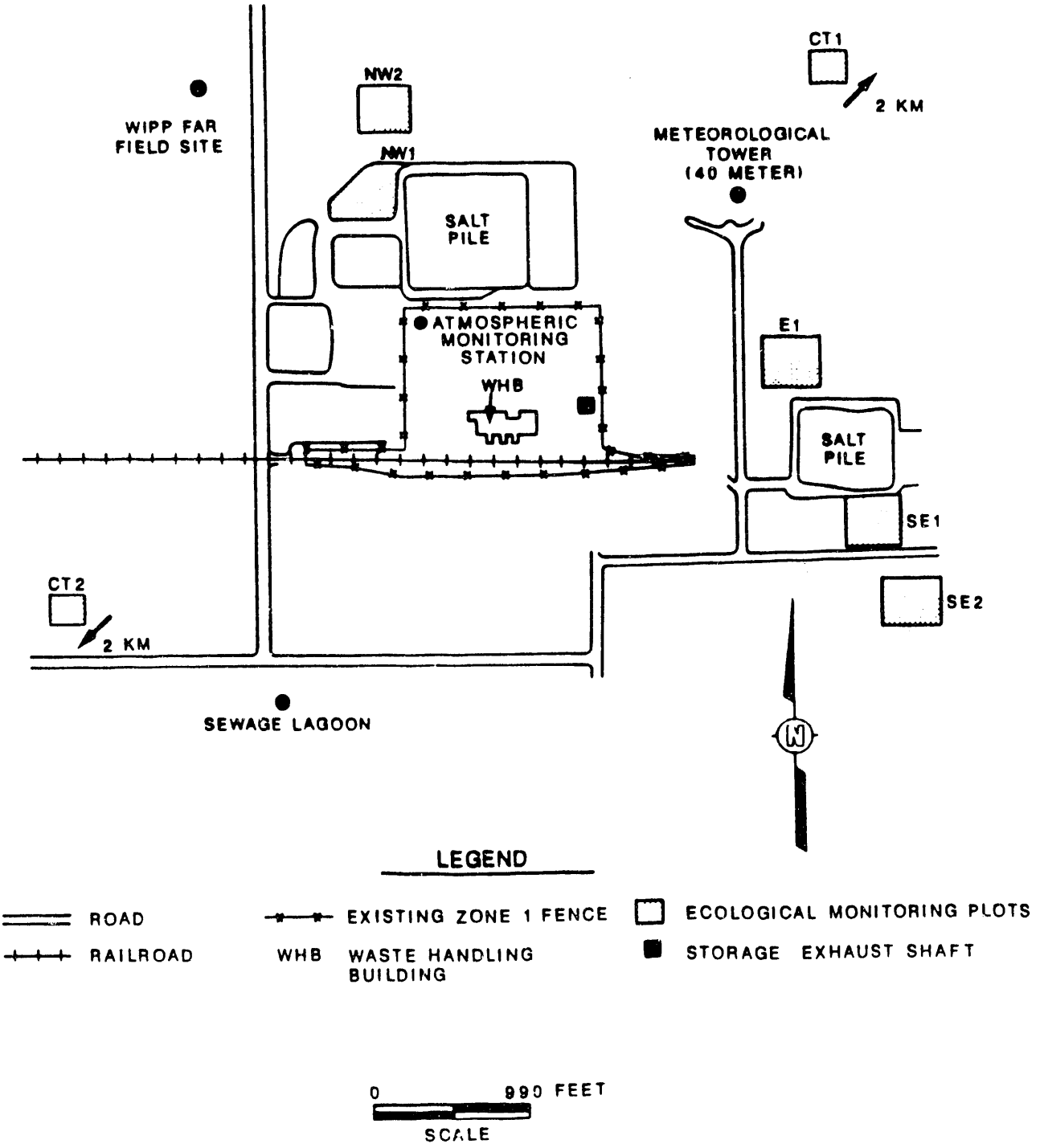


FIGURE 4-2 LOCATIONS OF ECOLOGICAL MONITORING PLOTS

scientific communities, a thorough and extensive monitoring effort is proposed for WIPP operations. The WIPP Operational Environmental Monitoring Program will monitor a comprehensive set of parameters in order to detect and quantify any present or future environmental impacts. It is also critical to the success and credibility of the program that the individual monitoring efforts remain flexible. As required in DOE Order 5400.1 (DOE, 1988a), the OEMP will be reviewed annually. The OEMP scope and intensity will be adjusted in response to changing facility processes, environmental parameters, and program results.

Parameters measured include ambient radiation levels, atmospheric conditions, air and water quality, soil properties, and the status of the local biological community. Nonradiological portions of the program focus on the immediate area surrounding the site, whereas radiological surveillance generally covers a broader geographic area including nearby ranches, villages, and cities. Environmental monitoring will continue at the site during project operations and through decommissioning activities.

The goal of the OEMP is to determine whether there are impacts during the operational phase of WIPP on the local ecosystem and, if so, to evaluate their severity, geographic extent, and environmental significance. Table 4-3 summarizes the OEMP sampling schedule. The table lists the sample types, the number of sampling stations, the approximate sampling schedule and the environmental/ecological parameters to be monitored. Additional or different types of samples will be collected and analyzed as necessary to investigate and explain trends or anomalies that may have a bearing on the WIPP's environmental impacts. The OEMP radiological sampling and analysis schedule is less extensive than that of the RBP. Baseline conditions were characterized by the RBP prior to waste emplacement at WIPP. RBP sampling was extensive because additional baseline data cannot be collected after wastes arrive. Environmental and ecological sampling during operations will be increased if warranted.

As recommended in DOE/EP-0023 (Corley et al., 1981), the OEMP monitors levels of naturally occurring radionuclides and those associated with world-wide fallout in addition to those expected in the WIPP wastes. The geographic scope of radiological sampling is based on projections of potential release pathways

TABLE 4-3

OEMP SAMPLING SCHEDULE

TYPE OF SAMPLE	SAMPLING LOCATIONS	SAMPLING FREQUENCY
Liquid Influent	1	Semiannual
Liquid Effluent	1	Semiannual
Airborne Effluent	3	Continuous
Meteorology	2	Continuous
Thermoluminescent Dosimeters	22	Quarterly
Exposure Rate Meter	1	Continuous
Atmospheric Particulate (Lo-Vol)	7	Weekly
Air Quality	1	Continuous
Vegetation	4	Annual
Beef	2	Annual*
Game Birds	2	Annual
Rabbits	2	Annual
Soil	7	Biennial
Surface Water	8	Annual
Groundwater	14	Annual
Fish	2	Annual
Sediment	6	Biennial
Aerial Photography	Site Wide	Annual
Salt Impact Studies		
Surface Photography	7	Biannual
Soil Chemistry	7	Quarterly
Soil Microbiota	7	Semiannual
Vegetation Survey	7	Biannual
Wildlife Survey	4	Annual

*If available

for the types of radionuclides in the WIPP wastes. Also, the surrounding population centers are monitored even though release scenarios involving radiation doses to residents of those population centers are improbable. Ecological sampling activities will continue to be performed at the permanent ecological monitoring plots, whose locations are unchanged from the earlier EMP.

4.1.4 Water Quality Sampling Program

The Water Quality Sampling Program was developed to collect reproducible and representative groundwater samples from water-bearing zones in the WIPP vicinity. The WQSP is described in detail in Section 7.0, Groundwater Protection.

4.2 ENVIRONMENTAL PERMITS

The WIPP must comply with specified permitting and approval requirements of several federal and state regulating agencies. A record is maintained of required permits, notices, and approvals which apply to the WIPP project. This record enables environmental personnel to anticipate commitments such as renewal dates, fee payments, and reclamation requirements. A preoperational environmental permit compliance plan has been developed for the WIPP (Louderbough, 1986). Table 4-4 lists permits which were active in 1988, as well as approvals granted and notices filed during 1988.

4.3 NATIONAL ENVIRONMENTAL POLICY ACT ACTIVITIES

During 1988, two separate documents were prepared to evalute the environmental consequences of certain proposed WIPP activities which were not included in the FEIS. These were:

- Action Description Memorandum: Upgrading Site Security Facilities (WEC, 1988b), and
- Action Description Memorandum: Air Intake Shaft (WEC, 1988a).

The purpose of these Action Description Memoranda (ADMs) was to comply with DOE-AL Order AL 5440.1B (DOE, 1982) regarding the implementation of the National Environmental Policy Act (NEPA). The analyses performed for these

TABLE 4-4
ENVIRONMENTAL PERMITS ACTIVE IN 1988

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
Department of the Interior, Bureau of Land Management	Land Use Permit for placement of raptor platforms	NM-060-LUP-235	9/12/86	9/12/89	NA		
As above	Right-of-Way for water pipeline	NM53809	8/24/83	NA	NA		Right-of-way extended in perpetuity
As above	Right-of-Way for north access road	NM55676	8/24/83	NA	NA		Right-of-way extended in perpetuity
As above	Land Use Permit to Dispose of Contruction Debris	NM-067-LUP-237	2/9/87	2/9/90			Landfill has been cleaned up and procedure WP 02-503 issued
As above	Right-of-Way for railroad	NM55699	9/27/83	NA	NA		Right-of-way extended in perpetuity
As above	Right-of-Way for dosimetry and aerosol sampling sites	NM63136	7/3/86	NA	NA		

TABLE 4-4
ENVIRONMENTAL PERMITS ACTIVE IN 1988
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	Right-of-Way for seven subsidence monuments	NM65801	11/7/86	NA	NA		
As above	Approval to drill 2 new test wells on existing pads at P-1 and P-2	NA	9/18/86	NA	NA		
New Mexico Environmental Improvement Division	Open Burning Permit to train fire control crews	NA (initial)	2/24/88 (extension)	2/24/89	NA		
As above	Food or Drink Purveyor Permit for cafeteria	4CA08CARRS184A	10/10/86	NA	NA		
New Mexico Department of Game and Fish	Permit to collect biological samples	1775	1/14/88	12/31/88	Limit of 20 scaled quail and catfish		Permit renewal requested; 1988 Annual Report submitted 01/89

TABLE 4-4
ENVIRONMENTAL PERMITS ACTIVE IN 1988
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	Concurrence that construction of WIPP will have no significant adverse impact upon threatened or endangered species	NA	4/7/80	NA	NA		
New Mexico Commissioner of Public Lands	Right-of-way for high volume air sampler	RW-22789	10/3/85	10/3/2020	$500 annual fee		
New Mexico Department of Finance and Administration, Planning Division, Historic Preservation Bureau	Concurrence that the archaeological resources protection plan prepared by the DOE is adequate to mitigate any adverse impacts upon cultural resources resulting from construction of the full WIPP facility	NA	7/25/83	NA	NA	NA	

TABLE 4-4
ENVIRONMENTAL PERMITS ACTIVE IN 1988
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
U.S. Environmental Protection Agency	Notification of presence of 2 underground fuel storage tanks at WIPP	NA	4/15/86	NA	NA	Compliance with 40 CFR 280	$56 annual fee submitted 9/1/88
As above	Acknowledgement of Notification of Hazardous Waste Activity	NMD982283566	10/87	NA		Compliance with 40 CFR 262 and NMHWR	Biennial report submitted 5/88
As above	Acknowledgement of Notification of Hazardous Waste Activity (WIPP)	NMD982285488	1/88	NA		Compliance with 40 CFR 262 and NMHWR	Revisions to Notification submitted 7/88

ADMs indicated that implementing the proposed actions or alternatives is not expected to result in significant environmental consequences.

4.4 SIGNIFICANT ENVIRONMENTAL ACTIVITIES

4.4.1 Cooperative Raptor Research and Management Program

In 1985, The Los Medaños Cooperative Raptor Research and Management Program was initiated under the sponsorship of the DOE with support from the U.S. Bureau of Land Management and the Living Desert State Park. This program is independent of other monitoring programs at the WIPP site. Part of the goal of this study, conducted by researchers from the University of New Mexico, is to evaluate the impacts of the WIPP activities on the breeding success of raptors (e.g., hawks and owls) which are found in unusual abundance in the vicinity. Experiments are also being conducted to determine how these impacts may be mitigated.

Results from 1986 (Bednarz, 1987) indicate that adverse impacts on nest success, resulting from human intrusion during critical times in the nesting cycle, are measureably reduced by slightly modifying field work schedules to accommodate nesting activities. When nests have been found in locations potentially threatened by a nearby work area (such as a well pad), the Regulatory and Environmental Programs Section at the WIPP is notified and the scheduled use of the work area is examined. When possible, work schedules are modified to minimize impacts on the nests.

Results of the 1988 field season (Hayden and Bednarz, 1989) indicate that raptor reproduction was very poor throughout the raptor study area. The limited reproductive success was correlated with very low prey availability, rather than to any influence of the WIPP activities.

4.4.2 Reclamation of Disturbed Lands

A reclamation study has been established at the WIPP site by the Regulatory and Environmental Programs Section. The purpose of the project is twofold: to complete reclamation of roads, well pads, briney reserve pits, borrow pits, and pipelines at the site which are no longer needed for the WIPP activities and which must be reclaimed to meet the requirements of the Bureau of Land Management land use permits; and to evaluate the effectiveness of reclamation

techniques and various seed mixes in this environment. The tested seed mixes will include the standard BLM seed mix as well as a mix of native forb and grass species, or equivalents which are commercially available. Caliche-paved roads and well pads which are no longer in use were identified for this study and divided into test plots so that experimental results can be statistically evaluated. The study is projected to continue for up to three years, and the effective reclamation method(s) will be utilized for future reclamation activities at the site. Final study results will be presented as a report to DOE; as results become available, they will be summarized in future Annual Site Environmental Reports.

5.0 ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

The following sections provide a description of the radiological monitoring program at the WIPP.

5.1 RADIOACTIVE EFFLUENT MONITORING

Draft DOE Order 5400.xy, "Requirements for Radiological Effluent Monitoring and Environmental Surveillance for U.S. DOE Operations" (DOE, 1988c), requires that monitoring of liquid waste effluent streams be adequate to demonstrate compliance with dose limits in draft DOE Order 5400.xx, "Radiation Protection of the Public and the Environment" (DOE, 1988b). This Order also requires the monitoring of potential sources of contaminated airborne emissions. There was no radioactive waste at the WIPP site in 1988. Radioactive Effluent Monitoring will commence when waste is received.

5.2 ENVIRONMENTAL RADIOACTIVITY MONITORING

The following subsections present the monitoring results of the various subprograms of the RBP for 1988. These include the atmospheric radiation, ambient radiation, terrestrial radiation, hydrologic radiation and biotic radiation baseline subprograms. Table 5-1 includes sample location codes for the WIPP and vicinity for the various subprograms.

5.2.1 The Atmospheric Radiation Baseline

Sampling airborne particulates is an important component of the RBP program. The draft Final Safety Analysis Report (DOE, 1988e) identifies the atmospheric pathway as essentially the only release pathway resulting in a potential dose to the public near the WIPP site. Continuous particulate samplers operate at eight locations, four within the Zone II boundary and at four local ranches and communities (Figure 5-1). The model CMP-14CV samplers (HiQ Environmental Products), presently in use, maintain a regulated flow rate of approximately 950 milliliters per second (two cubic feet per minute) of air through a 47-millimeter (1.9-inch) glass fiber filter for particulate collection. These air samplers are installed two meters (6.4 feet) above the ground surface. In Carlsbad and Eunice, however, air samplers are sited on top of the municipal buildings to provide a more secure location in a populated area.

TABLE 5-1

SAMPLE LOCATION CODES FOR WIPP AND VICINITY

The following eight locations are at or near the WIPP Secured Area Boundary (SAB) fence in the direction indicated:

WEE -- WIPP SAB East
WNE -- WIPP SAB Northeast
WNN -- WIPP SAB North
WNW -- WIPP SAB Northwest
WSE -- WIPP SAB Southeast
WSS -- WIPP SAB South
WSW -- WIPP SAB Southwest
WWW -- WIPP SAB West

The following 16 TLD locations are approximately 8 km from WIPP in the direction indicated:

R01 -- Outer TLD Ring N
R02 -- Outer TLD Ring NNE
R03 -- Outer TLD Ring NE
R04 -- Outer TLD Ring ENE
R05 -- Outer TLD Ring E
R06 -- Outer TLD Ring ESE
R07 -- Outer TLD Ring SE
R08 -- Outer TLD Ring SSE
R09 -- Outer TLD Ring S
R10 -- Outer TLD Ring SSW
R11 -- Outer TLD Ring SW
R12 -- Outer TLD Ring WSW
R13 -- Outer TLD Ring W
R14 -- Outer TLD Ring WNW
R15 -- Outer TLD Ring NW
R16 -- Outer TLD Ring NNW

Sandia National Laboratory (SNL) Correlation TLD Locations:

SL1 -- ERDA-9 Well (WIPP Site)
SL2 -- Sandia National Lab Met. Station (WIPP Site)
SL3 -- AEC-8 Well (6 km NE of WIPP)
SL4 -- ERDA-6 Well (8 km NE of WIPP)
SL5 -- Badger Well (3 km NE of WIPP)
SL6 -- WIPP-11 Well (4 km N of WIPP)
SL7 -- AEC-7 Well (10 km NE of WIPP)

TABLE 5-1

SAMPLE LOCATION CODES FOR WIPP AND VICINITY
(CONTINUED)

Surface Water Sampling Locations

HLT -- Hill Tank (4 km WNW of WIPP)
INT -- Indian Tank (13 km SW of WIPP)
LGS -- Laguna Grande de la Sol (19 km WSW of WIPP)
LMC -- Lake McMillan (58 km WNW of WIPP)
NOT -- Noya Tank (8 km NNW of WIPP)
PCN -- Pierce Canyon (26 km SSW of WIPP)
RDT -- Red Tank (6 km E of WIPP)
TUT -- Tut Tank (14 km NW of WIPP)
UPP -- Upriver Pecos (69 km NW of WIPP)

Groundwater Well Sampling Locations:

D01 -- DOE-1 Well
D02 -- DOE-2 Well
H01 -- H-01 Well
H02 -- H-02a Well
H03 -- H-03b1 and H-03b3 Wells
H04 -- H-04b and c Wells
H05 -- H-05b and c Wells
H06 -- H-06b and c Wells
H07 -- H-07b Well
H08 -- H-08b Well
H09 -- H-09b Well
H11 -- H-11b3 Well
H12 -- H-12 Well
H14 -- H-14 Well
H15 -- H-15 Well
H17 -- H-17 Well
H18 -- H-18 Well
P14 -- P-14 Well
P17 -- P-17 Well
W13 -- WIPP-13 Well
W19 -- WIPP-19 Well
W25 -- WIPP-25 Well
W26 -- WIPP-26 Well
W29 -- WIPP-29 Well
W30 -- WIPP-30 Well

Private Well Sampling Locations:

CL8 -- Clifton Well
CW8 -- Comanche Wells
B8 -- Barn Well
E8 -- Engle Windmill
F8 -- Fairview Windmill

TABLE 5-1

SAMPLE LOCATION CODES FOR WIPP AND VICINITY
(CONTINUED)

Private Well Sampling Locations (Continued):

MOB -- Mobley Well
P8 -- Poker Trap Windmill
R8 -- Ranch Well
TNW -- Twin Wells
U8 -- Unger Windmill

Other WIPP Area Sampling Locations:

AMS -- Atmospheric Monitoring Station (NW Corner of WIPP Zone I)
ANR -- Angel Ranch (53 km NW of WIPP)
ART -- Artesia (68 km NW of WIPP)
CBD -- Carlsbad (42 km W of WIPP)
DRR -- Railroad Spur (10 km WSW of WIPP)
EUN -- Eunice (60 km E of WIPP)
GNO -- Gnome Site (14 km SSW of WIPP)
HBS -- Hobbs (72 km ENE of WIPP)
HHW -- Hobbs Hwy. (US 62/180) at the North Access Road (18 km N of WIPP)
JAL -- Jal (64 km ESE of WIPP)
LVG -- Loving (29 km WSW of WIPP)
MLR -- Mills Ranch (5 km SSW of WIPP)
MNT -- Monument (56 km ENE of WIPP)
NMP -- New Mexico Potash Co. (14 km N of WIPP)
PCA -- PCA Cutoff: SR 31 at US 62/180 (26 km NW of WIPP)
SMR -- Smith Ranch (9 km WNW of WIPP)
STR -- Stell Ranch (60 km SW of WIPP, used for control purposes)
WFF -- WIPP Far Field (1 km NW of WIPP)

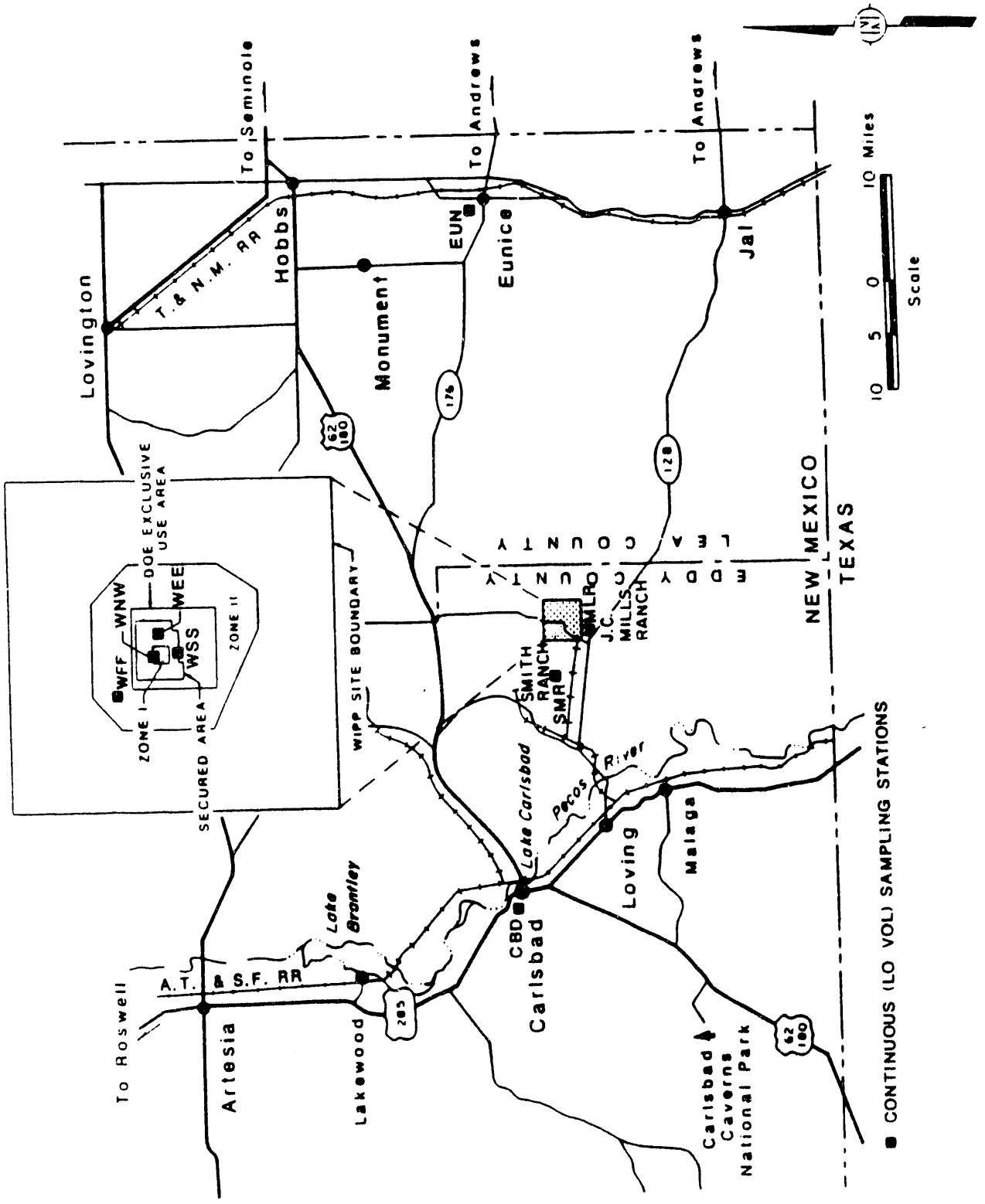


FIGURE 5-1 RBP AIRBORNE PARTICULATE SAMPLING STATIONS

Airborne particulate sampling was initiated in July 1985 at a few locations. Routine weekly filter collections and subsequent radiochemical analysis began in early 1986 for all locations except Far Field, where data collection began in October 1986. Particulate filters were collected weekly at all locations in 1988. These filters are shipped to the analytical laboratory where a gross alpha and gross beta count of each weekly filter is completed prior to compositing filters from each location for each sampling quarter. This quarterly composite is analyzed, using gamma spectroscopy, for representative gamma-emitting radionuclides typically present in the environment or expected to occur in the waste to be emplaced. Finally, the composite sample undergoes destructive chemical analysis for the specific alpha and beta emitters of concern at the site.

Figure 5-2 represents the mean gross alpha concentrations for all eight sampling locations and Figures 5-3 and 5-4 depict the gross alpha concentrations reported for each location. Mean gross alpha concentrations in Figure 5-2 shows limited fluctuation throughout the year and are consistently less than 4 E-15 microcuries per milliliter. This fluctuation appeared to be consistent among all sampling locations.

Mean gross beta concentrations, (Figure 5-5), fluctuate throughout the year, typically within the range of 1 to 4 E-14 microcuries per milliliter. Figures 5-6 and 5-7 show the 1988 gross beta concentrations for each individual sampling location. During the fourth quarter of 1988, all eight sampling locations show an increased variation in gross beta concentrations and exhibit several elevated values. The Eunice, Carlsbad, and Smith Ranch samplers had the highest reported gross beta concentration, 5.5 E-14 microcuries per milliliter. Review of preliminary isotopic data appears to indicate that Pb-210 (a Radon-222 decay progeny) concentrations increased for that time period. The thermoluminescent dosimeters and the Reuter-Stokes used for ambient radiation monitoring also show a rise in mean gamma radiation for the fourth quarter. (A seasonal rise in ambient radiation has been observed in the fourth through the first quarter in previous years.) As stated in previous reports, it is speculated that this fluctuation may be due to variations in the emission and dispersion of Radon-222 from the soil around

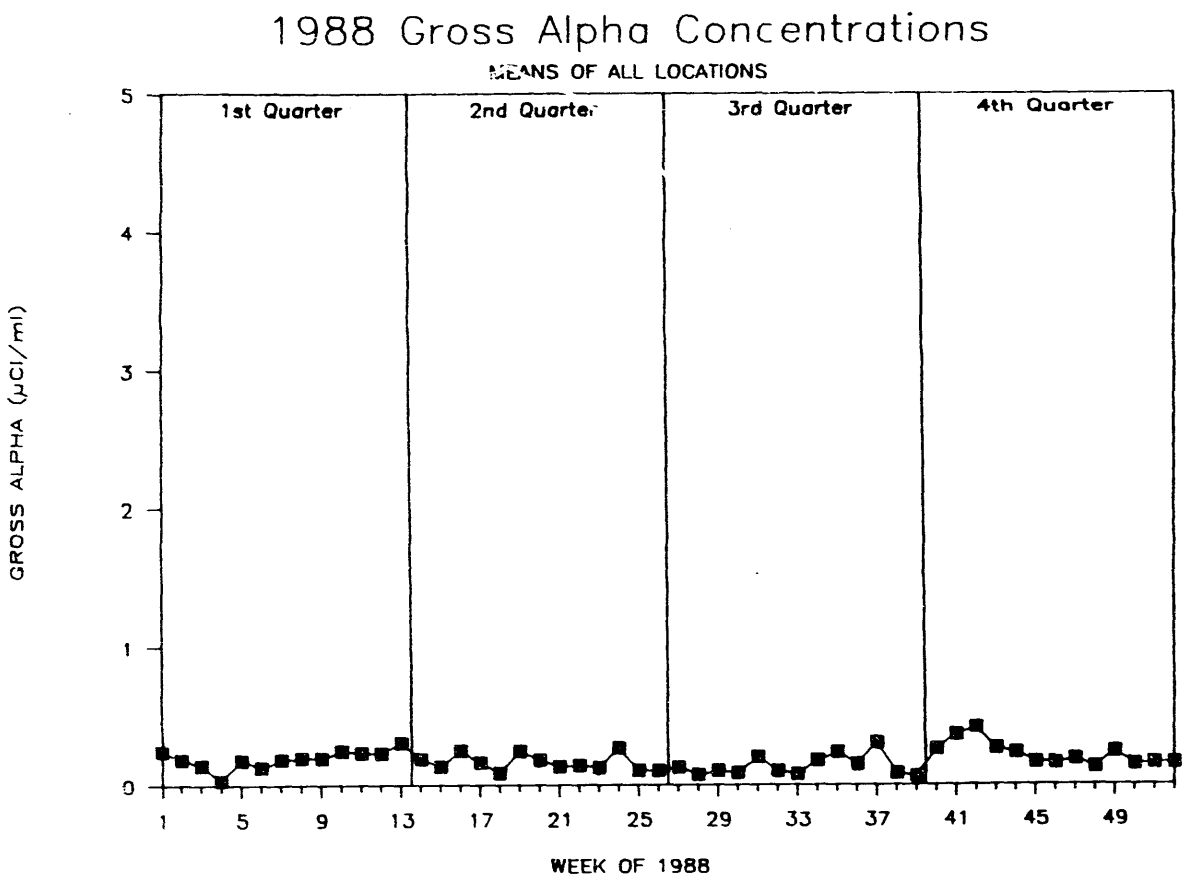


FIGURE 5-2 MEAN GROSS ALPHA CONCENTRATIONS - WEEKLY SUMMARIES - CY 1988

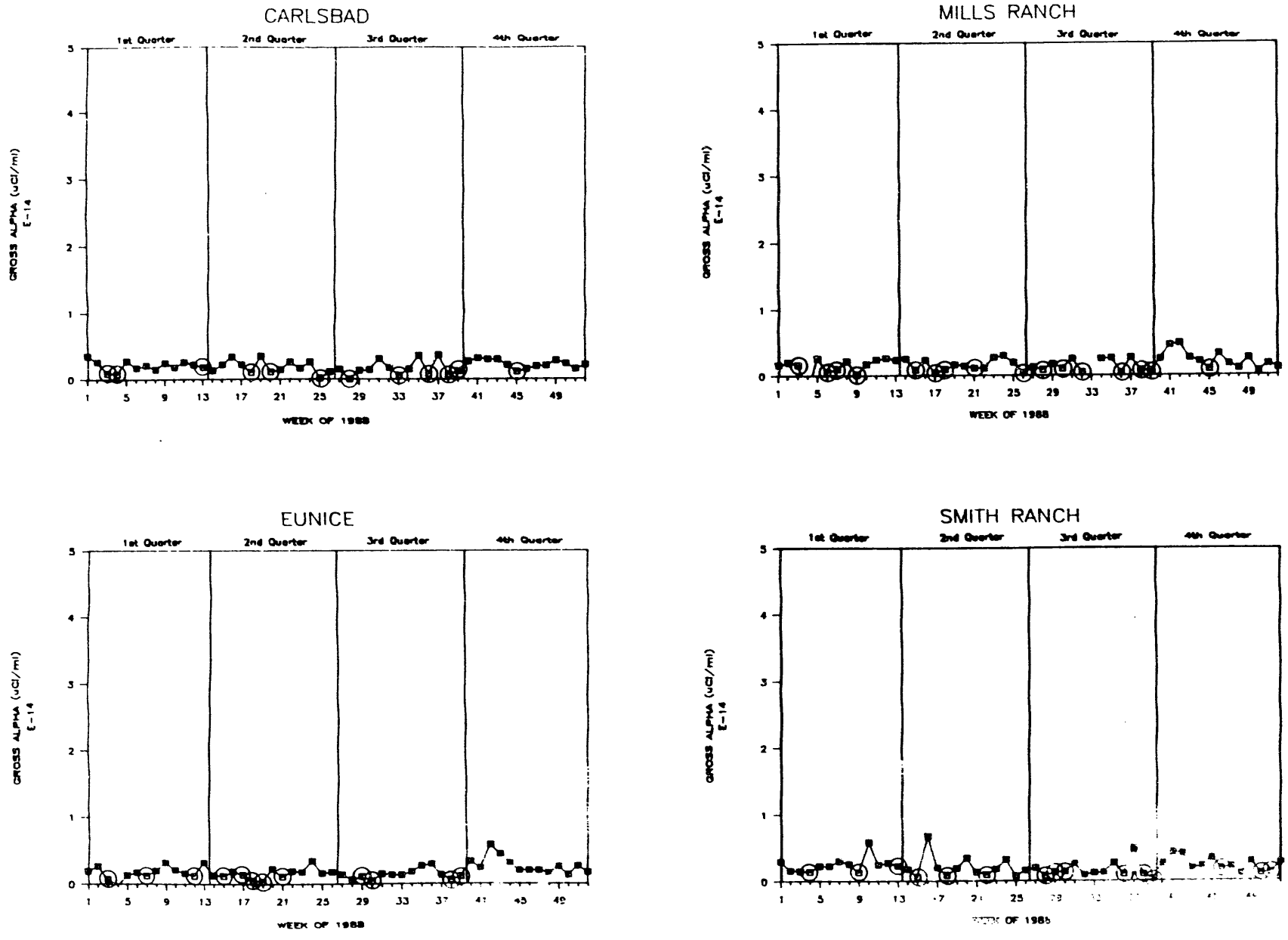


FIGURE 5-3 GROSS ALPHA CONCENTRATIONS FOR RANCH AND CITY SAMPLE LOCATIONS

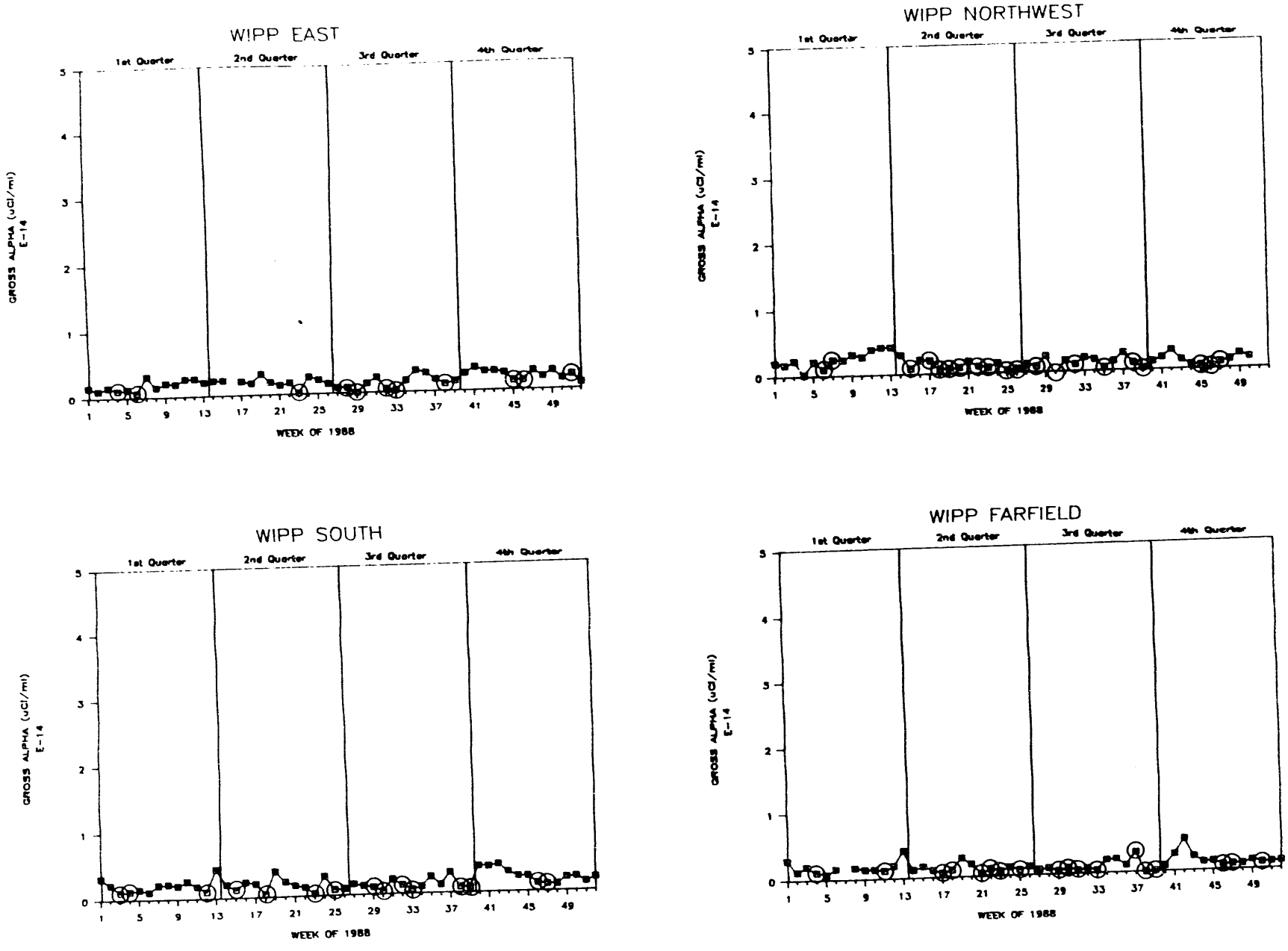


FIGURE 5-4 GROSS ALPHA CONCENTRATIONS FOR SAMPLE LOCATIONS AT THE WIPP SITE

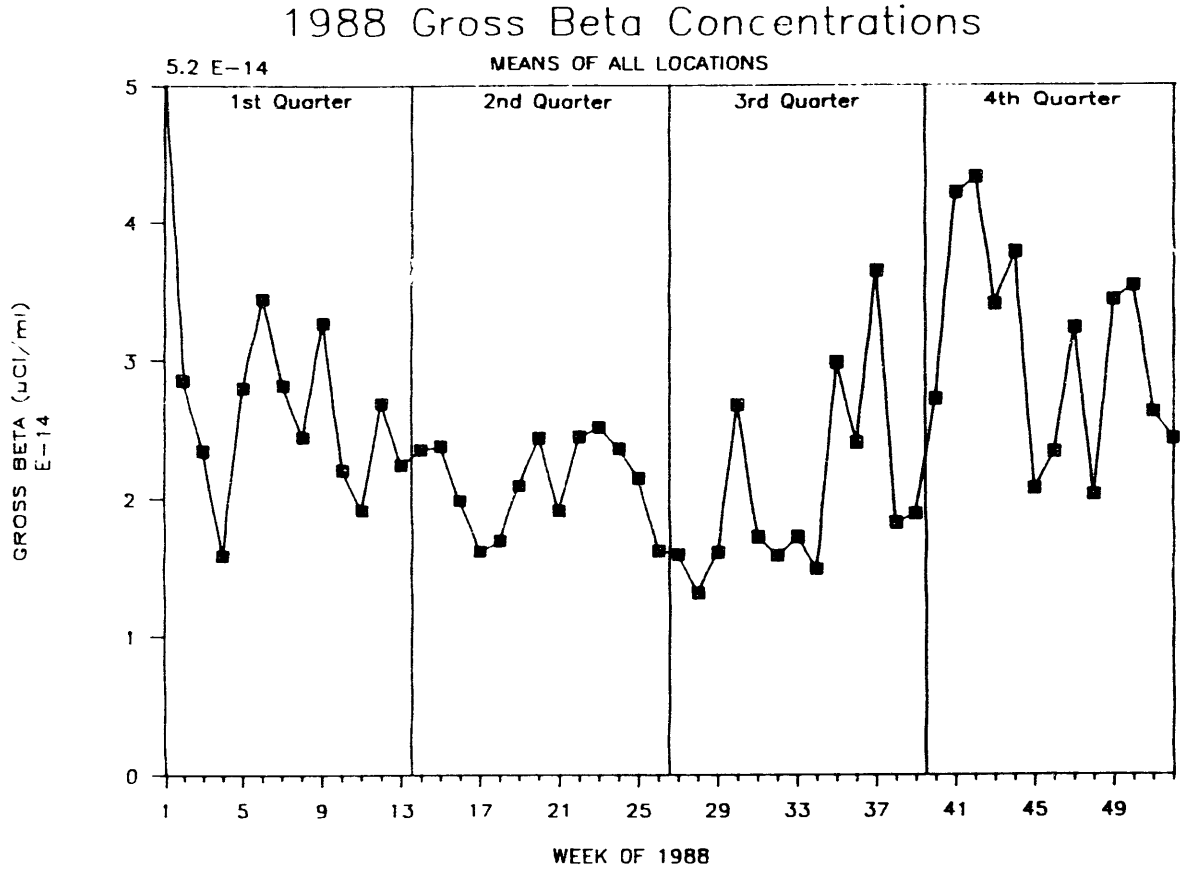
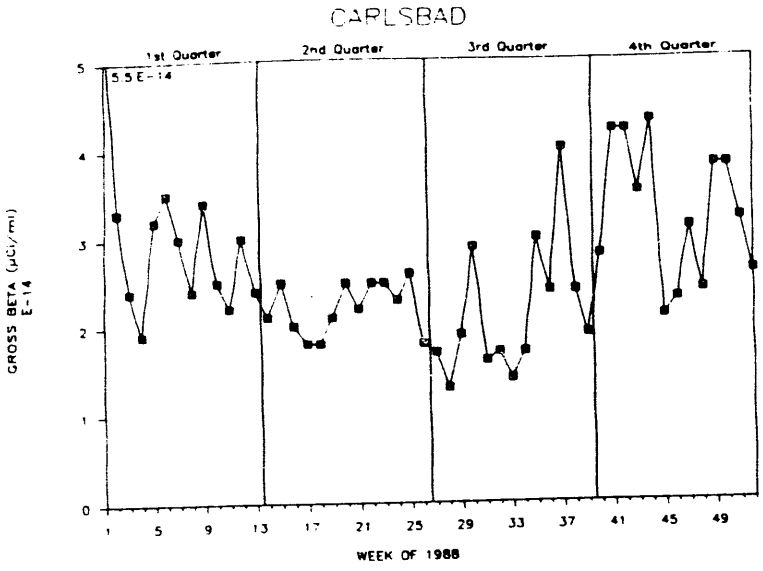
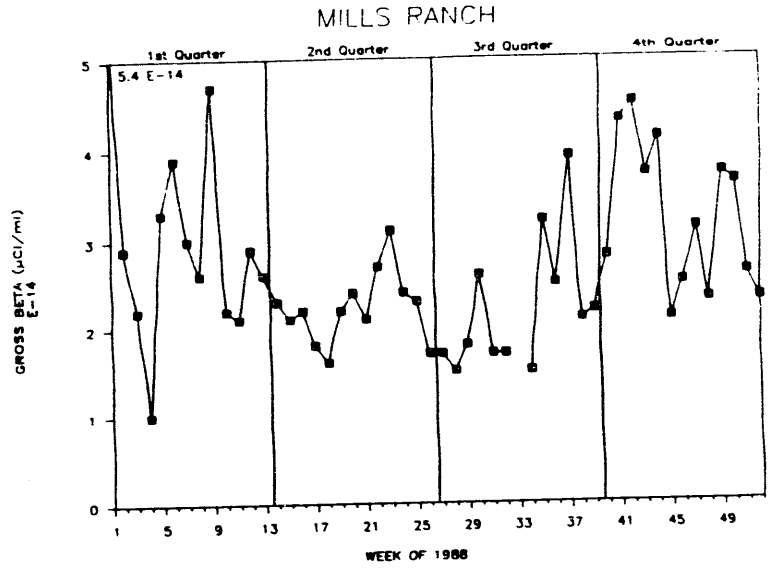
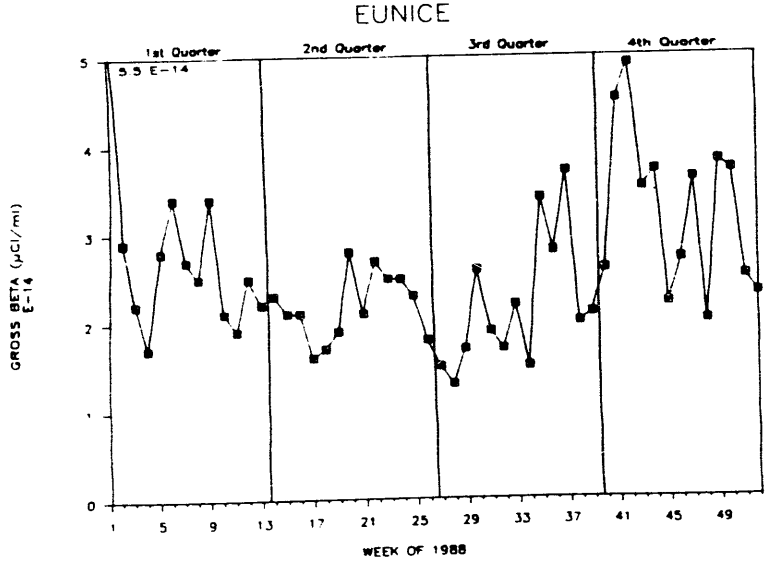
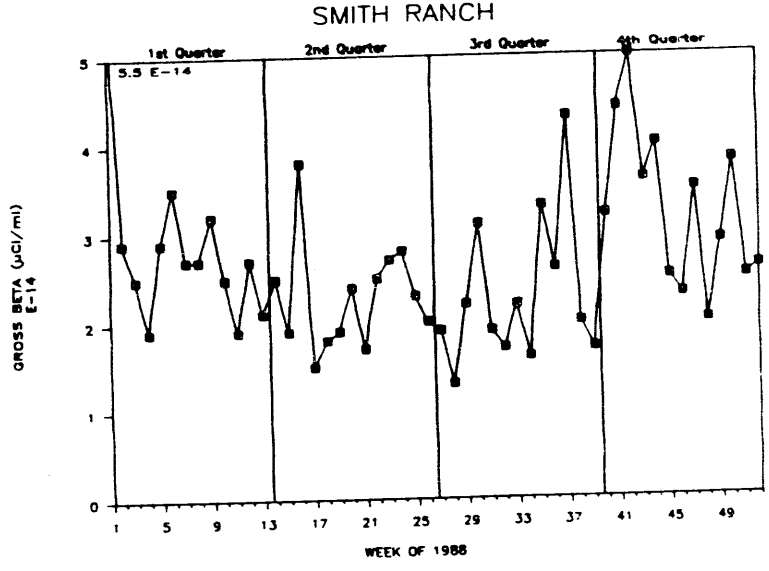


FIGURE 5-5 MEAN GROSS BETA CONCENTRATIONS - WEEKLY SUMMARIES - CY 1988



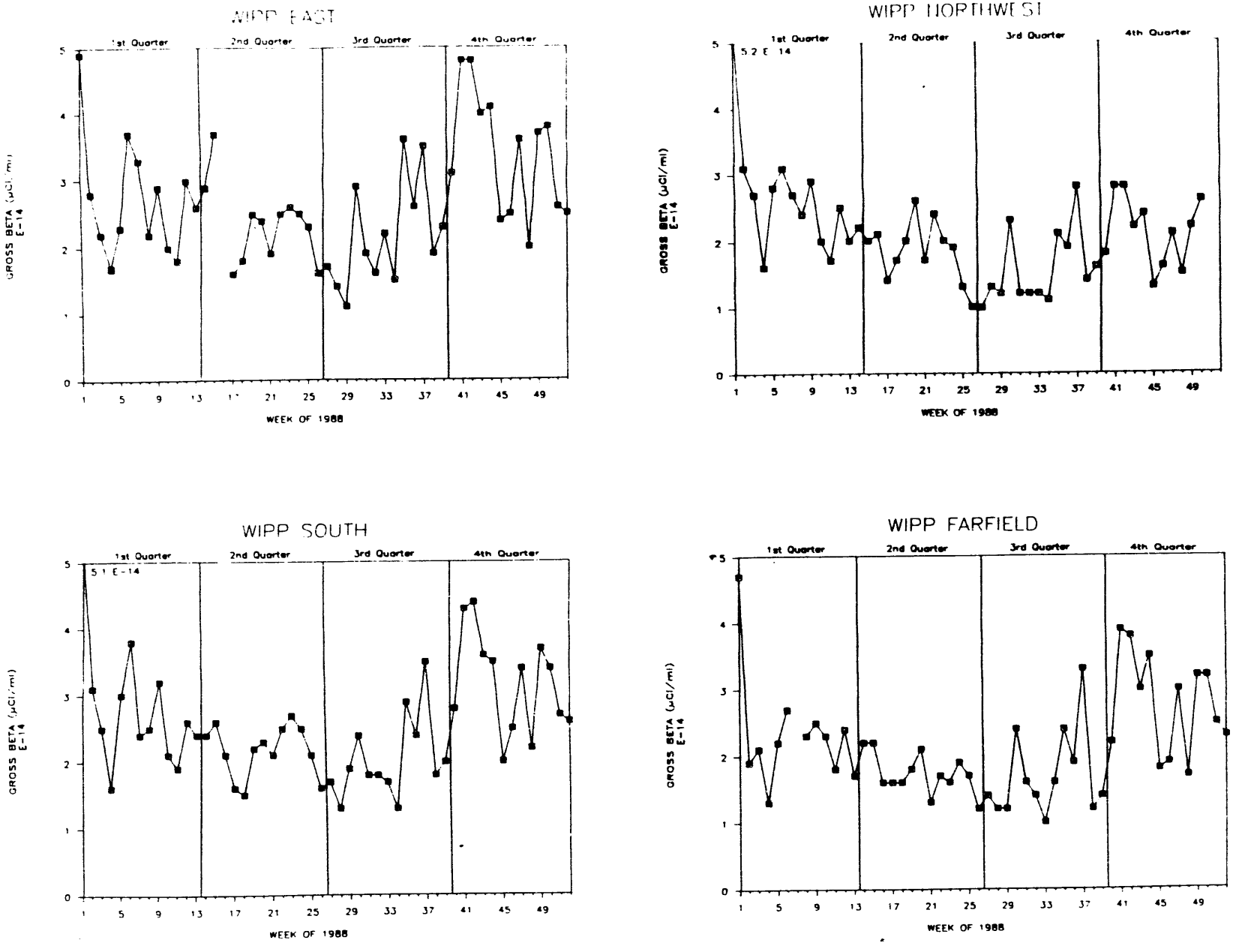






■ DATA POINT

[illegible] LOCATIONS



■ DATA POINT

FIGURE 5-7 GROSS BETA CONCENTRATIONS FOR SAMPLE LOCATIONS AT THE WIPP SITE

the WIPP site. These variations can be caused by unusual rainfall events which would drive more radon from the soil or by unusually stable meteorological conditions such as inversions which would prevent the radon from dispersing.

Gross beta and gross alpha measurements may indicate total radionuclide concentration or may indicate changes in a specific radionuclide concentration. These measurements are also used for screening to assure that important radionuclides are not overlooked when performing a specific measurement. However, gamma spectroscopy and specific radiochemical analysis are required to identify contributions from individual radionuclides and define specific baseline environmental parameters.

Concentrations of specific radionuclides in quarterly composites of low volume air filters for all locations are summarized in Tables 5-2 through 5-5. Levels of all transuranic radionuclides are not significantly different from analytical sensitivity. Levels of other radionuclides are within the expected environmental range.

5.2.2 Ambient Radiation Baseline

Thermoluminescent dosimeters (TLDs) are used to measure penetrating (gamma) radiation levels at numerous locations in and around the WIPP site (Figure 5-8). TLD packages containing five lithium fluoride (LiF) chips are installed from one meter (3.28 feet) to 1.5 meters (4.92 feet) above ground level, and are collected and evaluated quarterly. Dosimeters are provided, read, and annealed by Eberline Corporation in Albuquerque, New Mexico. Field dosimeters are accompanied during shipment and installation by control dosimeters, which are kept in a copper-lined lead cave during the field cycle (quarterly) exposure period. These control dosimeters enable data to be corrected for transient exposure during shipment and distribution.

RBP dosimeters were initially placed around the WIPP site in July 1984 for quarterly exchange and processing. Table 5-6 includes the reported quarterly averages in millirem per week and an estimated annual exposure due to background radiation.

TABLE 5-2

RADIONUCLIDE CONCENTRATIONS IN QUARTERLY COMPOSITES
FIRST QUARTER 1988[1]
(μCi/ml)

LOCATION CODE	Be-7 (E-14)	K-40 (E-15)	Co-60	Sr-90	Cs-137	Pb-210 (E-15)
EUN	15 (.65)	5.7 (3.6)	LD[2]	LD	LD	33 (8.5)
CBD	16 (.70)	4.9 (3.6)	LD	LD	LD	36 (7.8)
WEE	15 (.70)	6.6 (4.1)	LD	LD	LD	23 (8.0)
WNW	15 (.69)	6.2 (3.7)	LD	LD	LD	25 (8.4)
WSS	15 (.70)	LD	LD	LD	LD	29 (9.7)
WFF	14 (.78)	4.5 (3.9)	LD	LD	LD	33 (10)
MLR	16 (.77)	6.2 (3.7)	LD	LD	LD	27 (8.1)
SMR	16 (.73)	3.9 (3.4)	LD	LD	LD	24 (7.8)

LOCATION CODE	Ra-226	Ra-228	Th-228	U-233	U-234 (E-18)	U-235
EUN	LD	LD	LD	LD	LD	LD
CBD	LD	LD	LD	LD	110 (80)	LD
WEE	LD	LD	LD	LD	LD	LD
WNW	LD	LD	LD	LD	LD	LD
WSS	LD	LD	LD	LD	LD	LD
WFF	LD	LD	LD	LD	LD	LD
MLR	LD	LD	LD	LD	90 (57)	LD
SMR	LD	LD	LD	LD	LD	LD

LOCATION CODE	U-238 (E-17)	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-244
EUN	5.7 (5.1)	LD	LD	LD	---[3]	---
CBD	12 (7.8)	LD	LD	LD	---	---
WEE	6.4 (5.7)	LD	LD	LD	---	---
WNW	LD	LD	LD	LD	---	---
WSS	LD	LD	LD	LD	---	---
WFF	LD	LD	LD	LD	---	---
MLR	11 (5.7)	LD	LD	LD	---	---
SMR	LD	LD	LD	LD	---	---

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

TABLE 5-3

RADIONUCLIDE CONCENTRATIONS IN QUARTERLY COMPOSITES
SECOND QUARTER 1988(1)
(μCi/ml)

LOCATION CODE	Be-7 (E-14)	K-40 (E-15)	Co-60	Sr-90	Cs-137	Pb-210 (E-15)
EUN	20 (.95)	5.1 (3.9)	LD(2)	LD	LD	15 (7.7)
CBD	19 (.93)	4.3 (3.8)	LD	LD	LD	21 (8.4)
WEE	22 (1.1)	5.3 (4.1)	LD	LD	LD	22 (8.9)
WNW	16 (.91)	4.8 (4.0)	LD	LD	LD	23 (9.3)
WSS	20 (.98)	6.0 (3.7)	LD	LD	LD	22 (7.6)
WFF	15 (.92)	4.9 (3.6)	LD	LD	LD	16 (7.4)
MLR	21 (.99)	LD	LD	LD	LD	18 (8.0)
SMR	20 (1.0)	LD	LD	LD	LD	16 (7.2)

LOCATION CODE	Ra-226	Ra-228	Th-228	U-233	U-234 (E-18)	U-235
EUN	LD	LD	LD	LD	120 (75)	LD
CBD	LD	LD	LD	LD	160 (95)	LD
WEE	LD	LD	LD	LD	LD	LD
WNW	LD	LD	LD	LD	120 (52)	LD
WSS	LD	LD	LD	LD	LD	LD
WFF	LD	LD	LD	LD	620 (59)	LD
MLR	LD	LD	LD	LD	180 (160)	LD
SMR	LD	LD	LD	LD	99 (58)	LD

LOCATION CODE	U-238 (E-17)	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-244
EUN	11 (7.2)	LD	LD	LD	---(3)	---
CBD	19 (10)	LD	LD	LD	---	---
WEE	10 (7.6)	LD	LD	LD	---	---
WNW	9.7 (4.7)	LD	LD	LD	---	---
WSS	LD	LD	LD	LD	---	---
WFF	1.9 (2.7)	LD	LD	LD	---	---
MLR	3.6 (7.2)	LD	LD	LD	---	---
SMR	LD	LD	LD	LD	---	---

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

TABLE 5-4

RADIONUCLIDE CONCENTRATIONS IN QUARTERLY COMPOSITES THIRD QUARTER 1988[1]

(μCi/ml)

LOCATION CODE	Be-7 (E-14)	K-40 (E-15)	Co-60	Sr-90	Cs-137	Pb-210 (E-15)
EUN	13 (.62)	6.2 (3.5)	LD[2]	LD	LD	19 (7.5)
CBD	12 (.75)	4.6 (3.8)	LD	LD	LD	14 (6.7)
WEE	12 (.65)	4.3 (3.9)	LD	LD	LD	14 (7.1)
WNW	9.1 (.59)	6.3 (4.2)	LD	LD	LD	13 (6.8)
WSS	12 (.63)	5.7 (3.8)	LD	LD	LD	15 (7.8)
WFF	9.2 (.76)	5.3 (3.6)	LD	LD	LD	13 (7.4)
MLR	14 (.88)	LD	LD	LD	LD	22 (8.7)
SMR	14 (.87)	3.4 (3.2)	LD	LD	LD	17 (7.6)

LOCATION CODE	Ra-226	Ra-228 (E-16)	Th-228 (E-16)	U-233	U-234 (E-18)	U-235
EUN	LD	LD	2.1 (1.9)	LD	LD	LD
CBD	LD	LD	LD	LD	91 (85)	LD
WEE	LD	9.2 (8.9)	LD	LD	70 (66)	LD
WNW	LD	LD	LD	LD	190 (100)	LD
WSS	LD	LD	LD	LD	LD	LD
WFF	LD	LD	LD	LD	110 (87)	LD
MLR	LD	LD	LD	LD	70 (68)	LD
SMR	LD	LD	LD	LD	LD	LD

LOCATION CODE	U-238 (E-17)	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-244
EUN	7.5 (5.9)	---[3]	---	---	---	---
CBD	9.0 (6.8)	---	---	---	---	---
WEE	LD	LD	LD	LD	---	---
WNW	9.5 (6.7)	LD	LD	LD	---	---
WSS	8.7 (5.8)	LD	LD	LD	---	---
WFF	11 (7.3)	LD	LD	LD	---	---
MLR	LD	---	---	---	---	---
SMR	10 (7.3)	LD	LD	LD	---	---

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

TABLE 5-5

RADIONUCLIDE CONCENTRATIONS IN QUARTERLY COMPOSITES
FOURTH QUARTER 1988[1]
(μCi/ml)

LOCATION CODE	Be-7 (E-14)	K-40 (E-15)	Co-60	Sr-90	Cs-137	Pb-210 (E-15)
EUN	16 (.73)	4.5 (3.7)	LD[2]	LD	LD	28 (8.1)
CBD	16 (.75)	LD	LD	LD	LD	28 (9.0)
WEE	16 (.67)	LD	LD	LD	LD	20 (9.8)
WSS	16 (.75)	7.1 (3.8)	LD	LD	LD	20 (7.9)
WFF	14 (.68)	5.9 (3.4)	LD	LD	LD	25 (8.6)
MLR	16 (.77)	5.6 (3.7)	LD	LD	LD	34 (8.9)
SMR	16 (.78)	7.0 (3.6)	LD	LD	LD	27 (7.8)

LOCATION CODE	Ra-226	Ra-228 (E-16)	Th-228	U-233	U-234 (E-18)	U-235
EUN	LD	LD	LD	LD	48 (45)	LD
CBD	LD	LD	LD	LD	68 (56)	LD
WEE	LD	LD	LD	LD	100 (59)	LD
WSS	LD	8.8 (8.7)	LD	LD	LD	LD
WFF	LD	LD	LD	LD	77 (72)	LD
MLR	LD	LD	LD	LD	69 (56)	LD
SMR	LD	LD	LD	LD	59 (46)	LD

LOCATION CODE	U-238 (E-17)	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-244
EUN	8.5 (6.2)	---[3]	---	---	---	---
CBD	LD	LD	LD	LD	---	---
WEE	6.0 (5.6)	LD	LD	LD	---	---
WSS	LD	LD	LD	LD	---	---
WFF	LD	LD	LD	LD	---	---
MLR	LD	LD	LD	LD	---	---
SMR	LD	LD	LD	LD	---	---

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

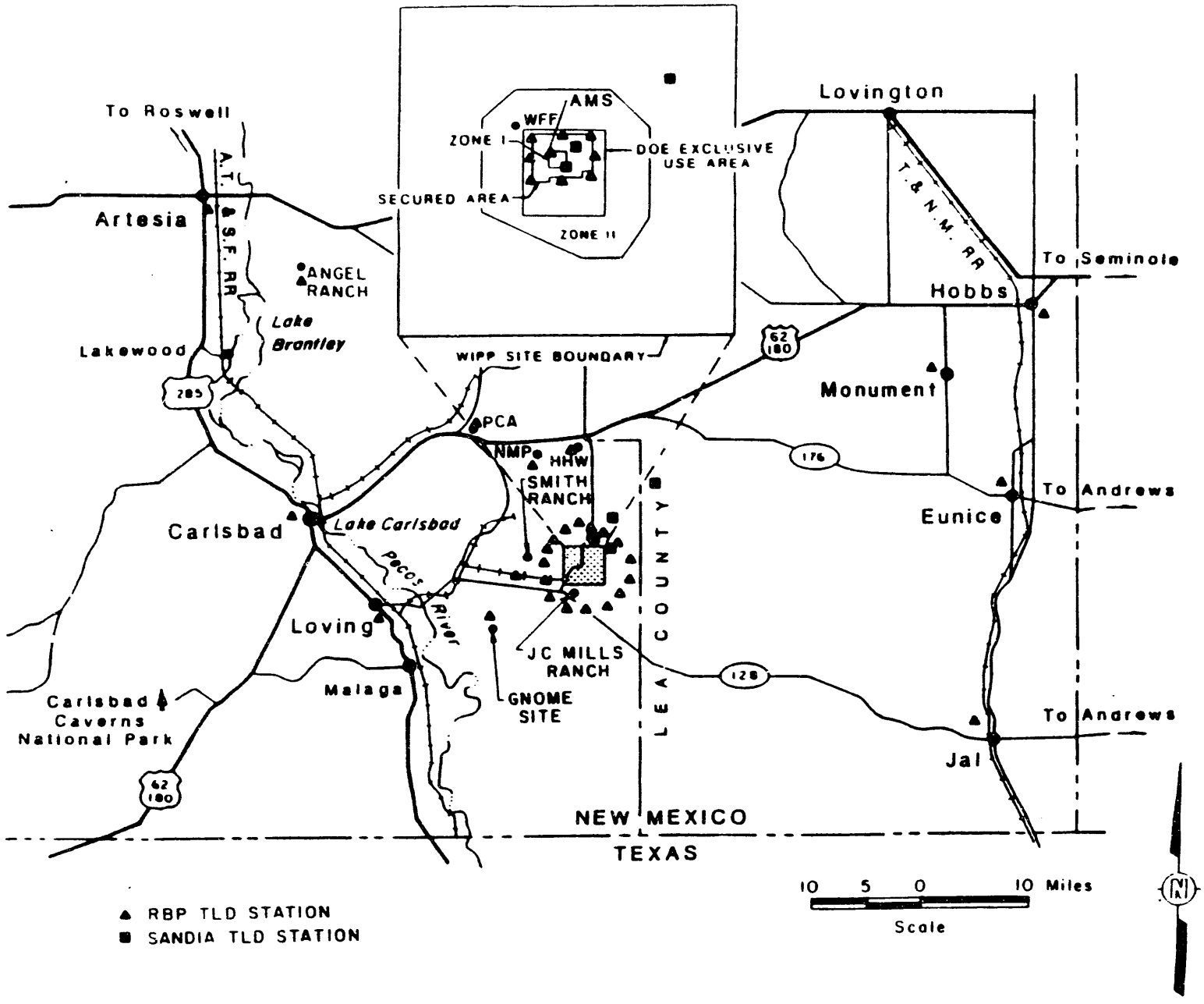


FIGURE 5-8 RBP THERMOLUMINESCENT DOSIMETER (TLD) LOCATIONS

TABLE 5-6

1988 THERMOLUMINESCENT DOSIMETRY RESULTS

WIPP VICINITY

LOCATION CODE	ESTIMATED DOSE RATES (mrem/week) FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	ESTIMATED ANNUAL DOSE (mrem)
WIPP Secured Area Boundary					
WNN	0.67		0.51	0.74	25*
WNE	0.78	0.45	0.46	0.70	31
WEE	0.55	0.43	0.56	0.73	30
WSE	0.71	0.45	0.52	0.82	32
WSS	0.59	0.50	0.51	0.73	30
WSW	0.74	0.45	0.51	0.68	31
WWW	0.64	0.47	0.49	0.65	29
WNW	0.74	0.39	0.67	0.70	32
WIPP Outer Dosimeter Ring					
R01	0.93	0.63	0.53	1.01	40
R02	0.54	0.45	0.39	0.72	27
R03	0.68	0.50	0.49	0.81	32
R04	0.76	0.45	0.49	0.75	32
R05	0.6[illegible]	0.37	0.45	0.77	29
R06	0.63	0.40	0.36	0.66	27
R07	0.57	0.45	0.36	0.74	28
R08	0.69	0.42	0.43	0.69	29
R09	0.57	0.47	0.48	0.74	29
R10	0.73	0.48	0.51	0.77	32
R11	0.77	0.55	0.56	0.87	36
R12	1.11	0.81	0.84	1.29	53
R13	0.63	0.43	0.49	0.77	30
R14	0.71	0.52	0.53	0.78	33
R15	0.73	0.48	0.51	0.78	32
R16	0.54	0.47	0.39	0.77	28

* - Only three quarters of data.

TABLE 5-6
1988 THERMOLUMINESCENT DOSIMETRY RESULTS
(CONTINUED)

LOCATION CODE	ESTIMATED DOSE RATES (mrem/week) FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	ESTIMATED ANNUAL DOSE (mrem)
Points of Interest					
AMS	0.67	0.37	0.45	0.70	28
ANR	1.03	0.40	0.43	0.74	34
ART	1.11	0.75	0.92	1.24	52
CBD	0.70	0.82	0.92	1.21	48
DRR	0.81	0.44	0.37	0.72	30
EUN	0.77	0.56	0.71	0.95	39
GNO	0.72	0.56	0.54	0.83	34
HBS	0.78	0.56	0.63	0.78	36
HHW	0.80	0.64	0.78	0.89	41
JAL	0.73	0.39	0.52	0.74	31*
LVG	0.70	0.47	0.51		22*
MNT	1.22	0.89	0.94	1.31	57
NMP	0.92	0.63	0.65	0.98	41
PCA	0.67	0.61	0.67	0.87	37
Sandia comparisons					
SNL-1	0.57		0.43	0.97	26*
SNL-2	0.77	0.40	0.51	0.82	32**
SNL-3	0.62	0.44			14**
SNL-4	0.58	0.49	0.46	0.71	29
SNL-5	0.60	0.53	0.53	0.85	33
SNL-6	0.69	0.44	0.48	0.83	32
SNL-7	0.69	0.41	0.61	0.97	35

* - Only three quarters of data
** - Only two quarters of data

Sandia National Laboratories (SNL) maintains a small number of TLD stations around the WIPP site. This SNL program was initiated in 1976 during the early site characterization at the WIPP. The RBP has seven TLD stations in parallel with the SNL stations with the intent of providing a correlation between these two programs (Table 5-6).

A Reuter-Stokes, RSS-1012, Environmental Monitoring System, designed to monitor low levels of gamma radiation in the environment, was put into operation in May 1986. This unit was located at the atmospheric monitoring station in the northwest corner of Zone I until November, when it was relocated to the WIPP Far Field Site (Figure 4-2). The detector used with the RSS-1012 unit at the site is a pressurized ion chamber and measures levels of radiation from 1 microRoentgen per hour to 100 microRoentgen per hour. Figures 5-9 and 5-10 depict the results of the RSS-1012 monitoring for 1988. Assuming an average rate of 7.4 microRoentgen per hour, the estimated annual gamma exposure is approximately 65 millirem. Most of the spike values noted in Figures 5-9 and 5-10 are due to calibration of the system. Due to relocation of the Reuter-Stokes unit, data is not available for part of November. December also has partial data due to Reuter-Stokes preventive maintenance.

An aerial radiological survey was conducted during the period April 8 to 19 over a 399-square-kilometer (156-square-mile) area covering the WIPP and the surrounding area (EG&G, 1988). The survey was conducted at a nominal altitude of 91 meters (300 feet) with a line spacing of 152 meters (500 feet). The average terrestrial exposure rates ranged from approximately 6.0 to 9.0 micro-Roentgen per hour. Two areas of increased exposure rate were evident. Both areas indicated higher than normal concentrations of naturally occurring radionuclides. A machine-aided search of the data for man-made sources of radiation indicated the presence of Cs-137 at the Gnome Site, which was expected from previous survey work done in the area. No other sources of man-made radiation were found.

5.2.3 Terrestrial Radiation Baseline

Soil samples were collected in August 1988 at 37 dosimeter stations (Figure 5-11). A template insert allows the collection of samples at three depths at each location: 1) a surface sample, 0 - 2 centimeters (0.8 inch); 2) an

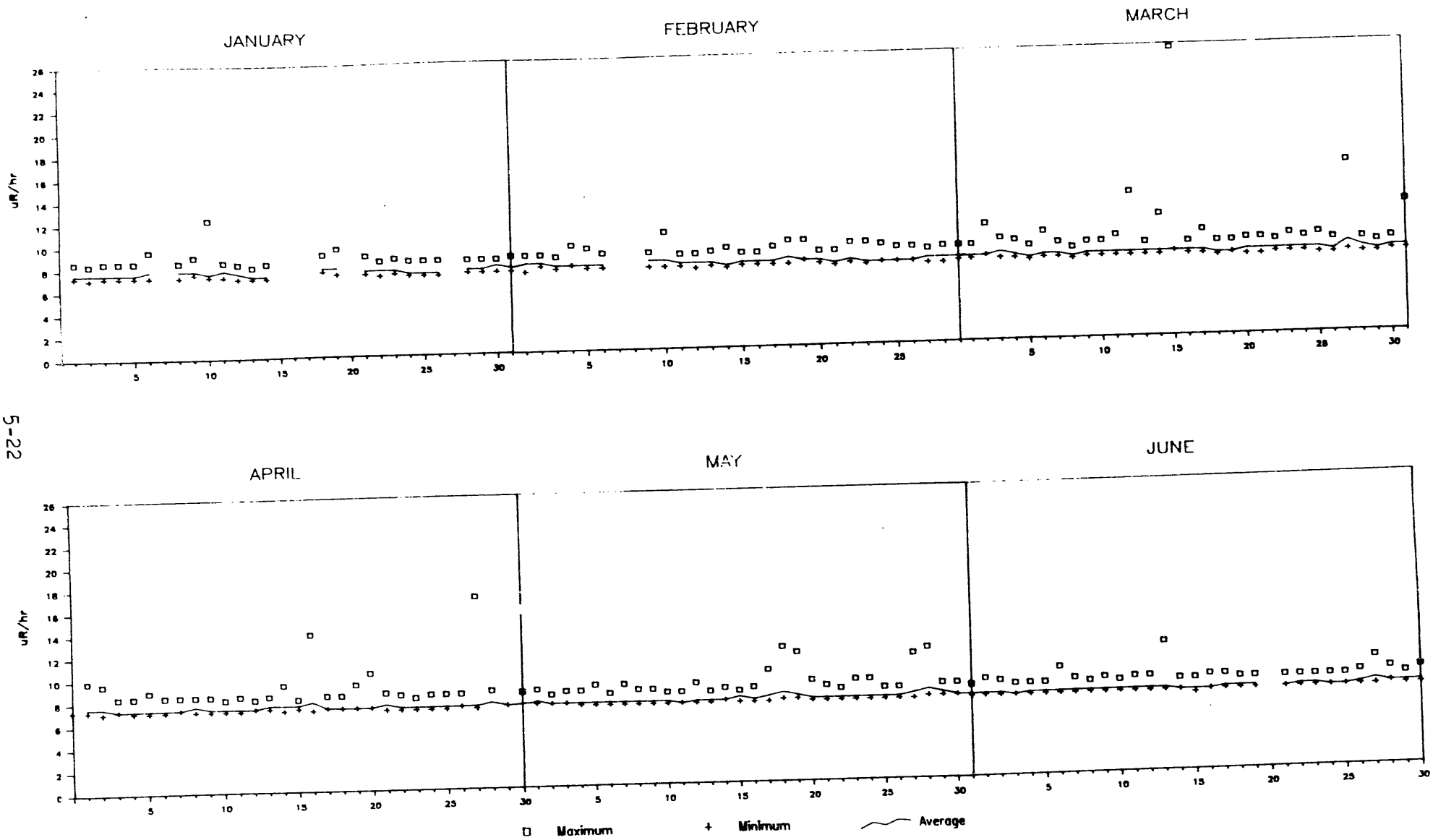


FIGURE 5-9 BACKGROUND GAMMA RADIATION, JANUARY THROUGH JUNE, 1988

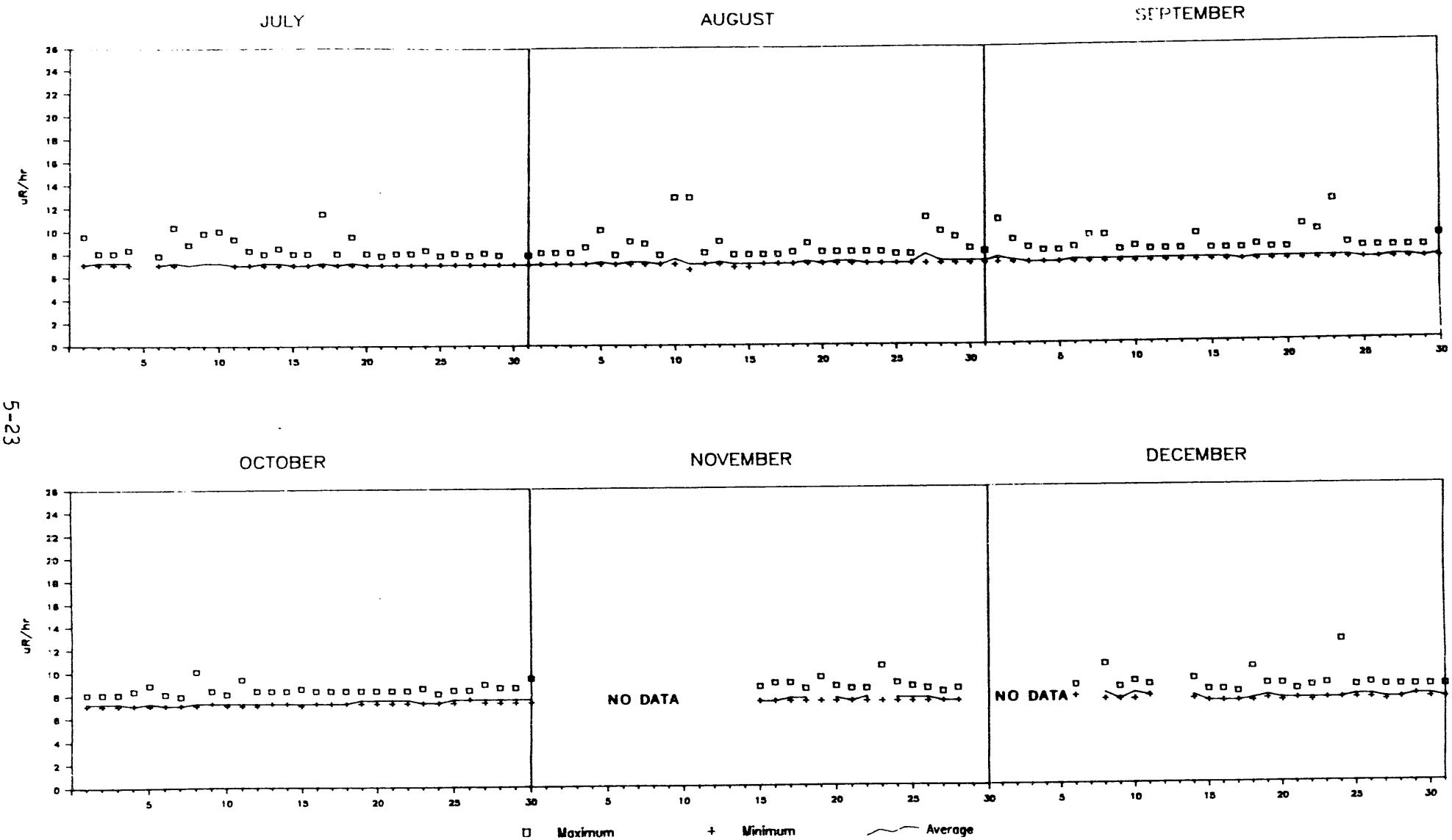


FIGURE 5-10 BACKGROUND GAMMA RADIATION, JULY THROUGH DECEMBER, 1988

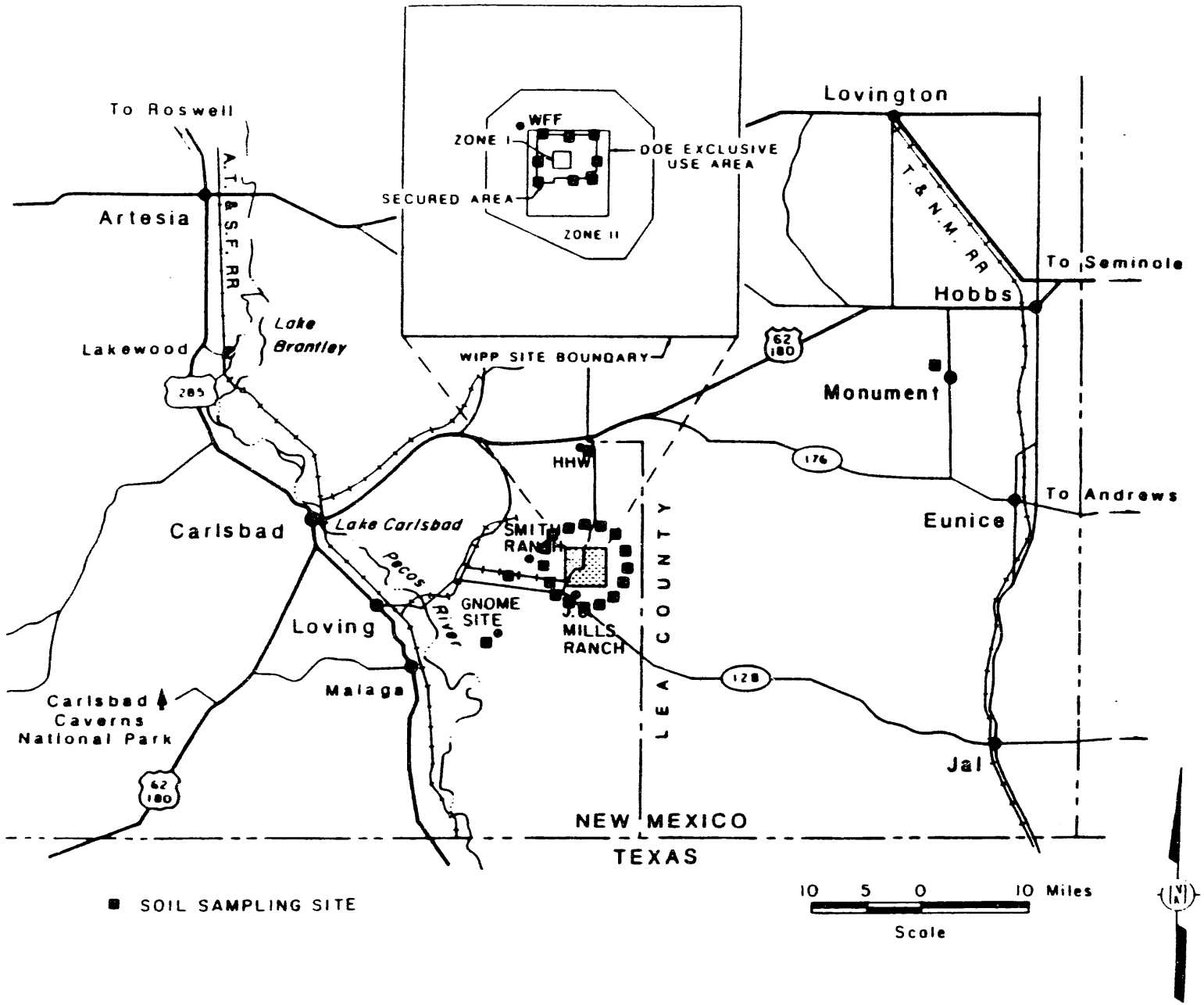


FIGURE 5-11 RBP SOIL SAMPLING LOCATIONS

intermediate (middle) sample, 2 - 5 centimeters (0.8 - 2.0 inches); and 3) a deep sample, 5 - 10 centimeters (2.0 - 3.9 inches). Every sample was a composite of 10 randomly located subsamples, each delineated by a 10 by 10 centimeters (3.9 by 3.9 inches) stainless steel template. Soil samples collected during 1988 were archived since the required number of baseline soil samples have already been collected and analyzed to comply with the RBP.

5.2.4 Hydrologic Radiation Baseline

This subprogram is designed to establish baseline radiation levels in surface water bodies, bottom sediments, and groundwater. The following discussion of the hydrologic program includes sampling locations, times and data collected during 1988, and refinements made to the program since the publication of the RBP Sampling Plan (Reith and Daer, 1985). Since data analysis lags sample collection, some samples have not yet been analyzed.

5.2.4.1 Surface Water

Surface water sampling commenced with the sampling of eight locations in December 1985. Of these eight locations, four were used for sediment sample collection (Figure 5-12). The same eight locations were resampled in April and October of 1986. Twelve locations were sampled in 1988 and five sediment samples were taken. Detailed information regarding sampling methods, locations and types of samples to be collected appear in a report on surface water and sediment sampling for the RBP (Prill and Buckle, 1987).

Data from surface water sampling are shown in Table 5-7, and sediment sampling results are shown in Table 5-8. These do not show unusual levels of environmental radioactivity. Sediment sample results from previous years have indicated that the concentrations of radionuclides cesium, radium and uranium are above that of the surface water's. These levels are within expected environmental radioactivity ranges (NCRP, 1976).

5.2.4.2 Groundwater

The Water Quality Sampling Program was initiated in 1985 and supports the RBP. The primary objective of the WQSP is to obtain representative and repeatable groundwater quality data from selected wells under rigorous field and laboratory procedures and protocols. At each well site, the well is pumped and the

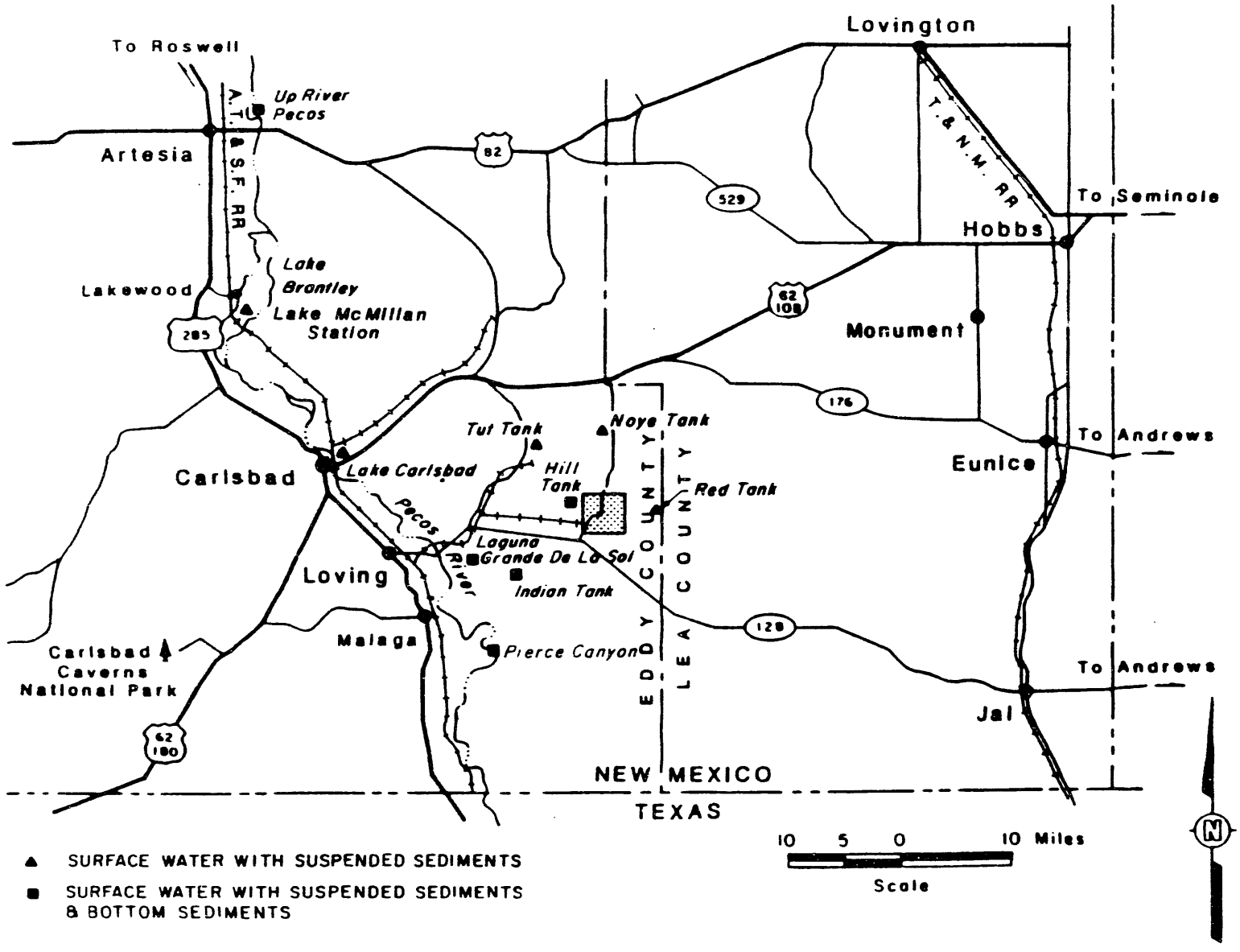


FIGURE 5-12 RBP SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

TABLE 5-7

RADIONUCLIDE CONCENTRATIONS IN SURFACE WATER SAMPLES
1988[1]
(μCi/ml)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228	Th-228	Th-230 (E-10)	Th-232
NOT	LD[2]	LD	LD	LD	LD	LD	LD	LD	LD
RDT	LD	LD	LD	LD	LD	LD	LD	LD	LD
INT	LD	LD	LD	LD	LD	LD	LD	LD	LD
HLT	LD	LD	LD	LD	LD	LD	LD	LD	LD
LGS	360 (11)	LD	LD	LD	LD	LD	LD	---[3]	---
CBD	LD	LD	LD	LD	LD	LD	LD	5.9 (3.3)	LD
PCN	2.6 (1.4)	LD	LD	LD	18 (15)	LD	LD	LD	LD
PCN-DUP.	LD	LD	LD	LD	LD	LD	LD	9.9 (5.5)	LD
UPP	LD	LD	LD	LD	LD	LD	LD	LD	LD
TUT	LD	LD	LD	LD	LD	LD	LD	41 (15)	LD
LMC	LD	LD	LD	LD	LD	LD	LD	LD	LD
BLANK SAMPLE	LD	LD	LD	LD	LD	LD	LD	LD	LD

LOCATION CODE	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-237	Pu-238	Pu-239/240	Pu-241
NOT	LD	LD	LD	1.5 (.89)	LD	LD	LD	LD
RDT	LD	LD	LD	LD	LD	LD	LD	LD
INT	LD	LD	LD	LD	LD	LD	LD	LD
HLT	LD	LD	LD	LD	LD	LD	LD	LD
LGS	LD	270 (10)	55 (17)	130 (7.3)	---	LD	LD	LD
CBD	LD	19 (4.2)	LD	8.9 (2.8)	LD	LD	LD	LD
PCN	LD	31 (3.9)	12 (8.0)	13 (2.5)	LD	LD	LD	LD
PCN-DUP.	LD	LD	26 (23)	14 (4.9)	LD	LD	LD	LD
UPP	LD	LD	LD	7.6 (2.3)	LD	LD	LD	LD
TUT	LD	3.1 (1.7)	LD	1.9 (1.2)	LD	LD	LD	LD
LMC	LD	13 (2.4)	7.3 (5.9)	7.2 (1.7)	LD	LD	LD	LD
BLANK SAMPLE	LD	LD	LD	LD	LD	LD	LD	LD

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

TABLE 5-8

RADIONUCLIDE CONCENTRATIONS IN SEDIMENT SAMPLES
1988[1]
(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-08)	Ra-228 (E-07)
HLT	230 (1.2)	LD[2]	LD	33 (8.2)	11 (3.6)
INT	190 (11)	LD	LD	45 (5.5)	12 (2.5)
PCN	61 (8.2)	LD	LD	LD	3.4 (1.8)
BLANK SAMPLE	55 (5.8)	LD	LD	LD	3.1 (1.9)
UPP	46 (7.3)	LD	LD	LD	2.4 (1.8)

LOCATION CODE	Th-228 (E-08)	Ra-266	U-233	U-234 (E-08)	U-235	U-238 (E-08)
HLT	78 (12)	LD	LD	43 (10)	LD	61 (12)
INT	100 (11)	LD	LD	44 (16)	LD	50 (15)
PCN	30 (7.6)	LD	LD	42 (16)	LD	19 (12)
BLANK SAMPLE	23 (6.1)	LD	LD	25 (10)	LD	24 (9.9)
UPP	19 (7.3)	LD	LD	39 (20)	LD	13 (11)

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)

groundwater serially analyzed for specific field parameters. Once the field parameters have stabilized, denoting a chemical steady-state with respect to those parameters analyzed, a final groundwater sample is collected to be analyzed for radionuclides. The controlling document for the WQSP is the "WIPP Water Quality Sampling Manual" (WP 07-2 of the Geotechnical and Geosciences Procedure Manual).

The primary water bearing units being evaluated by the WQSP are the Culebra and Magenta Dolomite Members of the Rustler Formation. Samples have also been collected from the Dewey Lake Redbeds Formation at local ranches. A general discussion of local groundwater hydrology appears in Section 7.0, Groundwater Protection.

Figure 5-13 provides a map of the groundwater sampling locations. Table 5-9 presents pertinent information for the wells sampled in 1988 as part of the WQSP.

Approximately 23 wells are being monitored by the WQSP in support of the RBP. In 1988, 16 Culebra and three Magenta wells were sampled for the full suite of radionuclides routinely analyzed by the RBP. Due to pump failure, the H-01 and WIPP-30 samples were aborted. Four recently drilled wells were added to the WQSP and sampled for the first time in 1987. Wells H-14 and H-15 were drilled in 1986. Wells H-17 and H-18 were drilled in 1987. WIPP-19 was also sampled for the first time in 1987. All five wells are completed in the Culebra and are located to give the RBP and WQSP a more complete coverage of the area surrounding the WIPP site.

The WQSP sampled groundwater at ten privately owned water wells that supply drinking water for livestock and human consumption. Table 5-10 presents pertinent information for these private wells. Of these ten wells, nine supply groundwater for livestock consumption and one (Barn Well) supplies groundwater for human consumption.

The concentrations of radionuclides in groundwater samples obtained by the WQSP are consistent with reported historical data for samples taken prior to the initiation of the baseline program (Mercer, 1983 and Simpson et al.,

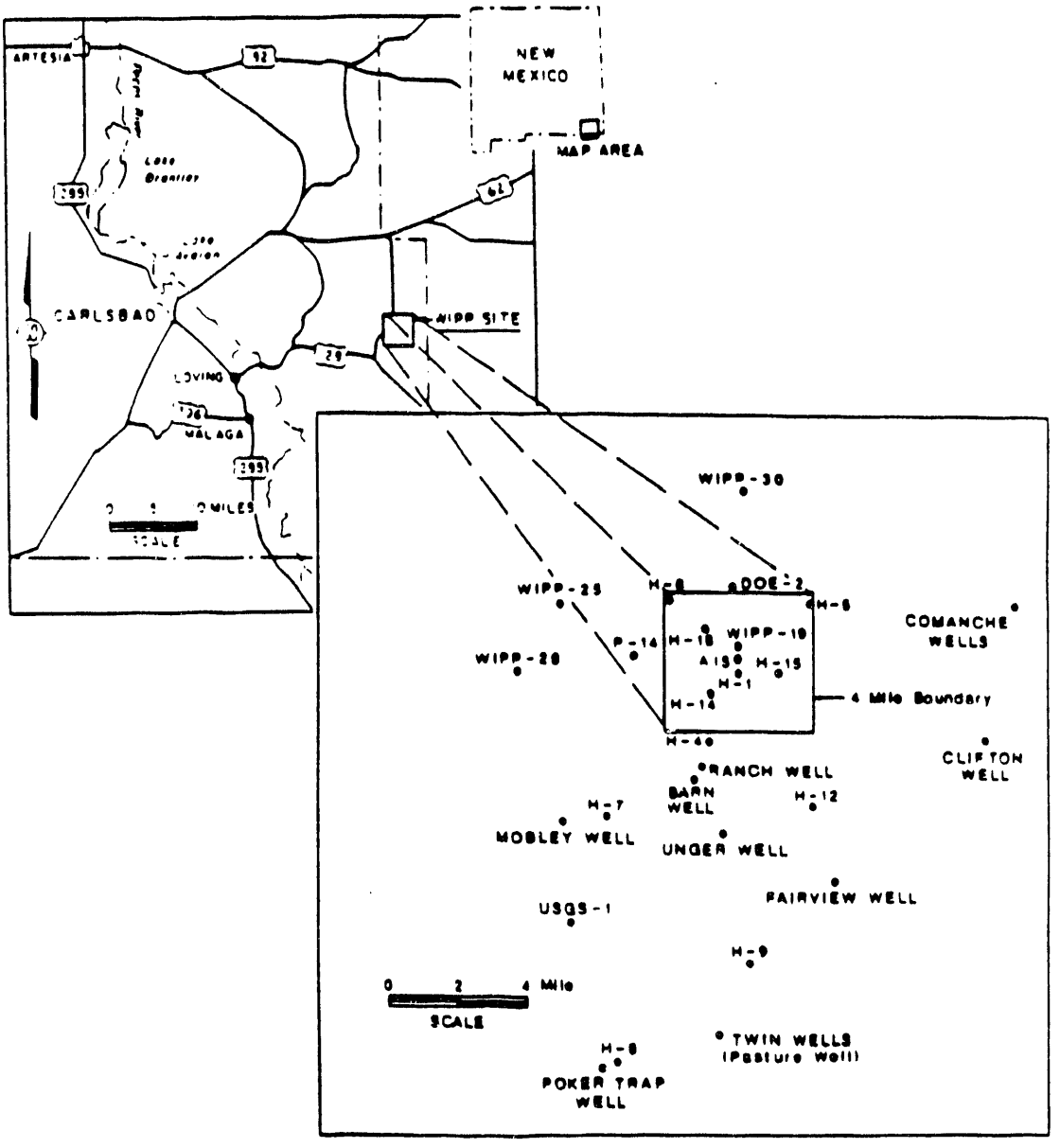


FIGURE 5-13 LOCATION OF 1988 GROUNDWATER WELLS

TABLE 5-9

1988 WELL SAMPLING LOG

WELL NAME	UNIT SAMPLED	ROUND	1988 DATES PUMPED	GALLONS PUMPED	BTOC TO PUMP INTAKE FEET	PUMP TYPE	SAMPLE TYPE
H-15	CULEBRA	2	01/07 - 01/13	1100	845	ADP	WQM/RBP/SNL (b)
H-14	CULEBRA	2	01/18 - 01/27	3000	535	ADP	WQM/RBP/SNL
WIPP-19	CULEBRA	2	01/26 - 02/12	3050	745	ADP	WQM/RBP/SNL
WIPP-30	CULEBRA	1	02/02 - 03/05 (a)	3000	612	ADP	SNL (c)
H-05b	CULEBRA	3	02/17 - 02/24	1450	875	ADP	WQM/RBP/SNL
H-05c	MAGENTA	2	02/24 - 03/03	1900	784	ADP	WQM/RBP/SNL
P-14	CULEBRA	3	03/08 - 03/16	5550	589	ADP	WQM/RBP/SNL
WIPP-25	CULEBRA	3	03/17 - 03/28	48000	433	ES	WQM/RBP/SNL
H-18	CULEBRA	2	02/26 - 04/07 (a)	33000	689	ES	WQM/RBP/SNL
WIPP-26	CULEBRA	3	04/05 - 04/14	9200	173	ADP	WQM/RBP/SNL (d)
H-07b1	CULEBRA	3	04/13 - 04/25	112400	198	ES	WQM/RBP/SNL (d)
DOE-2	CULEBRA	3	04/27 - 05/19	149000	821	ES	WQM/RBP/SNL (d)
H-08b	CULEBRA	3	06/01 - 06/08	4600	584	ADP	WQM/RBP/SNL
H-09b	CULEBRA	3	06/14 - 06/21	5150	634	ADP	WQM/RBP/SNL
H-04c	MAGENTA	3	07/12 - 07/19	700	358	ADP	WQM/RBP/SNL
H-06c	MAGENTA	3	07/19 - 07/26	2200	483	ADP	WQM/RBP/SNL
H-05c	MAGENTA	3	08/09 - 08/18	2500	759	ADP	WQM/RBP/SNL
WIPP-19	CULEBRA	3	08/17 - 08/29	5300	754	ADP	WQM/RBP/SNL
H-01	CULEBRA	1	09/19 - 10/07	5300	650	ADP	WQM (e)
AIS	CULEBRA		10/28		717		WQM/RBP/SNL (f)
H-15	CULEBRA	3	10/25 - 11/08	2200	850	ADP	WQM/RBP/SNL
H-12	CULEBRA	3	11/08 - 12/14	2900	808	ADP	WQM/RBP/SNL

TABLE 5-9

1988 WELL SAMPLING LOG
(CONTINUED)

Abbreviations:

AIS	Air intake shaft
ADP	Air driven piston
BTOC	Below top of casing
ES	Electric submersible
RBP	Radiologic Baseline Program
SNL	Sandia National Laboratories (Site Characterization Program)
WQM	Water quality monitoring

Notes:

(a) Pumping system operated by Sandia National Laboratories.
(b) No analyses for dissolved gases and redox couples.
(c) Serial sample field analyses and final sample analyses by SNL only.
(d) No analyses for dissolved gases.
(e) Values reflect date of sampling and depth location below ground surface. Samples collected for general chemistry, inorganic constituents, and radionuclide analyses. Samples also provided to SNL for analysis.

TABLE 5-10

1988 PRIVATE WELL SAMPLING LOG

WELL NAME	UNIT SAMPLED	ROUND	PUMP TYPE	SAMPLE TYPE
USGS-1	CULEBRA	1	W	WQM/RBP/SNL
MOBLEY WELL	(CULEBRA)	2	ES	WQM/RBP/SNL
BARN WELL	DEWEY LAKE	2	ES	WQM/RBP/SNL
RANCH WELL	DEWEY LAKE	3	ES	WQM/RBP/SNL
COMANCHE WELL	(SANTA ROSA)	2	EJ	WQM/RBP/SNL
CLIFTON WELL	(SANTA ROSA)	2	ES	WQM/RBP/SNL
FAIRVIEW WINDMILL	DEWEY LAKE	2	W	WQM/RBP/SNL
UNGER WINDMILL	DEWEY LAKE	2	W	WQM/RBP/SNL
USGS-1	CULEBRA	2	W	WQM/RBP/SNL
POKER TRAP WINDMILL	(CULEBRA)	2	W	WQM/RBP/SNL
TWIN WELLS-PASTURE	DEWEY LAKE	2	W	WQM/RBP/SNL

Abbreviations:

- () Sampled Interval Uncertain
- EJ Electric Jack
- ES Electric Submersible
- RBP Radiologic Baseline Program
- SNL Sandia National Laboratories (Site Characterization Program)
- W Windmill
- WQM Water Quality Monitoring

1985). Radionuclide concentrations in the groundwater samples collected in 1988 are reported in Tables 5-11 and 5-12.

The naturally occurring radionuclides that are frequently detected in many of the groundwater samples are Ra-226, U-234, U-235, and U-238. Naturally occurring radionuclides that are detected less frequently in the water samples are Th-228 and K-40. Tritium (hydrogen-3) has been analyzed in groundwater samples collected since 1985. To date, tritium has not been observed in the Culebra or Magenta Formations.

Several wells that monitor the Rustler Formation have reported concentrations of Ra-226 that range from less than detectable to 2.8×10^{-7} microCuries per milliliter in 1986 and less than detectable to 2.9×10^{-7} microCuries per milliliter in 1987. For Ra-228 the range is from less than detectable to 6.0×10^{-8} microCuries per milliliter in 1986 to less than detectable to 4.6×10^{-8} microCuries per milliliter in 1987. In some wells the total radium concentration exceeds the Primary Drinking Water Standards of 5 picoCuries per liter (5.0×10^{-9} microCuries per milliliter. As the data shows, this is a historically observed phenomena due to naturally occurring radium.

5.2.5 Biotic Radiation Baseline

This subprogram characterizes background radiation levels in key organisms along possible food chain pathways to man. Vegetation, rabbits, quail, beef, and fish are sampled, and palatable tissues are analyzed for concentrations of transuranics and common naturally occurring radionuclides. During 1988, samples of fish, quail and rabbits were collected for analysis (Figure 5-14). Results of analyses for these samples appear in Table 5-13. These values are within the expected range of environmental levels for biotic samples and are comparable to historical data found in Bradshaw and Louderbough (1987).

5.3 ASSESSMENT OF RADIATION EXPOSURE

No waste was received at the WIPP during 1988, therefore, there was no exposure of the public to radiation due to WIPP operations. Exposure to naturally occurring background radiation is discussed in Section 5.2.2, Ambient Radiation Baseline.

TABLE 5-11
RADIONUCLIDE CONCENTRATIONS IN GROUND WATER SAMPLES
WIPP VICINITY
1988
(μCi/ml)

LOCATION CODE	H-3	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-09)	Ra-226 (E-09)	Ra-228 (E-08)	Th-228 (E-10)	Th-230
H-15	LD	11 (4.3)	LD[2]	LD	LD	250 (27)	3.0 (2.2)	LD	LD
H-14	LD	1.7 (1.5)	LD	LD	LD	70 (16)	LD	LD	LD
WIPP-19	LD	5.6 (4.2)	LD	LD	31 (29)	110 (22)	2.5 (1.8)	LD	LD
H-05b	---[3]	9.7 (1.6)	LD	LD	LD	250 (25)	3.9 (2.3)	LD	LD
H-05c	---	LD	LD	LD	LD	LD	LD	LD	LD
P-14	---	LD	LD	LD	LD	42 (21)	LD	LD	LD
WIPP-25	---	LD	LD	LD	LD	LD	LD	LD	LD
H-18	---	LD	LD	LD	LD	80 (26)	LD	LD	LD
WIPP-26	---	LD	LD	LD	LD	LD	LD	LD	LD
H-07b1	---	LD	LD	LD	LD	LD	LD	LD	---
DOE-2	---	2.3 (1.4)	LD	LD	LD	120 (23)	2.3 (2.0)	56 (37)	---
H-08b	---	LD	LD	LD	LD	LD	LD	LD	LD
H-09b	---	LD	LD	LD	LD	LD	LD	LD	---
H-04c	---	LD	LD	LD	LD	33 (18)	4.6 (3.5)	LD	---
H-06c	---	LD	LD	LD	LD	9.2 (8.6)	LD	LD	---
H-05c	---	LD	LD	LD	LD	LD	LD	LD	---
WIPP-19	---	6.0 (1.5)	LD	LD	LD	130 (23)	LD	70 (43)	---
H-15	---	---	---	---	---	---	---	---	---
H-12	---	---	---	---	---	---	---	---	---

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

TABLE 5-11
RADIONUCLIDE CONCENTRATIONS IN GROUND WATER SAMPLES
WIPP VICINITY
1988
(μCi/ml)
(CONTINUED)

LOCATION CODE	Th-232	U-233 (E-10)	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-237	Pu-238	Pu-239/240	Pu-241
H-15	LD	LD	17 (3.1)	LD	4.9 (1.8)	LD	LD	LD	LD
H-14	LD	LD	69 (8.4)	LD	6.2 (2.5)	LD	LD	LD	LD
WIPP-19	LD	LD	87 (14)	LD	12 (5.0)	LD	LD	LD	LD
H-05b	LD	LD	8.8 (2.1)	LD	LD	LD	LD	LD	LD
H-05c	LD	LD	LD	LD	LD	LD	LD	LD	LD
P-14	LD	LD	37 (3.7)	LD	LD	LD	LD	LD	LD
WIPP-25	LD	LD	49 (18)	LD	9.5 (9.0)	LD	LD	LD	LD
H-18	LD	LD	83 (5.6)	LD	13 (2.2)	LD	LD	LD	LD
WIPP-26	LD	LD	46 (4.6)	9.5 (8.9)	17 (2.8)	LD	LD	LD	LD
H-07b1	---	LD	43 (3.9)	LD	18 (2.5)	---	LD	LD	LD
DOE-2	---	LD	160(7.6)	19 (10)	31 (3.4)	---	LD	LD	LD
H-08b	LD	LD	110(7.2)	6.7 (6.0)	17 (2.8)	LD	LD	LD	LD
H-09b	---	3.9 (2.8)	100(9.3)	46 (21)	50 (6.3)	---	LD	LD	LD
H-04c	---	LD	LD	LD	LD	---	LD	LD	LD
H-06c	---	LD	75 (5.6)	LD	20 (2.8)	---	LD	LD	LD
H-05c	---	LD	6.5 (4.8)	LD	LD	---	LD	LD	LD
WIPP-19	---	LD	78 (5.0)	LD	11 (1.9)	---	LD	LD	LD
H-15	---	---	---	---	---	---	---	---	---
H-12	---	---	---	---	---	---	---	---	---

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

TABLE 5-12
RADIONUCLIDE CONCENTRATIONS IN GROUND WATER SAMPLES
PRIVATE WELLS
1988[1]
(μCi/ml)

WELL NAME	K-40	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228	Th-228	Th-230	Th-232
USGS-1	LD[2]	LD	LD	LD	LD	LD	LD	---	---
Mobley Well	LD	LD	LD	LD	LD	LD	LD	---	---
Barn Well	LD	LD	LD	LD	LD	LD	LD	LD	LD
Ranch Well	LD	LD	LD	LD	LD	LD	LD	LD	LD
Comanche Well	---[3]	---	LD	---	---	---	---	---	---
Clifton Well	---	---	LD	---	---	---	---	---	---
Fairview Windmill	---	---	LD	---	---	---	---	---	---
Unger Windmill	---	---	LD	---	---	---	---	---	---
USGS-1	---	---	LD	---	---	---	---	---	---
Poker Trap Windmill	---	---	LD	---	---	---	---	---	---
Twin Wells - Pasture	LD	LD	LD	LD	3.5 (8.5)	LD	LD	---	---

WELL NAME	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-237	Pu-238	Pu-239/240	Pu-241
USGS-1	LD	26 (3.8)	LD	8.2 (2.1)	---	LD	LD	LD
Mobley Well	LD	51 (6.6)	LD	22 (4.4)	---	LD	LD	LD
Barn Well	LD	18 (3.6)	LD	6.4 (2.1)	LD	LD	LD	LD
Ranch Well	LD	49 (5.7)	28 (18)	15 (3.1)	LD	LD	LD	LD
Comanche Well	LD	41 (4.6)	LD	21 (3.3)	---	LD	LD	LD
Clifton Well	LD	150 (7.3)	32 (12)	73 (5.2)	---	LD	LD	LD
Fairview Windmill	LD	43 (3.9)	15 (7.6)	23 (2.8)	---	LD	LD	LD
Unger Windmill	---	---	---	---	---	LD	LD	LD
USGS-1	LD	32 (3.7)	7.3 (5.9)	10 (2.0)	---	LD	LD	LD
Poker Trap Windmill	LD	19 (4.2)	LD	8.8 (2.8)	---	LD	LD	LD
Twin Wells - Pasture	LD	9.7 (2.1)	LD	3.7 (1.2)	---	LD	LD	LD

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
(2) Less Than Detectable (Refer to Table 8-2)
(3) Indicates Not Analyzed

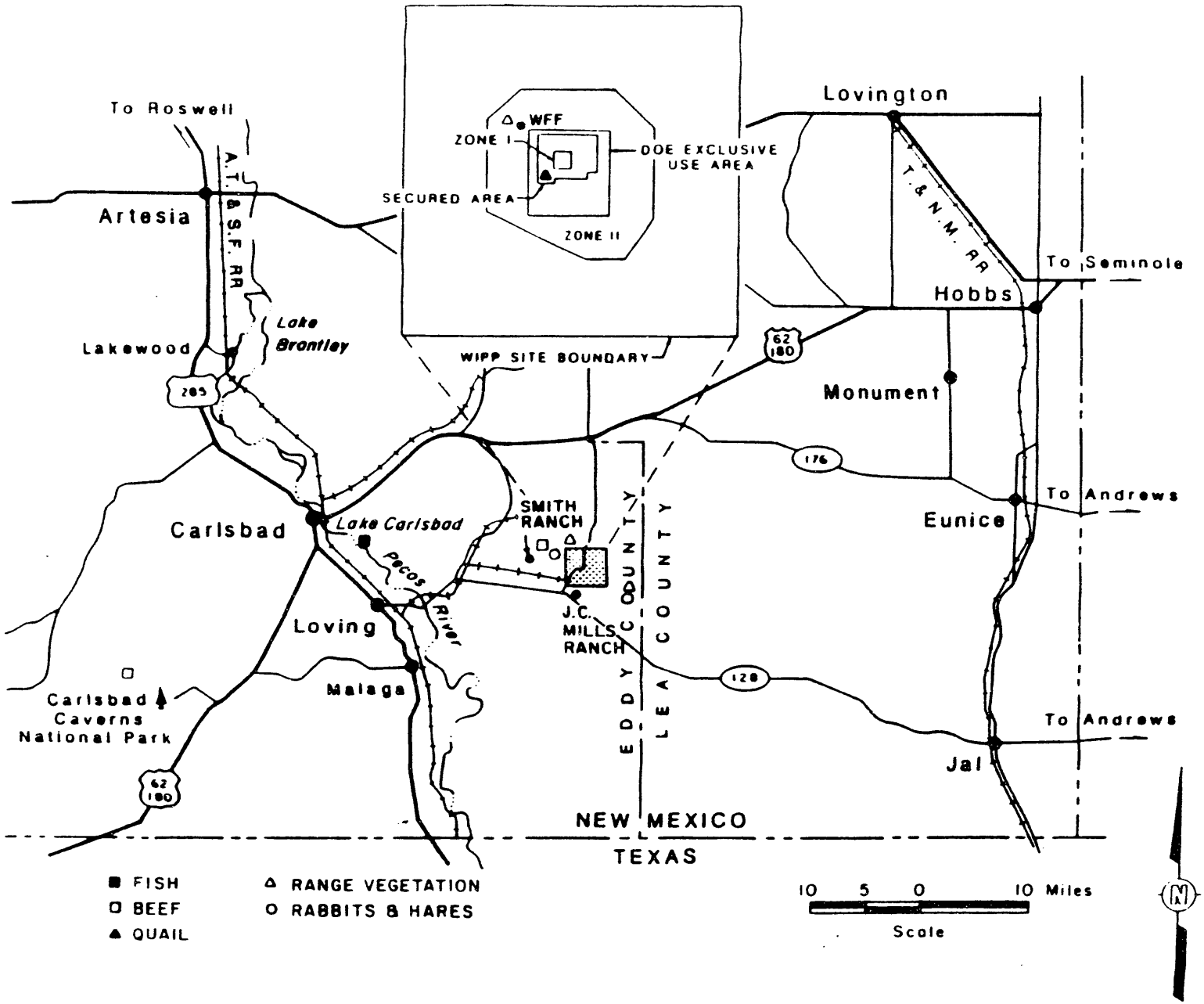


FIGURE 5-14 RBP BIOTIC BASELINE SAMPLING LOCATIONS

TABLE 5-13

RADIONUCLIDE CONCENTRATIONS IN BIOTIC SAMPLES 1988[1] (μCi/g)

SAMPLE CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137	Ra-226	Ra-228	Th-228
BF[2]-CFI-2.3	150 (19)	LD[4]	LD	LD	LD	LD	LD
BR[3]-SMR-2.3	120 (18)	LD	LD	LD	LD	LD	LD

SAMPLE	U-233	U-234	U-235	U-238	Pu-238	Pu-239/240	Pu-241
BF-CFI-2.3	LD	LD	LD	LD	LD	LD	LD
BR-SMR-2.3	LD	LD	LD	LD	LD	LD	LD

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations
(2) Fish Sample
(3) Rabbit Sample
(4) Less Than Detectable (Refer to Table 8-2)

6.0 NONRADIOLOGICAL MONITORING PROGRAM

The Ecological Monitoring Program (EMP) is conducted by the Regulatory and Environmental Programs Section (formerly Radiological and Environmental Programs Section) of the Safety, Security and Environmental Protection Department and was initiated in 1984. This program was preceded by the WIPP Biology Program (1975-1982), which combined scientific and technical expertise from six universities to develop an extensive baseline of information describing the major components of the Los Medaños ecosystem prior to the initiation of WIPP construction activities (see Reith et al., 1985, for a summary of this program). The principal functions of the EMP are:

- To detect and quantify the impacts of construction and operational activities at the WIPP on the surrounding ecosystem
- To continue the development of the ecological database for the Los Medaños Area initiated by the WIPP Biology Program
- To investigate unusual and unexpected elements in the ecological and radiological databases
- To provide environmental data which are important to the mission of the WIPP project, but which have not or will not be acquired by other programs.

This section of the Annual Report presents and discusses data collected between January 1, 1988, and December 31, 1988, as part of the EMP. Ecological monitoring at the WIPP includes five subprograms, surface disturbance monitoring through the analysis of aerial photographs, air quality monitoring, water quality monitoring, wildlife population monitoring, and meteorological monitoring. The salt impact studies include three subprograms: soil chemistry, soil microbial activity, and vegetation. The results of the environmental monitoring activities and discussions of significant findings are presented in this report. Sample location codes for the various subprograms are listed in Table 5-1.

Unless otherwise noted, all methods used in data collection are those described in the first Ecological Monitoring Program semiannual report (Reith et al., 1985) and incorporating the modifications described in subsequent reports (Fischer et al., 1985; Fischer, 1987; Fischer, 1988).

6.1 METEOROLOGY

The Ecological Monitoring Program has measured weather parameters at the WIPP since September, 1984. The purpose is to provide a continuous record of meteorological data to support the RBP, EMP, and other monitoring programs at the WIPP. Wind speed, wind direction, and ambient temperature are being recorded continuously, as well as humidity and barometric pressure. Rainfall is measured daily.

6.1.1 Meteorological Monitoring Instrumentation

In November 1988, the weather monitoring instruments located 20 meters northwest of the core storage building, within the Zone I boundary, were relocated to the WIPP Far-field air sampling area (Figure 4-2). The wind data are collected from instruments elevated ten meters above the ground, while temperature and rainfall are measured approximately two meters above the ground. Barometric pressure and humidity sensors were added to the weather monitoring instruments in 1988.

On September 1, 1986, the WIPP was designated as an official National Oceanic Atmospheric and Administration (NOAA) recording station. Since that date the precipitation data have been taken from the rain gauge provided by NOAA.

6.1.2 Results and Discussion

The weather data for 1988 are summarized below. These data include temperature, barometric pressure, humidity, precipitation and wind direction.

6.1.2.1 Daily Maximum/Minimum Temperatures at WIPP

Daily minimum and maximum temperatures are graphed in Figures 6-1 and 6-2. Temperature fluctuation is greatest in the winter and early spring, reflecting the periodic movement of cold air masses through the WIPP area. Drops of ten degrees or more in daily maximums are not uncommon during this time.

The last freezing day (0°C) of the year occurred on April 10, and the first recorded freezing day (-3°C) occurred on November 19. The maximum temperature was 38°C or higher 23 days out of the year. The minimum temperature fell to 0°C or below on 60 days out of the year. On February 6, the maximum temperature did not rise above 0°C.

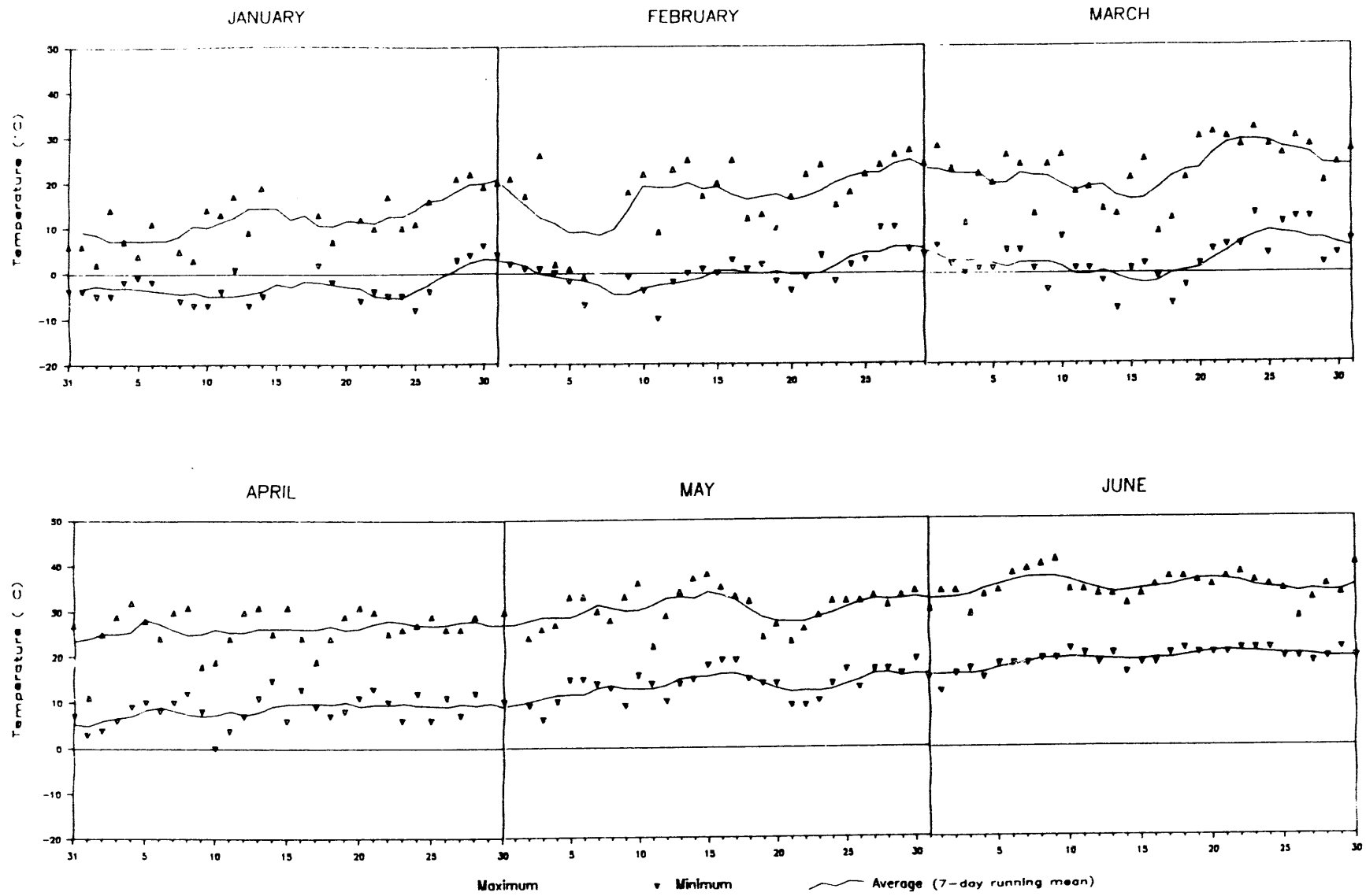


FIGURE 6-1 DAILY MAXIMUM/MINIMUM TEMPERATURES, JANUARY THROUGH JUNE, 1988

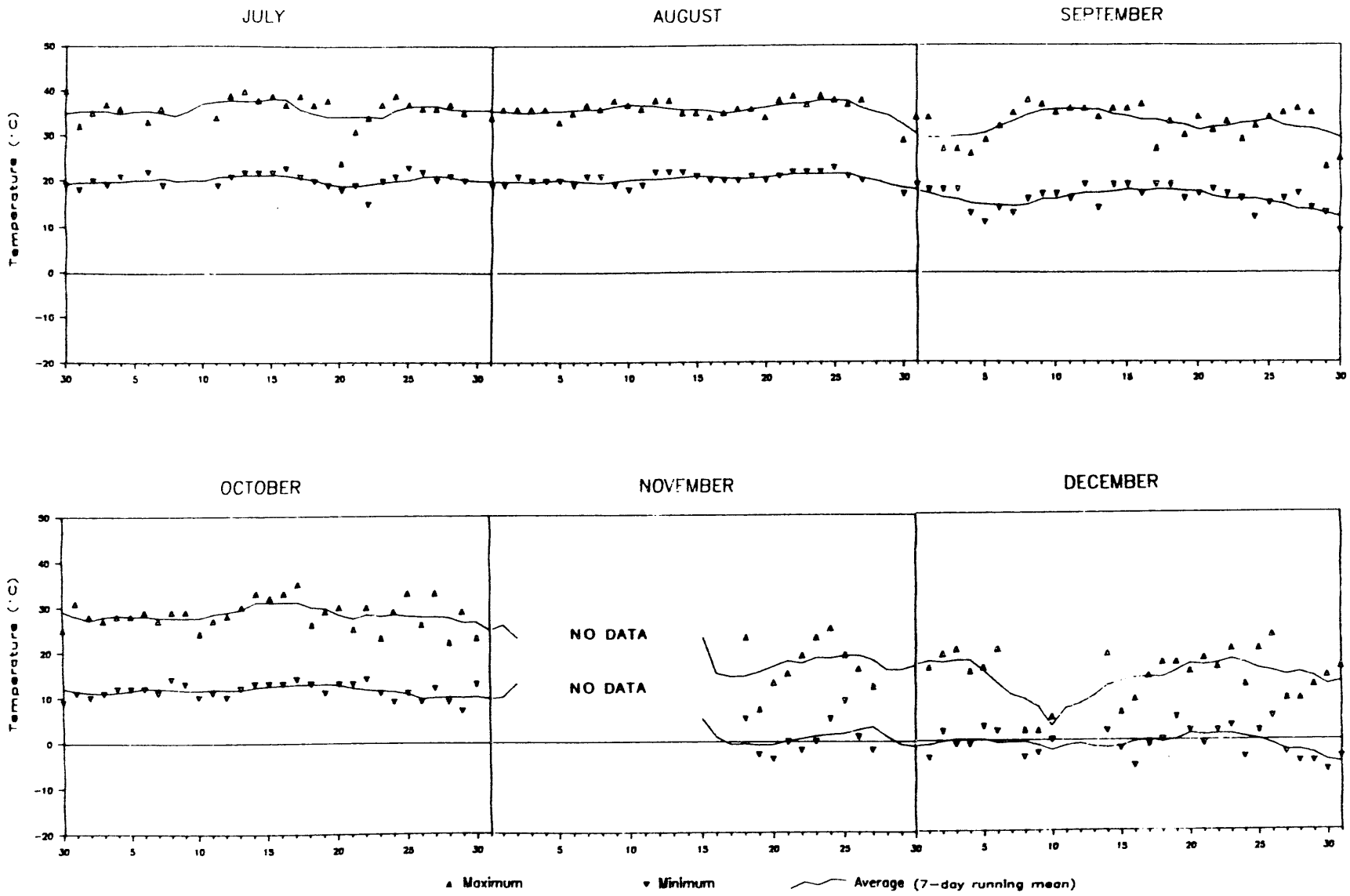


FIGURE 6-2 DAILY MAXIMUM/MINIMUM TEMPERATURES, JULY THROUGH DECEMBER, 1988

6.1.2.2 Barometric Pressure

Barometric pressure (Figures 6-3 and 6-4) averages between 26.20 and 26.50 inches of mercury (in. Hg) throughout the year. Fluctuations are apparent during the first and fourth quarter months, January through April and November and December, due to the high and low pressure air masses moving through the area.

6.1.2.3 Relative Humidity

As shown in Figures 6-5 and 6-6, the relative humidity fluctuates throughout the year. Marked increases occurred during the rainy season, March through September.

6.1.2.4 Precipitation

Precipitation data are provided for 1988 (Figure 6-7). A total of 41.98 centimeters of precipitation fell in 1988, which is 11 centimeters above the average rainfall for the southeastern plains. July and August both had approximately 8.6 centimeters of rain, while the winter months were very dry. Snowfall is a rare occurrence in southeastern New Mexico. However, on April 16, approximately 10.1 centimeters of snow (approximately 1.0 centimeters of rain) fell and 5.1 centimeters of snow (approximately 0.5 centimeters of rain) fell in December. Smaller amounts of snow (less than .03 centimeters) also fell in January and February.

6.1.2.5 Wind Direction and Wind Speed

Hourly average wind data from the Sum-X data logger (see Fischer, 1987, for a description of the Sum-X logging system) are compiled into monthly windroses illustrated in Figures 6-8 through 6-10. Wind speeds rarely fell below 1.3 meters per second, the lowest measurable speed. During the month of November, the atmospheric monitoring station was moved. No data was reported for that month.

Figure 6-11 shows the annual windrose for 1988. Winds greater than 8.5 meters per second were recorded from all 16 directions. Wind speeds in the 1.4 through 6.7 meters-per-second category were the most prevalent.

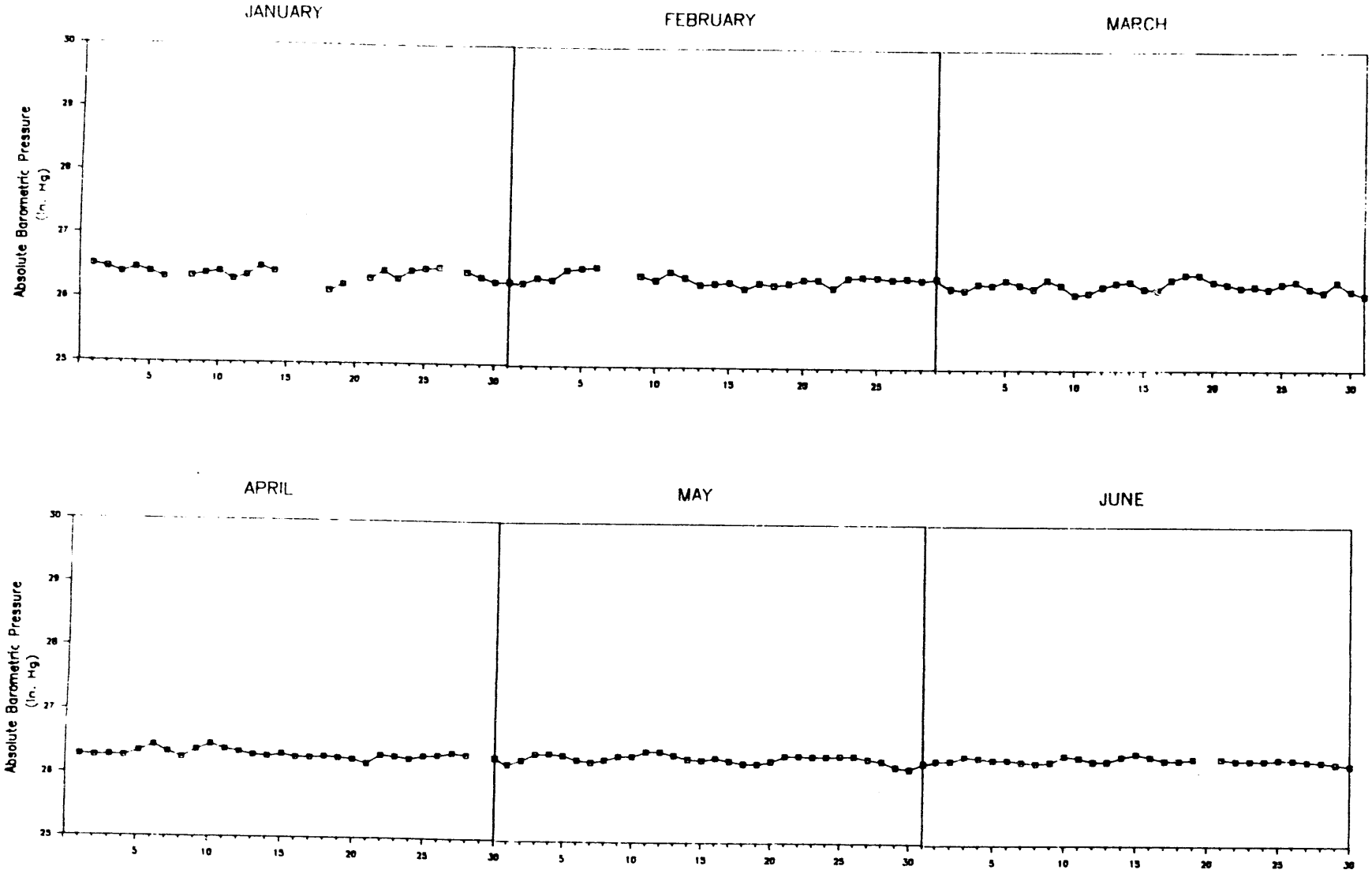


FIGURE 6-3 AVERAGE DAILY BAROMETRIC PRESSURE, JANUARY THROUGH JUNE, 1988

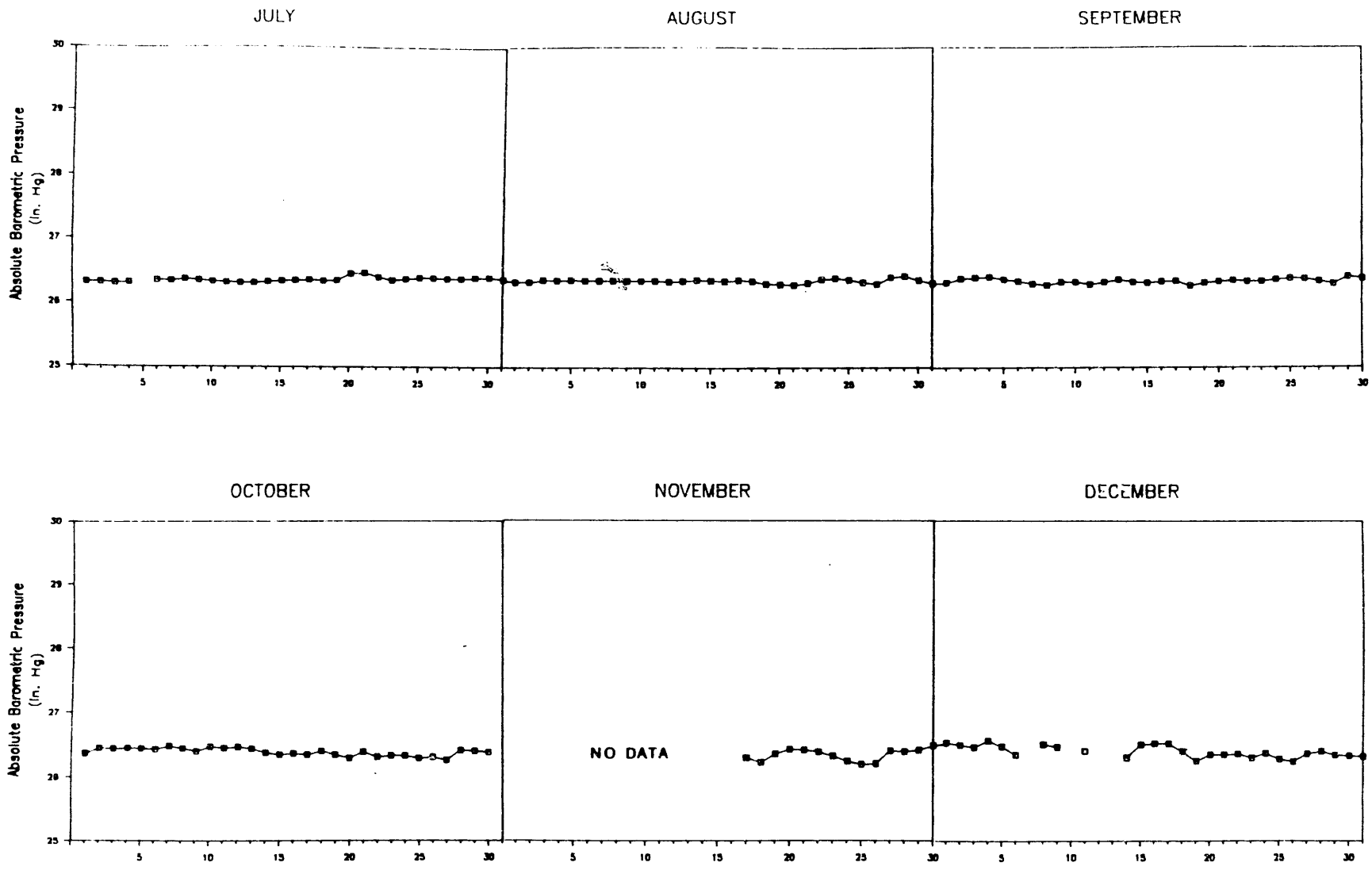


FIGURE 6-4 AVERAGE DAILY BAROMETRIC PRESSURE, JULY THROUGH DECEMBER, 1988

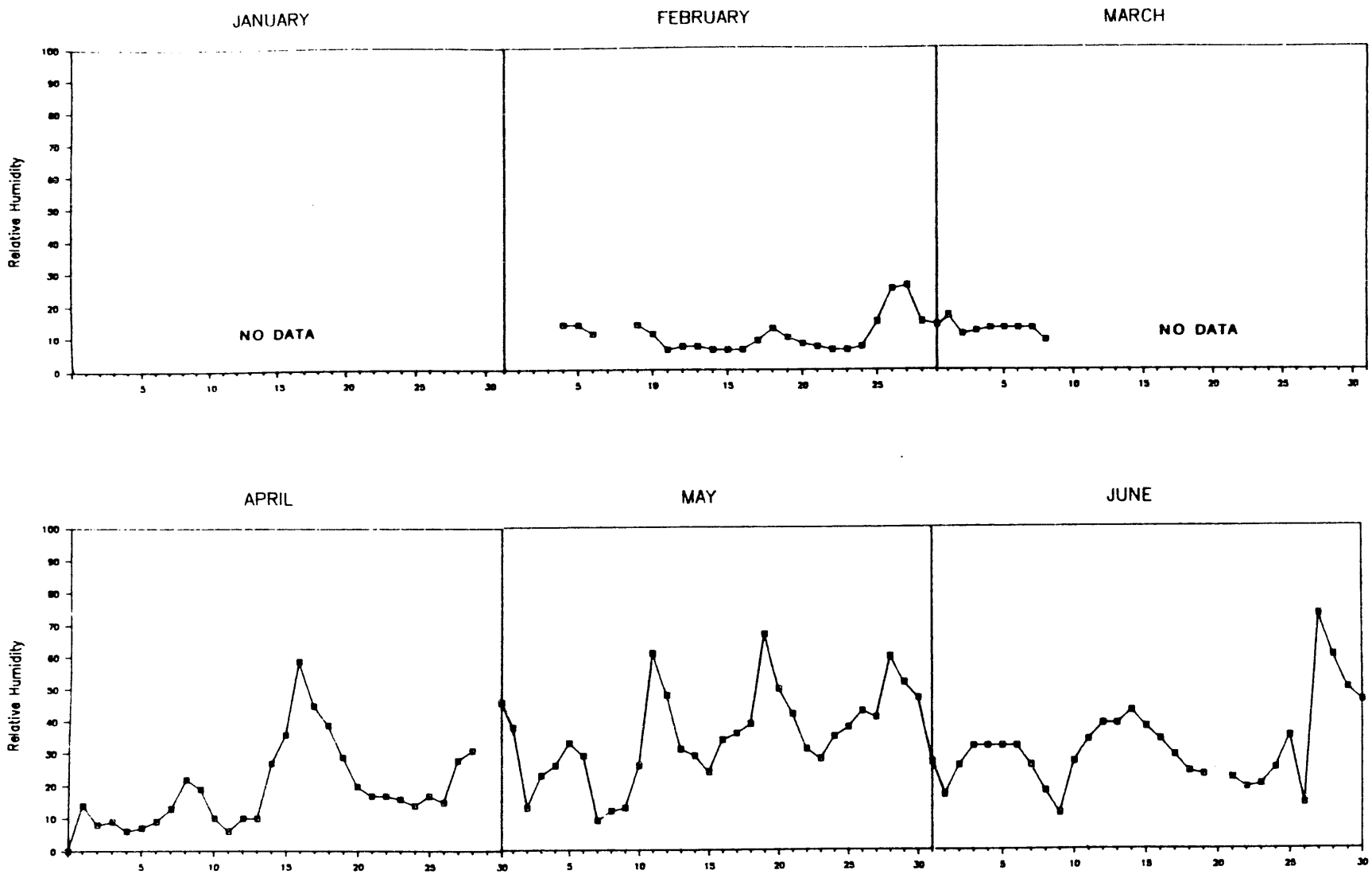


FIGURE 6-5 AVERAGE DAILY RELATIVE HUMIDITY, JANUARY THROUGH JUNE, 1988

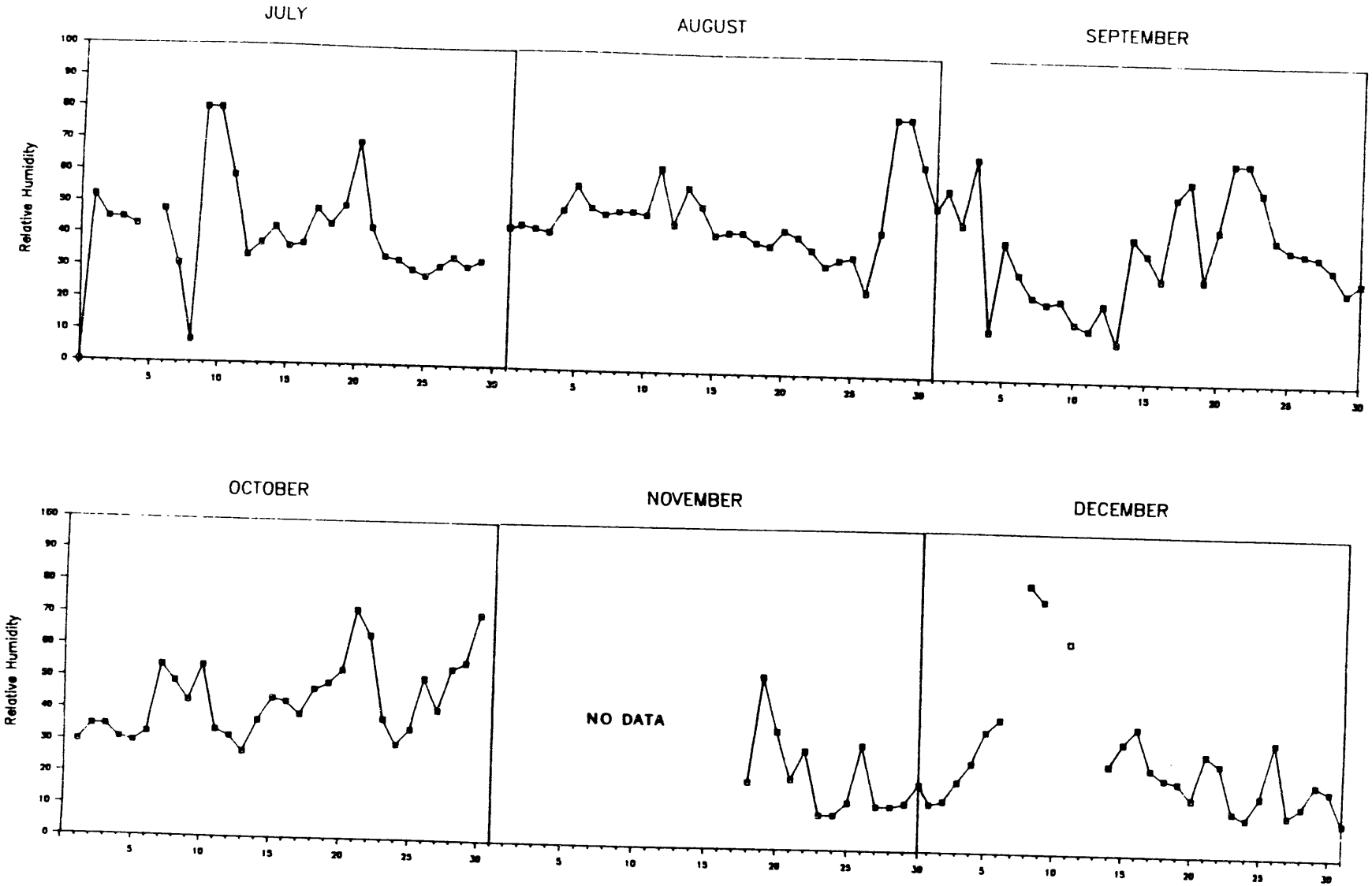


FIGURE 6-6 AVERAGE DAILY RELATIVE HUMIDITY, JULY THROUGH DECEMBER, 1988

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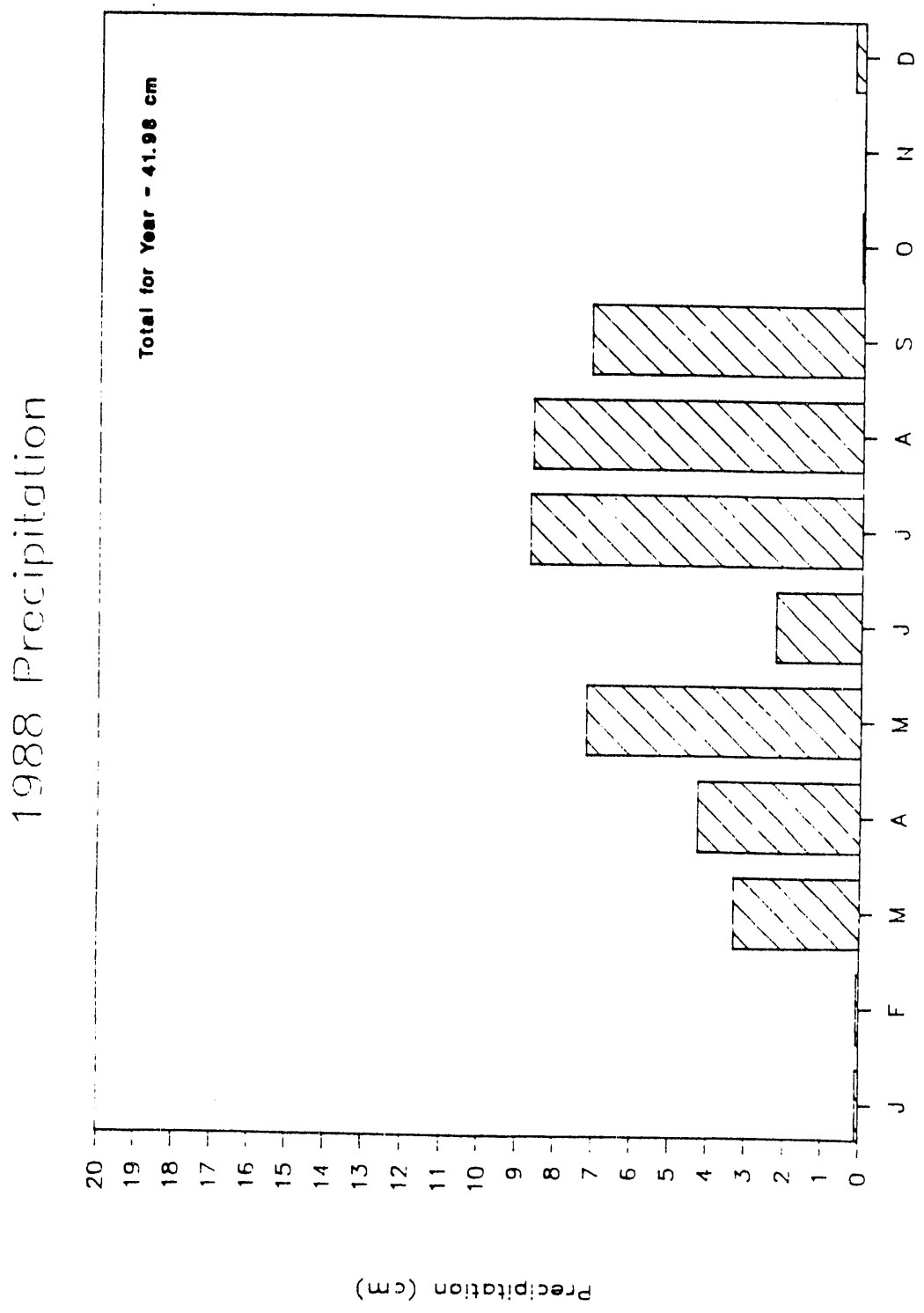
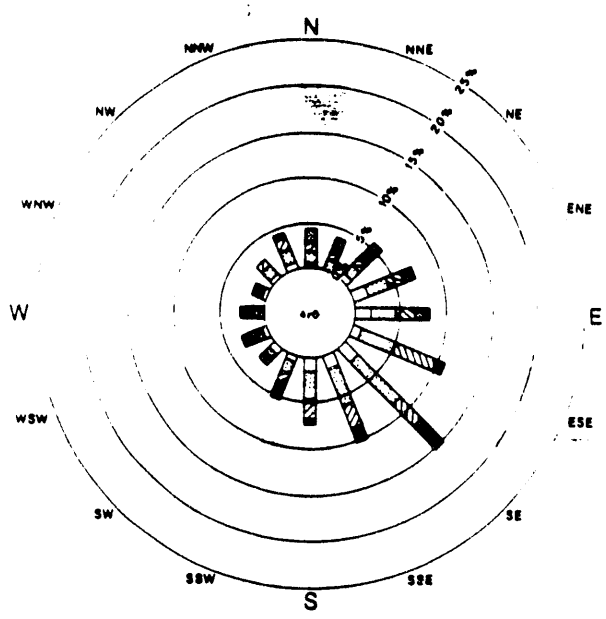
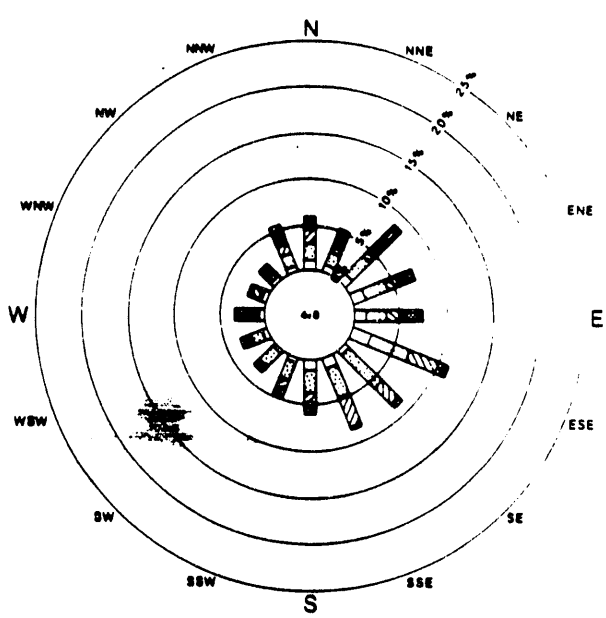


FIGURE 6-7 PRECIPITATION FOR 1988

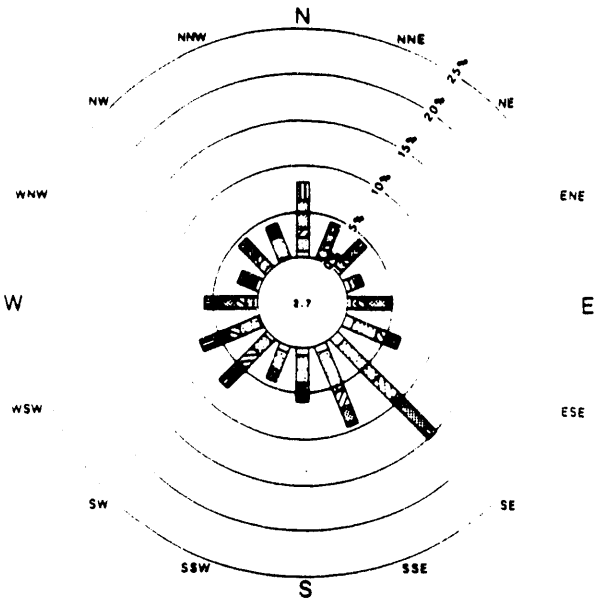
JANUARY



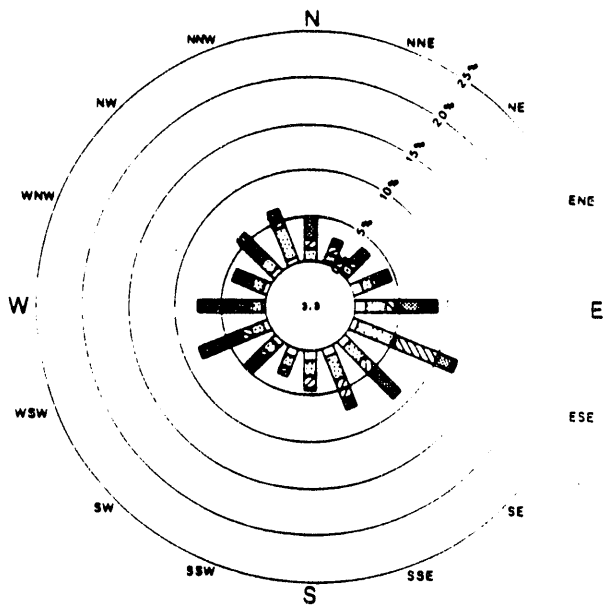
FEBRUARY



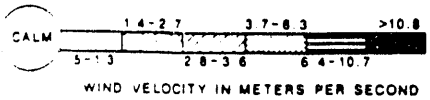
MARCH



APRIL



LEGEND



WIND VELOCITY IN METERS PER SECOND

FIGURE 6-8 WINDROSES FOR JANUARY THROUGH APRIL 1988

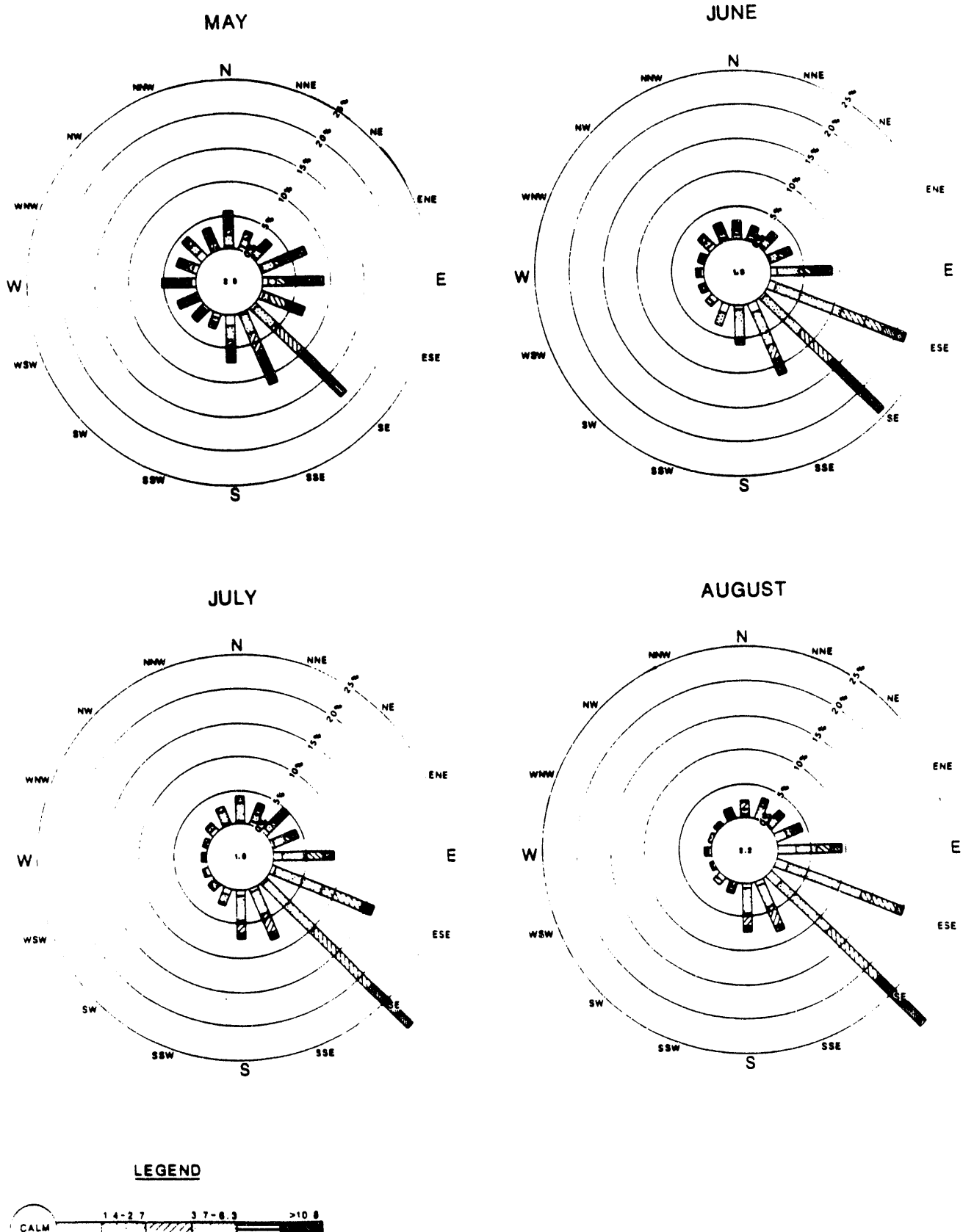
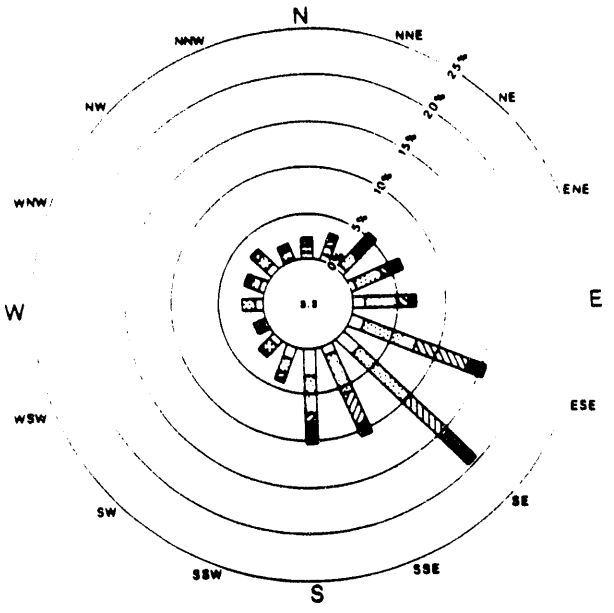
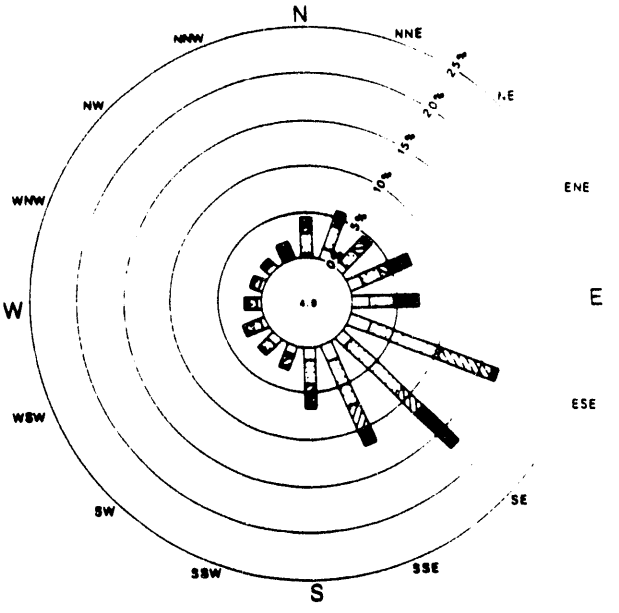


FIGURE 6-9 WINDROSES FOR MAY THROUGH AUGUST 1988

SEPTEMBER

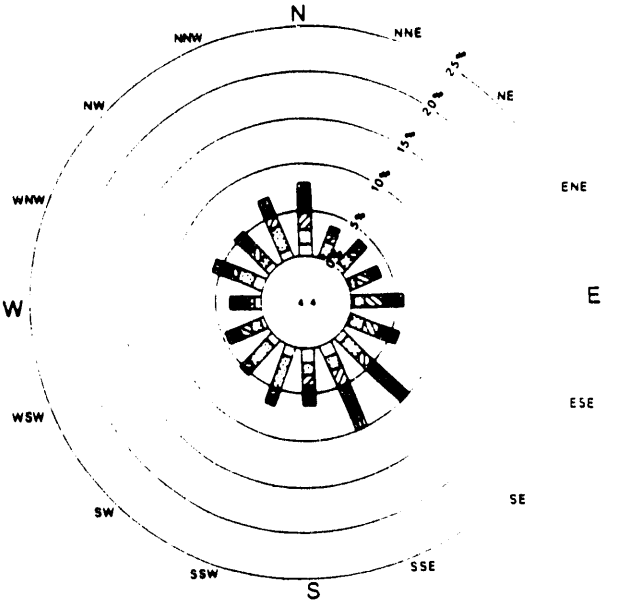


OCTOBER



NOVEMBER
(INSUFFICIENT DATA)

DECEMBER



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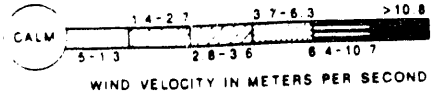

FIGURE 6-10 WINDROSES FOR SEPTEMBER THROUGH DECEMBER 1988

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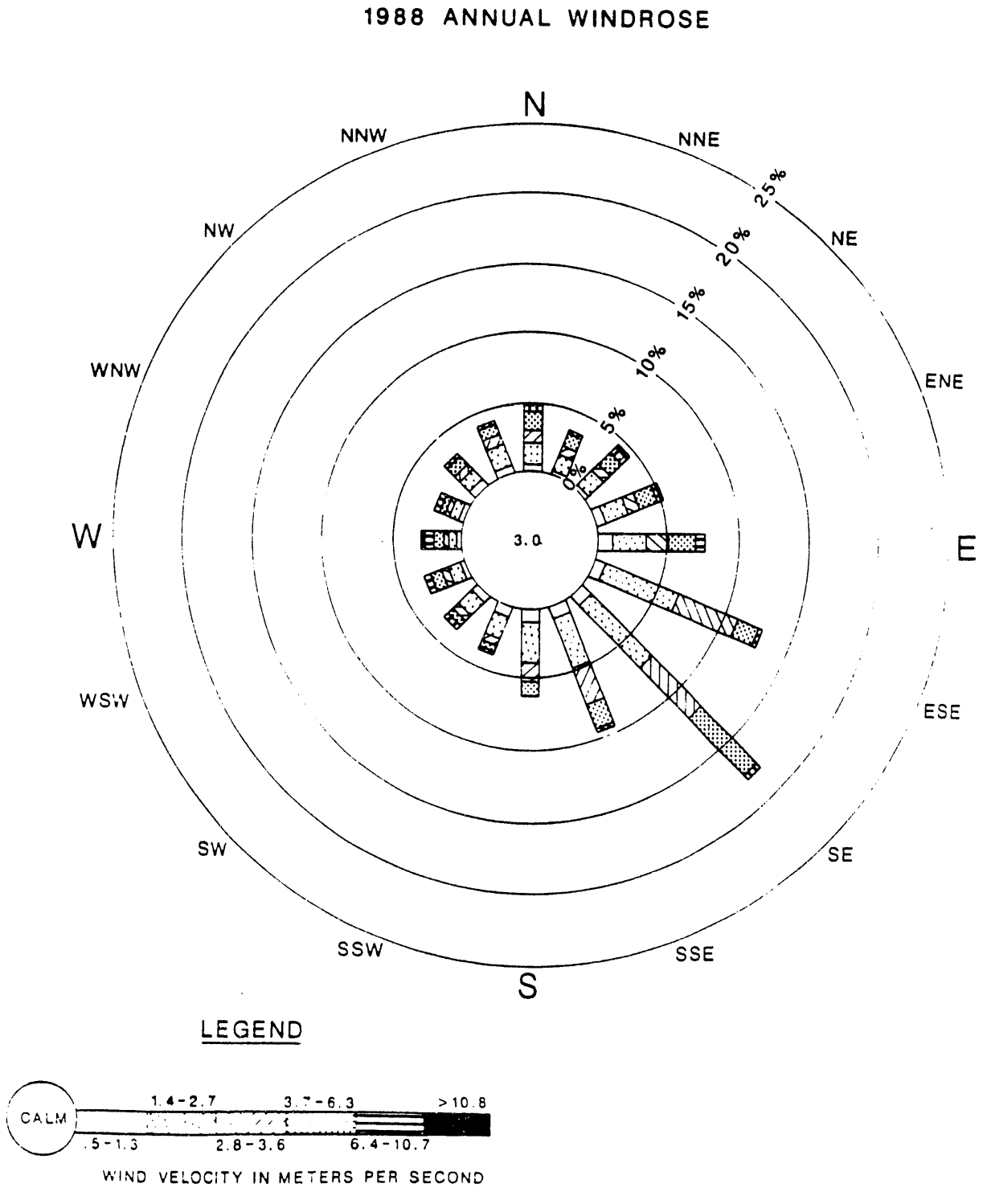

FIGURE 6-11 ANNUAL WINDROSE FOR 1988

6.2 ENVIRONMENTAL PHOTOGRAPHY

Aerial photographs of the WIPP site have been taken semiannually since 1982. In 1988, photographs were taken in July (Figure 6-12) and December (Figure 6-13). These photographs document surface construction and development activities to date. They are archived for future reference and for use by the Regulatory and Environmental Programs section. Portions of the surface at the facility, including the parking lot and the area around the Waste Handling and Support Buildings, have been paved.

6.3 AIR QUALITY MONITORING

Seven classes of pollutant gases are monitored at the WIPP site on a continuous basis. These are: sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), hydrogen sulfide (H_2S), and oxides of nitrogen (NO, NO_2, NO_x). In addition, weekly measurements of Total Suspended Particulates (TSP) are made from the particulates collected by the low-volume continuous air sampler at the far-field air sampling location. TSP was within the state standard throughout 1988.

Gas monitoring data collected prior to November 1988 are not considered representative of effluent air quality from the site. This is due to the encroachment of facility development around the original location of the gas monitoring station in the northwest corner of Zone I during the course of the year. In particular, the development of the Air Intake Shaft immediately south of this location and the paving of the parking lot, perimeter roads, and large areas of the facility pad adjacent to the monitoring station probably contributed significantly to the concentrations of gases measured. During the summer of 1988, hydrogen sulfide regularly exceeded the New Mexico State standard of 0.01 ppm during the afternoon hours (Figure 6-14). This may have been due to the paving activities during this period and the effects of daytime temperature on fresh asphalt.

To alleviate this problem and obtain more representative measurements of effluent air quality, the atmospheric gas monitoring station was moved to the Far Field air sampling location, approximately one kilometer northwest (downwind) from the facility. Since this relocation, most gases have remained below state air quality standards with hydrogen sulfide slightly exceeding the

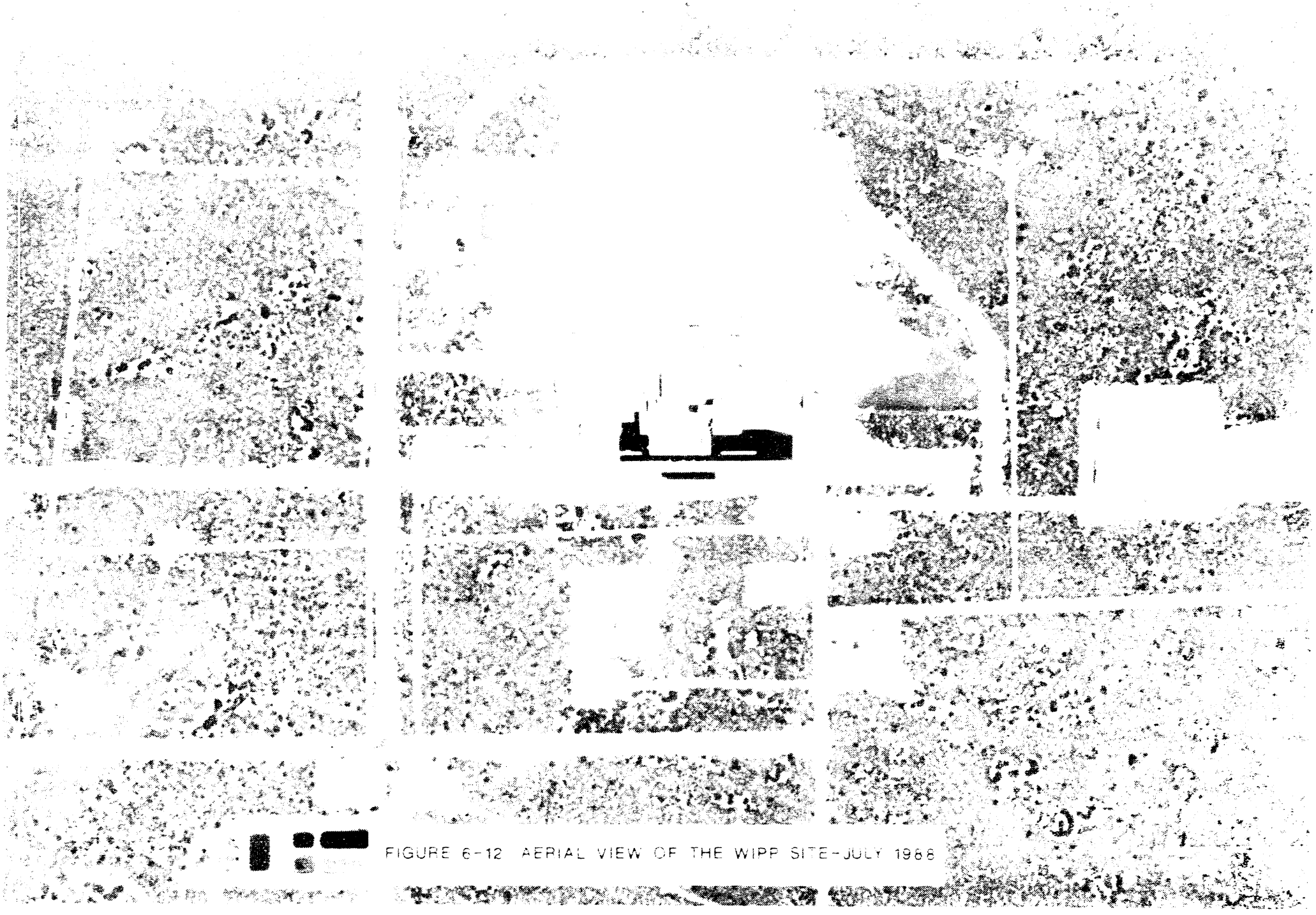

FIGURE 6-12 AERIAL VIEW OF THE WIPP SITE-JULY 1988

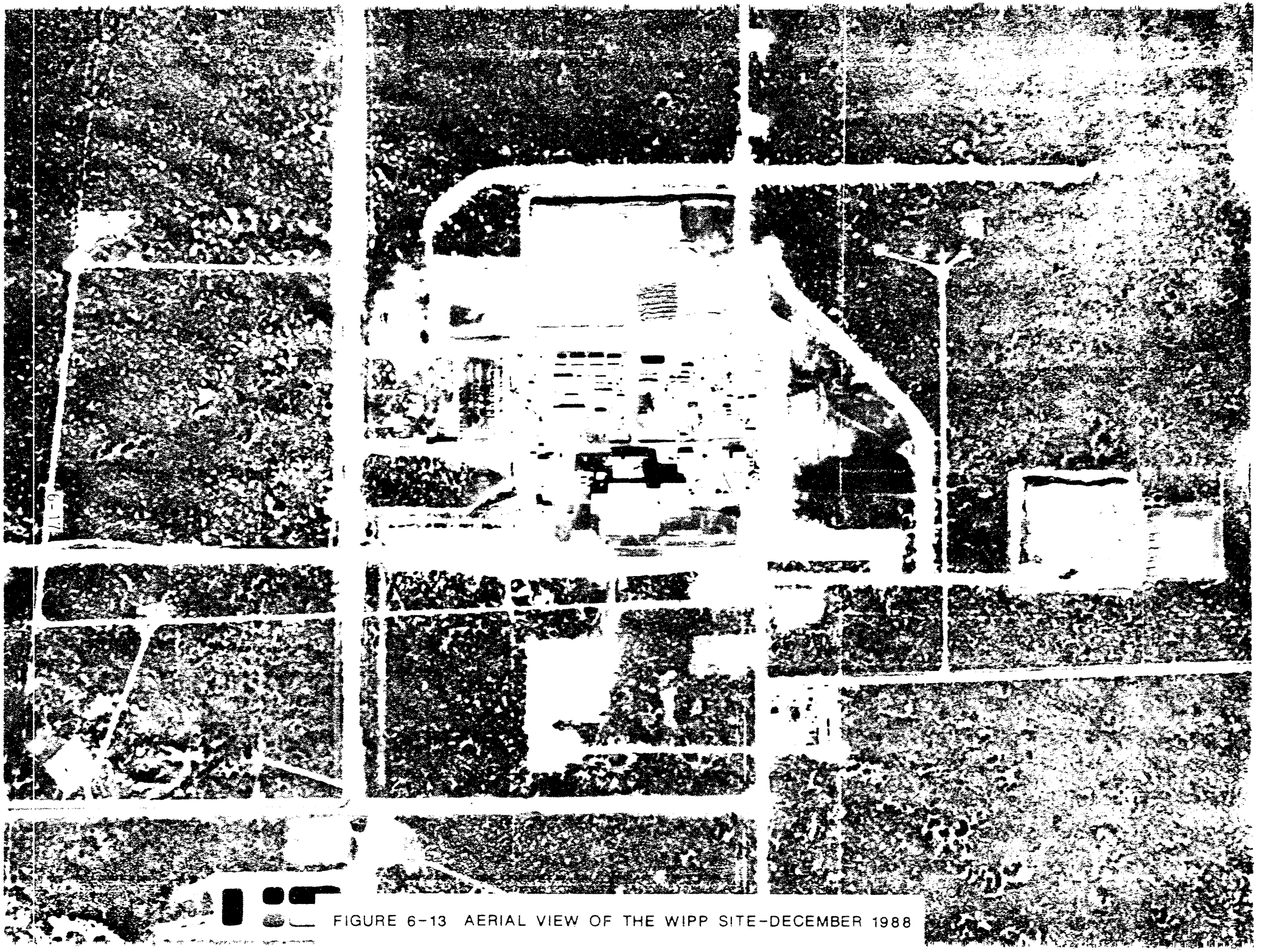

FIGURE 6-13 AERIAL VIEW OF THE WIPP SITE-DECEMBER 1988

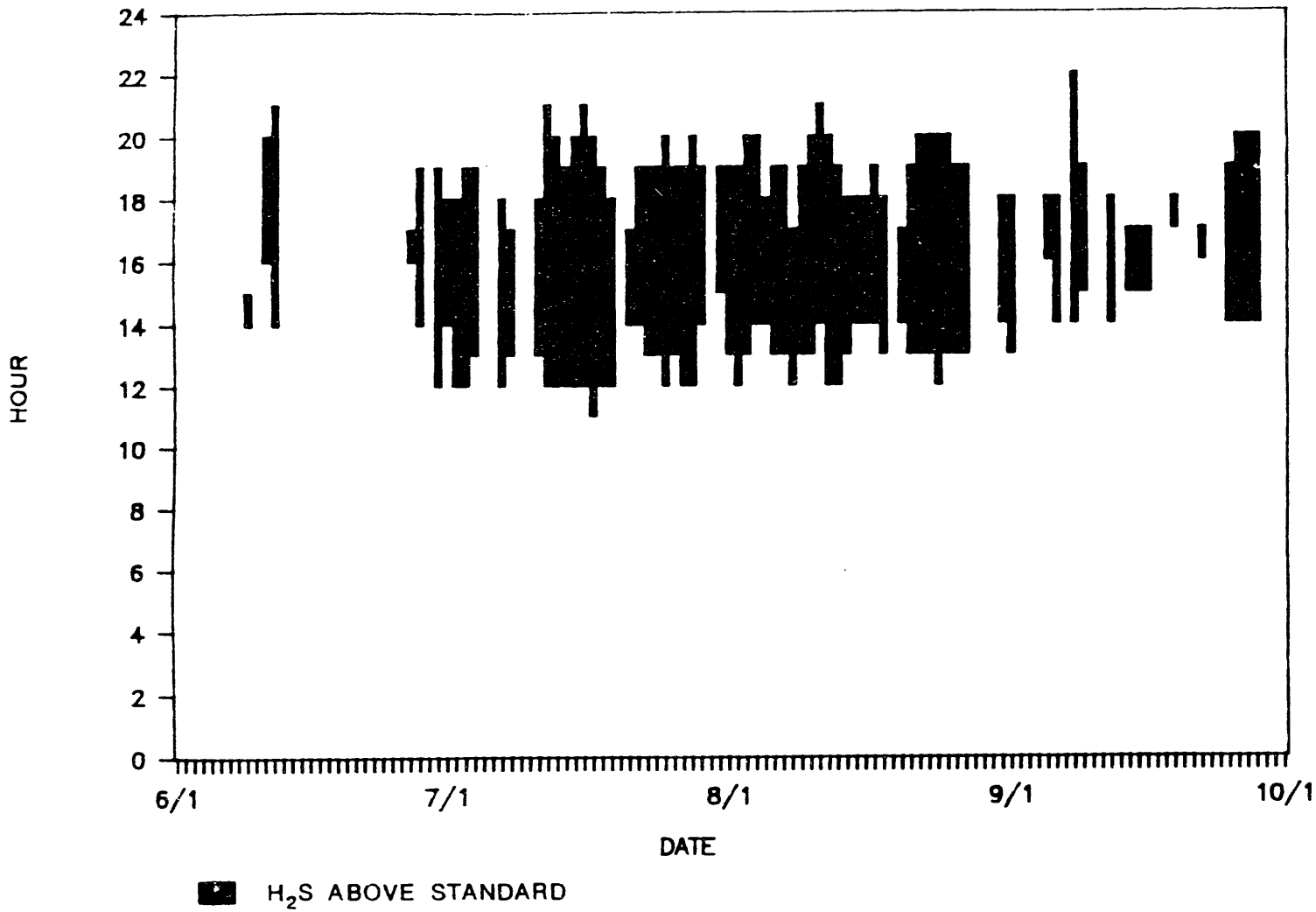

FIGURE 6-14 HYDROGEN SULFIDE CONCENTRATIONS, JUNE THROUGH SEPTEMBER 1988

standard during one hour on November 28. There were two significant rises in ozone during December, the first between the 13th and 16th, reaching a peak of 0.248 ppm, and the second from the 26th to the end of the year, reaching a peak of 0.273 ppm. No obvious on-site sources of ozone have been identified to account for these concentrations.

6.4 SURFACE WATER AND SEDIMENT QUALITY MONITORING

Samples of surface water were collected at four locations on May 23, 1988: Hill Tank, Red Tank, Indian Tank, and Laguna Grande de la Sal (Figure 6-15). Sediment samples were also collected from all except Laguna Grande. Duplicate samples of water and sediment were collected from Hill Tank and blank samples representing both water and sediment were also prepared. The duplicate and blank samples were assigned standard sample codes with false location identifications to allow blind analysis by the laboratory. The results of the analyses are presented in Tables 6-1, surface water, and 6-2, sediments.

The analyses of these samples show little difference from previous results (Fischer, 1988). Of note is the generally higher levels of total organic carbon in the three tanks. This is probably the result of algal growth, observed to be relatively high during the sampling period. Also of note is the level of arsenic detected in the Red Tank water sample (0.11 mg/l) which is almost twice the concentration measured the previous November and represents the second consecutive increase in this parameter during the period of record. Nonradioactive strontium was also found in concentrations elevated from previous water sample results in both Red Tank and Indian Tank. These concentrations may be due to dry conditions during the year prior to sampling, leading to high evaporative water loss and low recharge from precipitation. These concentrations, although high compared to previous years, are not considered a problem. Concentrations of all parameters listed in Table 6-1 for Laguna Grande de la Sol are higher than values reported from other locations. This is due to the fact that Laguna Grande is a playa lake, having no discharge other than evaporation.

6.5 WILDLIFE POPULATION MONITORING

Density measurements of breeding birds and small nocturnal mammals are performed annually at two locations to monitor the effects of the project and associated activities on the surrounding animal community (Figure 6-16). The

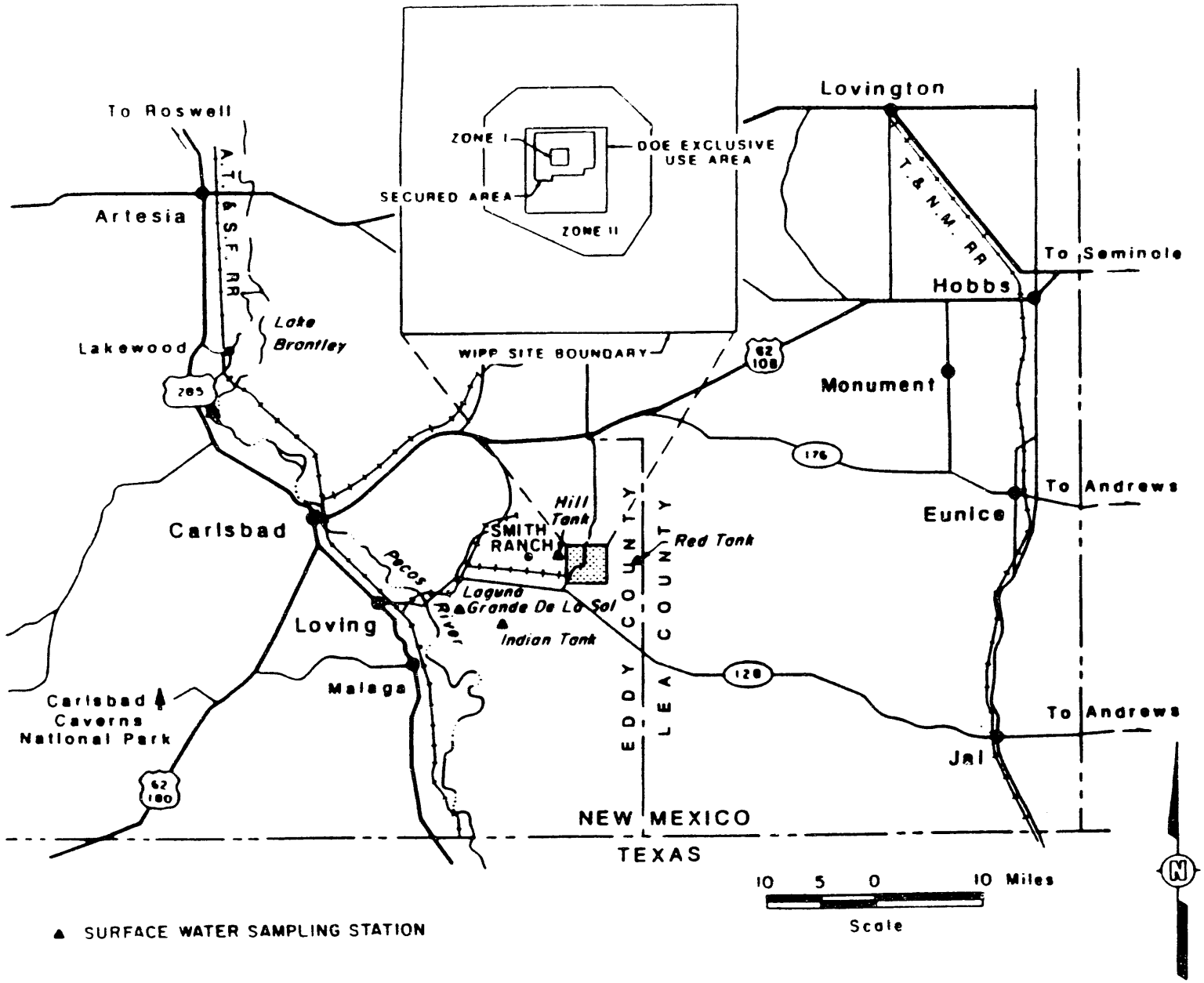

FIGURE 6-15 SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

TABLE 6-1

SUMMARY OF SURFACE WATER ANALYSIS
MAY 23, 1988

PARAMETERS[1]	HILL TANK	HILL TANK DUPLICATE	RED TANK	INDIAN TANK	LAGUNA GRANDE DE LA SAL	BLANK
FIELD						
Temperature (°C)	21	21	21	27	28.5	27
pH	8.8	--[2]	7.23	8.24	7.58	6.31
Conductivity (µmhos/cm)	154	--	304	277	36,000	2.27
MINERAL CHEMISTRY						
Bicarbonate	98	94	190	230	370	3
Carbonate	9	9	0	0	79	0
Chloride	7.6	8.1	24	11	182,000	0.2
Nitrate	LD(0.02)[3]	LD(0.02)	LD(0.02)	LD(0.02)	.9	LD(0.02)
Phosphate (total)	.22	.20	.43	2.4	.37	.02
Total Dissolved Solids (TDS)	150	150	260	320	372,000	LD(10)
Total Suspended Solids (TSS)	18	31	110	220	870	LD(4)
Moisture Content (%)	--	--	--	--	--	--
Sulfate	LD(1)	LD(1)	LD(1)	LD(1)	27,600	LD(1)
Total Organic Carbon (TOC)	23	22	34	58	11	LD(1)
Total Organic Halogen (TOX)	LD(.05)	.09	LD(.05)	.06	.58	LD(.05)
METALS						
Arsenic	.006	.005	.011	.009	.039	LD(.005)
Calcium	15	15	34	43	360	LD(.05)
Cesium	.23	.4	LD(.01	.04	.59	.08
Chromium	.07	.04	.03	.10	1.1	LD(.01)
Magnesium	8.0	7.9	11	18	17,900	.14
Potassium	23	22	26	19	43,800	LD(.4)
Selenium	LD(.005)	LD(.005)	LD(.025)	LD(.005)	LD(1.0)	LD(.005)
Sodium	11	7.9	21	3.3	92,500	LD(.4)
Strontium	.14	.17	.32	.22	16	.03

[1] All units, unless indicated otherwise, are in mg/l or parts per million (ppm) for surface water and mg/kg or ppm for sediments.
[2] -- = Not analyzed.
[3] LD(x) = Less than detectable at the level in parentheses.

WIP:8905-T6-1

TABLE 6-2

SUMMARY OF SEDIMENT ANALYSIS
MAY 23, 1988

PARAMETERS[1]	HILL TANK	HILL TANK DUPLICATE	RED TANK	INDIAN TANK	BLANK
MINERAL CHEMISTRY					
Bicarbonate	1,800	1,400	1,500	1,400	4
Carbonate	0	0	0	0	0
Chloride	96	96	71	42	LD(0.2)
Nitrate	LD(.3)[2]	LD(.3)	3.5	3.4	--
Phosphate (total)	980	980	455	590	--
Total Dissolved Solids (TDS)	--[3]	--	--	--	LD(10)
Total Suspended Solids (TSS)	--	--	--	--	LD(4)
Moisture Content (%)	28.32	30.87	38.0	41.79	--
Sulfate	LD(28)	LD(29)	LD(16)	ID(16)	LD(1.0)
Total Organic Carbon (TOC)	27,000	27,000	7,100	11,000	--
Total Organic Halogen (TOX)	LD(.5)	LD(.5)	LD(.5)	LD(.5)	--
METALS					
Arsenic	1.9	2.1	1.7	1.9	--
Calcium	54,700	58,300	53,800	44,300	--
Cesium	37	11	3.2	14	--
Chromium	26	19	2	36	--
Magnesium	12,600	14,800	7,800	43,400	--
Potassium	5,000	5,600	3,900	4,700	--
Selenium	LD(.67)	LD(.69)	LD(.77)	93	--
Sodium	58	72	82	71	--
Strontium	120	130	88	58	--

[1] All units, unless indicated otherwise, are in mg/l or parts per million (ppm) for surface water and mg/kg or ppm for sediments.
[2] LD(x) = Less than detectable at the level in parentheses.
[3] -- = Not analyzed.

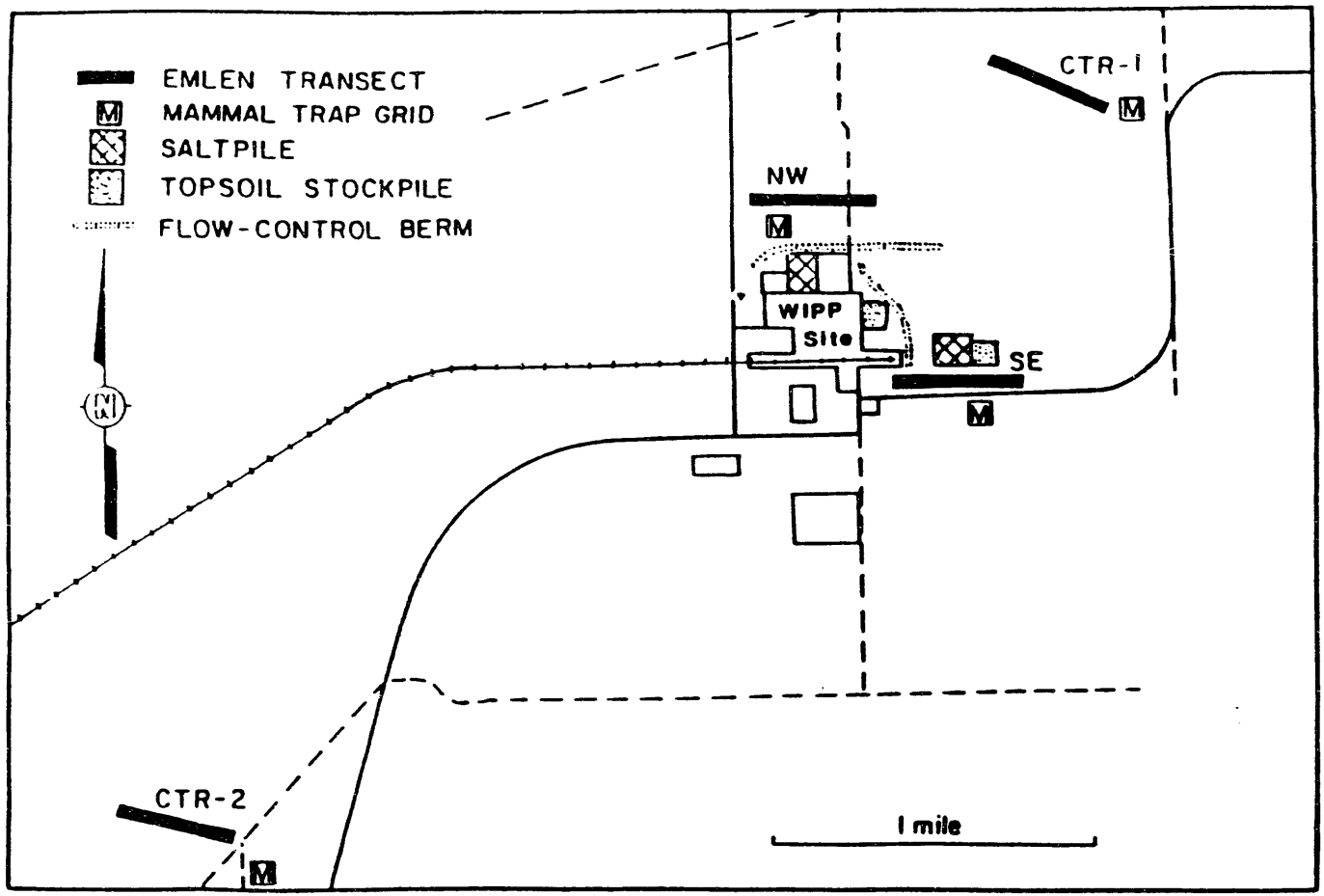

FIGURE 6-16 LOCATIONS OF EMLEN TRANSECTS AND MAMMAL TRAP GRIDS

1988 survey represents the fifth consecutive year of comparable data for breeding birds and the fourth for small mammals. The survey locations and methods are as described in the 1987 Ecological Monitoring Program Report (Fischer, 1988).

6.5.1 Breeding Bird Densities

Table 6-3 presents a summary of the five years of breeding bird density measurements. The species are divided into three groups. The Dominant Control Species are those with an average density greater than one bird per 40 hectare in the control transects. The Minor Control Species are those that have averaged one or fewer birds per 40 hectare in the control transects. The WIPP species are those that have only been recorded on the WIPP transects.

Species richness (number of species) in 1988 was similar to previous years with more species recorded in the WIPP transects than in the controls. The total densities were similar between control and WIPP transects in 1988; however, the numbers are approximately 30 percent less than the total densities recorded in 1987. This decline in total density reflects the generally poor conditions observed in the Los Medaños area in 1988 for vegetation, rabbit densities, and raptor nesting. Significant declines were noted for black-throated sparrows, northern bobwhite, morning dove, cactus wren, ash-throated flycatcher, and house finch.

The bird surveys continue to show a shift in the avian community structure toward greater diversity and, in particular, greater numbers of aerial insectivores ("fly-catchers") than the controls. The five-year average densities show all but two of the 11 Dominant Control Species in lesser numbers near the WIPP facility, and five of the Minor Control Species are found in greater numbers adjacent to WIPP. In 1988, seven species (three Minor Control Species and four WIPP species) were recorded in WIPP transects and not in the control transects, while only the crissal thrasher was recorded in the control transects and not in the WIPP transects. In terms of species present, the in the WIPP transects were less affected by the poor conditions in 1988 than the control transects.

TABLE 6-3

SUMMARY OF BREEDING BIRD DENSITIES (PER 40 HECTARES) IN FOUR EMLEN TRANSECTS OVER FIVE YEARS

	CONTROL TRANSECTS						WIPP TRANSECTS					
SPECIES	1984	1985	1986	1987	1988	ALL YRS.	1984	1985	1986	1987	1988	ALL YRS.
DOMINANT CONTROL SPECIES												
Black-Throated Sparrow	7.3	24.9	21.5	48.8	33.4	27.2	29.1	19.0	11.8	31.6	28.0	23.9
Pyrrhuloxia	4.1	17.3	16.1	25.8	24.8	17.6	5.5	8.7	16.5	21.5	22.6	14.9
Northern Bobwhite	29.5	3.6	8.7	20.1	2.2	12.8	0.5	2.1	8.1	14.4	4.3	5.9
Northern Mockingbird	0.5	15.4	15.1	14.4	15.6	12.2	4.6	16.0	12.9	13.6	18.8	13.2
Mourning Dove	6.8	23.6	9.4	5.7	2.2	9.5	4.1	3.5	0.6	10.0	4.3	4.5
Brown-Headed Cowbird	0.9	3.7	5.9	8.6	6.5	5.1		2.7	0.6	5.7	1.6	2.1
Loggerhead Shrike	3.2		9.4	5.7	6.5	4.9	1.8	1.9	2.5	5.7	6.5	3.7
Eastern Meadowlark	0.9	0.1	4.4	8.6	6.5	4.1	0.5	0.1	1.7	2.2	3.2	1.5
Scaled Quail	0.5	7.1	3.0	2.2	1.3	2.8		1.2	0.2	1.4	0.7	0.7
Common Nighthawk	0.5		3.3	3.6	4.3	2.3	2.7	1.8		1.4	2.2	1.6
Cactus Wren	0.9	1.6	2.0	4.3	2.2	2.2	3.2	2.4	7.9	18.7	1.3	6.7
MINOR CONTROL SPECIES												
Brewer's Sparrow		0.9	2.7			0.7						
Western Kingbird		0.7		2.9		0.7	2.3	5.8	3.5	7.9	7.5	5.4
Ash-Throated Flycatcher				2.9	0.5	0.7	2.7		4.3	5.7	2.2	3.0
Poorwill				2.9		0.6					2.2	0.4
Cassin's Sparrow	0.5	0.2	2.2			0.6	0.9	0.5				0.3
House Finch		2.0	0.8			0.6			0.6	11.5		2.4
Crissal Thrasher		0.1			2.2	0.4						
Chihuahuan Raven	1.4		0.6			0.4	1.8	1.1		0.7	1.1	0.9
Lark Bunting		1.0				0.2						
Yellow-Headed Blackbird		1.0				0.2		2.0				0.4

TABLE 6-3

SUMMARY OF BREEDING BIRD DENSITIES
(PER 40 HECTARES) IN FOUR EMLEN TRANSECTS
OVER FIVE YEARS
(CONTINUED)

	CONTROL TRANSECTS						WIPP TRANSECTS					
SPECIES	1984	1985	1986	1987	1988	ALL YRS.	1984	1985	1986	1987	1988	ALL YRS.
WIPP SPECIES												
Northern Oriole							0.9	0.5	5.1	2.9	2.2	2.3
Barn Swallow										2.9	1.6	0.9
Greater Roadrunner							1.8		2.7			0.9
Lark Sparrow							3.7					0.7
Ladder-Backed Woodpecker							1.4				2.2	0.7
Scissor-Tailed Flycatcher							2.7					0.5
Yellow Warbler									2.2			0.4
Killdeer									0.6	0.4	0.3	0.2
Swainson's Hawk								0.1	0.9			0.2
Great-Horned Owl								0.3				0.1
Harris' Hawk									0.2			0.0
NUMBER OF SPECIES	13	16	15	14	13	21	18	18	19	18	19	29
TOTAL DENSITY (per 40 Ha)	56.7	102.9	104.6	156.5	107.9	105.7	69.8	69.5	82.3	158.2	112.7	98.5

Blanks indicate no observations.

6.5.2 Small Nocturnal Mammal Densities

Table 6-4 presents a summary of the four years of small mammal density measurements. Average total densities for WIPP and control plots were similar for 1988 and were also similar between 1987 and 1988. Ord's kangaroo rats increased in the control plots while plain pocket mice, northern grasshopper mice, and southern plains woodrats showed declines. In the WIPP plots, population densities of Ord's kangaroo rats, plains pocket mice, northern grasshopper mice, and southern plains woodrats remained stable from 1987 to 1988. Of note is the increase in Peromyscus species (particularly white-footed mice) in the southeast WIPP plot which is continuing from 1987. Whether this is a spurious result or is indicative of a change in community structure due to the WIPP will be borne out in future sampling.

6.6 SOIL

The soil monitoring subprogram provides for the direct measurement of the concentration of selected ions at the soil surface and at two depths (30 to 45 centimeters and 60 to 75 centimeters) in the soil profile. Soil ion concentrations vary with input (deposition of windborne salts on the soil surface) and loss of the salts through leaching to the caliche layer. Surface stockpiles of salt and traffic at the partially caliche-paved facility are the sources for windblown salt in the immediate area.

Samples of surface soil are collected quarterly from the seven ecological monitoring plots and are analyzed for several soil parameters which may reflect salt-induced ecosystem impacts. The following patterns, when discerned in the analytical results, are of interest in identifying cause and effect relationships in the soil ecosystem:

- Consistent increases in concentrations of specific ions over time, indicating continual input of these ions;
- Seasonal variation in soil parameters which are consistent in all plots, delineating normal cycles of change for those parameters impacted by seasonal conditions, i.e., precipitation, wind direction, etc.;
- Identification of patterns which may indicate interactions among components of the soil ecosystem.

TABLE 6-4

DENSITIES OF SMALL NOCTURNAL MAMMALS IN CONTROL AND WIPP PLOTS OVER FOUR YEARS (IN ANIMALS PER TRAP GRID)

	CONTROL PLOTS					WIPP PLOTS				
SPECIES	1985	1986	1987	1988	AVG	1985	1986	1987	1988	AVG
Ord's Kangaroo Rat (*Dipodomys ordii*)	10	10	7	14	10	28	9	11	10	14
Plains Pocket Mouse (*Perognathus flavescens*)	51	1	9	4	16	16	1	4	3	6
Northern Grasshopper Mouse (*Onychomys leucogaster*)	5	4	3	1	3	38	2	4	2	11
Southern Plains Woodrat (*Neotoma micropus*)	1	2	3	1	2	1	1	1	1	1
White-Footed and Deer Mouse (*Peromyscus sp.*)	0	0	0	0	0	0	0	2	5	2
Hispid Cotton Rat (*Sigmodon hispidus*)	1	0	0	0	0	0	0	0	0	0

This chapter addresses the results of sampling conducted in calendar year 1988. Plot averages for each parameter measured quarterly are illustrated in Figures 6-17 through 6-23; letters denote statistically significant differences between plot means. Subsurface soils have been sampled annually, and the results of four sampling periods are presented in Section 6.6.3, Subsurface Soil.

6.6.1 Methods

The methods of sample collection and laboratory analysis have been described in previous reports (Reith et al., 1985; Fischer et al., 1985). Soil samples are analyzed for pH, electrical conductivity, and concentrations of chloride, calcium, magnesium, potassium, and sodium. Analytical results are evaluated statistically using a one-way analysis of variance (ANOVA) procedure. All data except pH values are log-normally transformed prior to analysis to allow the use of parametric statistics. When the analysis of variance indicates that a parameter varies significantly among plot means ($p<0.05$), a Student-Newman-Keuls (SNK) test is calculated to identify homogenous plots.

Control plots (CT1 and CT2) are located more than two kilometers from the facility in the directions perpendicular to the prevailing wind (NE and SW). Near-field plots (SE1, NW1, and E1) are located adjacent to the two surface salt piles. The far-field plots (SE2 and NW2) are located approximately 100 meters farther from the salt piles than the near-field plots. Therefore, when near-field or far-field plot means for a parameter do not differ significantly from one or the other control plot means, the variations measured over time are believed to reflect normal cycles of change within the system.

6.6.2 Results and Discussion

For the four sampling periods included in this report, ion concentrations in surface soils remain low. Following a pattern similar to that seen in previous years, precipitation was low during the first and fourth quarters of the year (3.51 and 0.08 centimeters, respectively), but fell at a higher rate between April and September (13.77 and 19.91 centimeters during the second and third quarters, respectively). Generally, ion concentration in the sandy soil at the WIPP is a function of precipitation as there is little clay or organic material in the soil to retain the ions. They remain in the surface soil as

Chloride

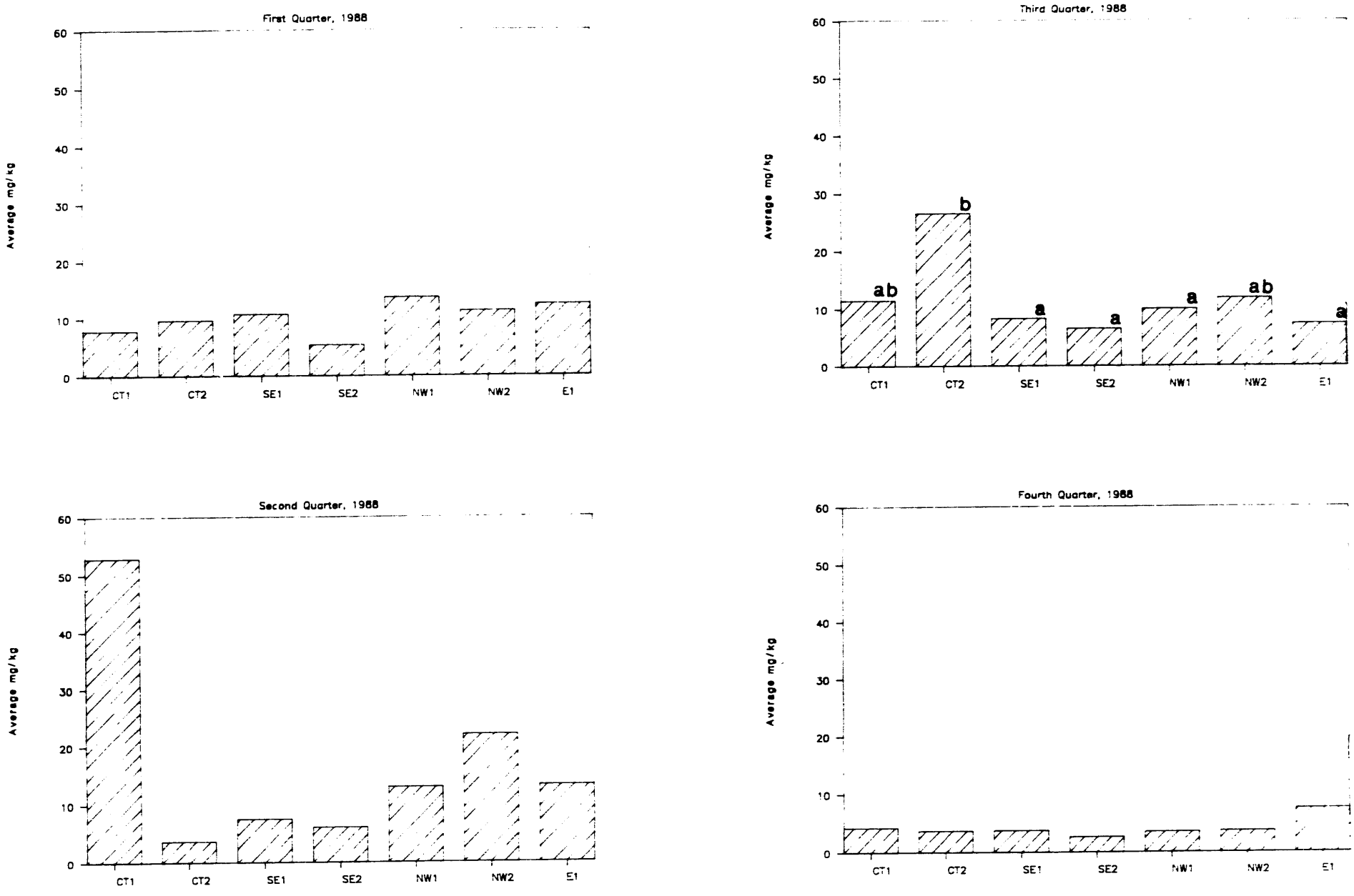

FIGURE 6-17 AVERAGE CHLORIDE CONCENTRATIONS IN THE ECOLOGICAL MONITORING PLOTS IN 1988. SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

pH

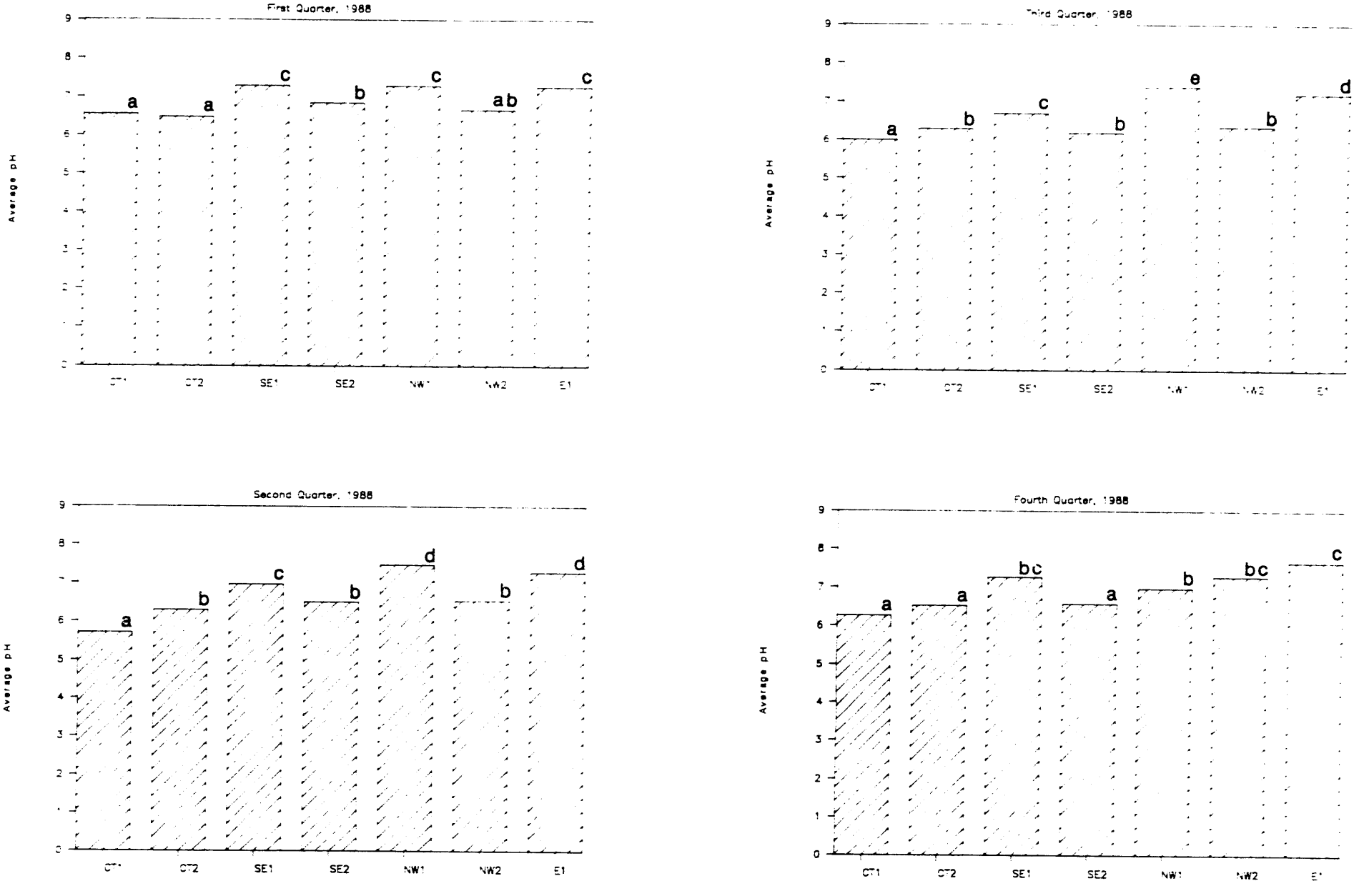

FIGURE 6-18 AVERAGE pH VALUES IN THE ECOLOGICAL MONITORING PLOTS IN 1988. SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

Electrical Conductivity

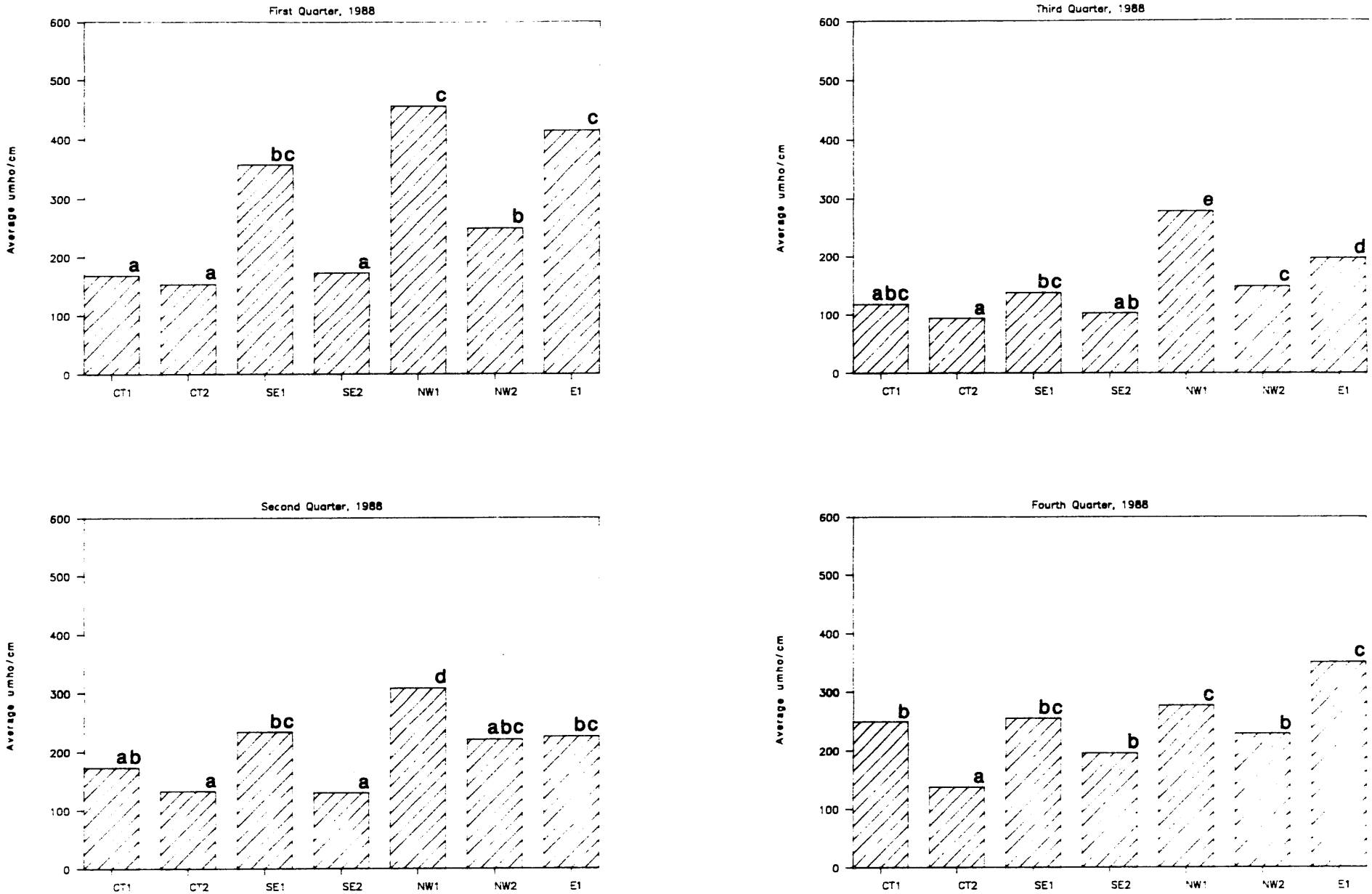

FIGURE 6-19 AVERAGE ELECTRICAL CONDUCTIVITY IN THE ECOLOGICAL MONITORING PLOTS IN 1988
SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

Calcium

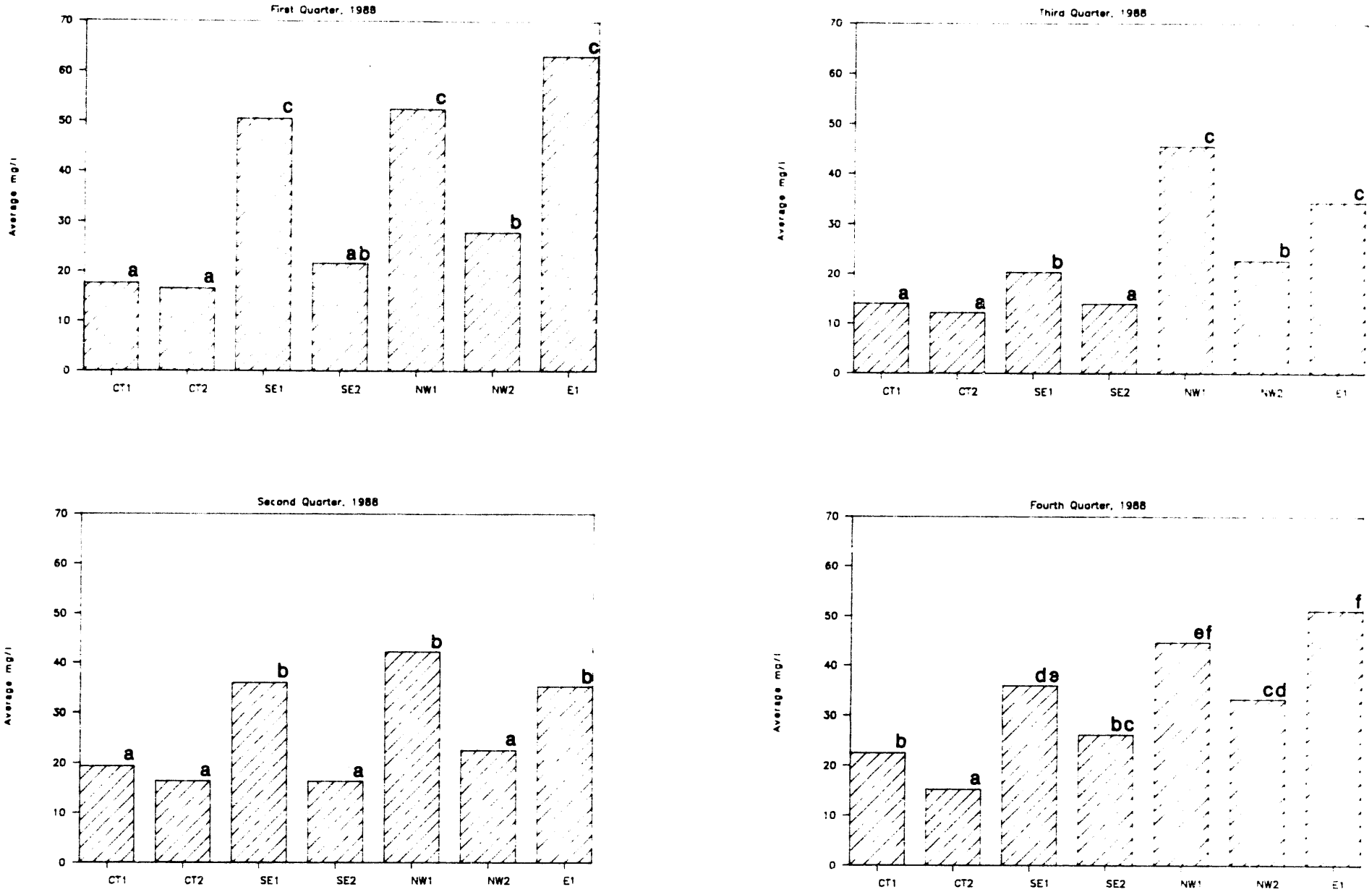

FIGURE 6-20 AVERAGE CALCIUM CONCENTRATIONS IN THE ECOLOGICAL MONITORING PLOTS IN 1988
SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

Magnesium

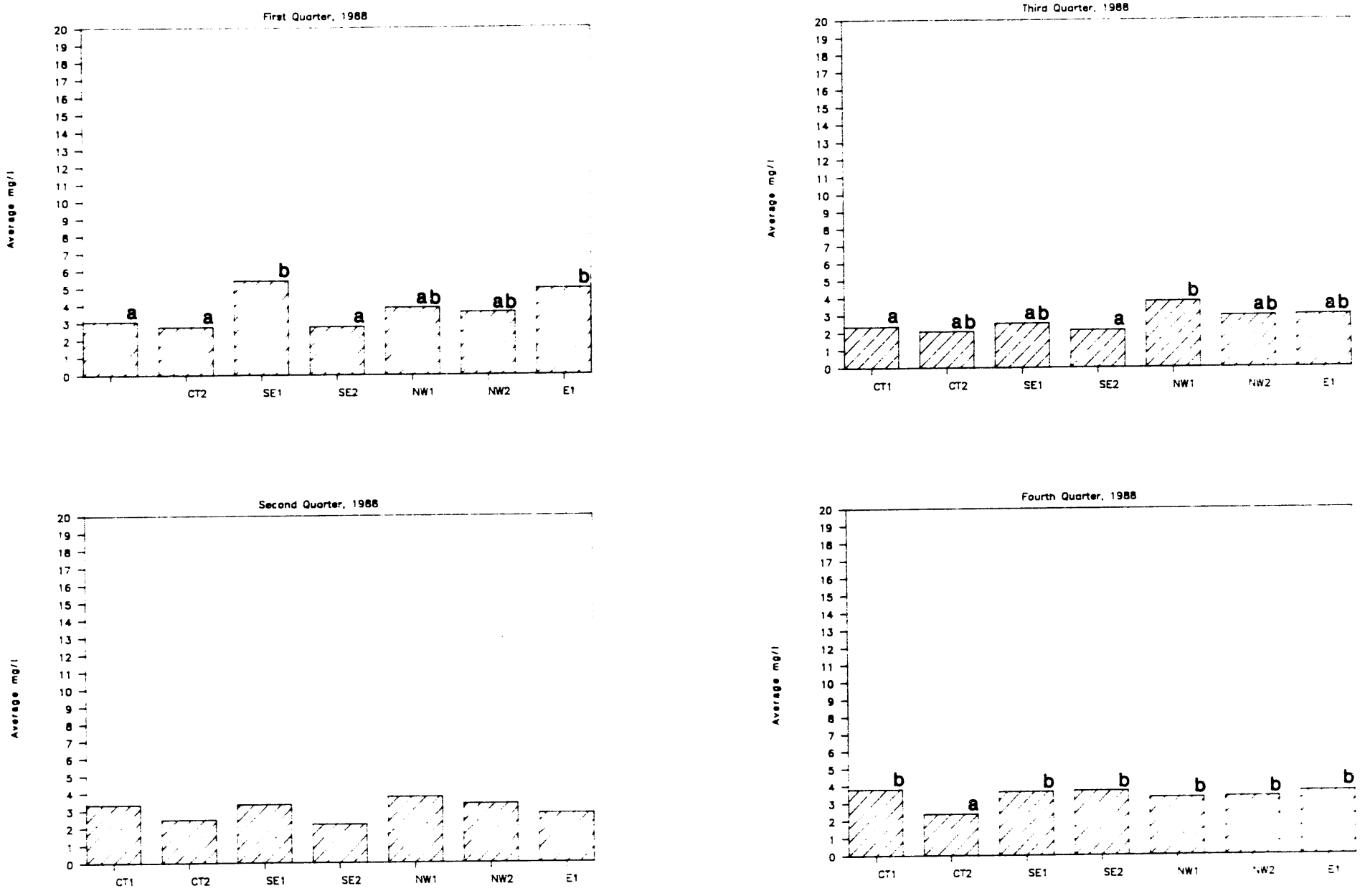

FIGURE 6-21 AVERAGE MAGNESIUM CONCENTRATIONS IN THE ECOLOGICAL MONITORING PLOTS IN 1988. SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

Potassium

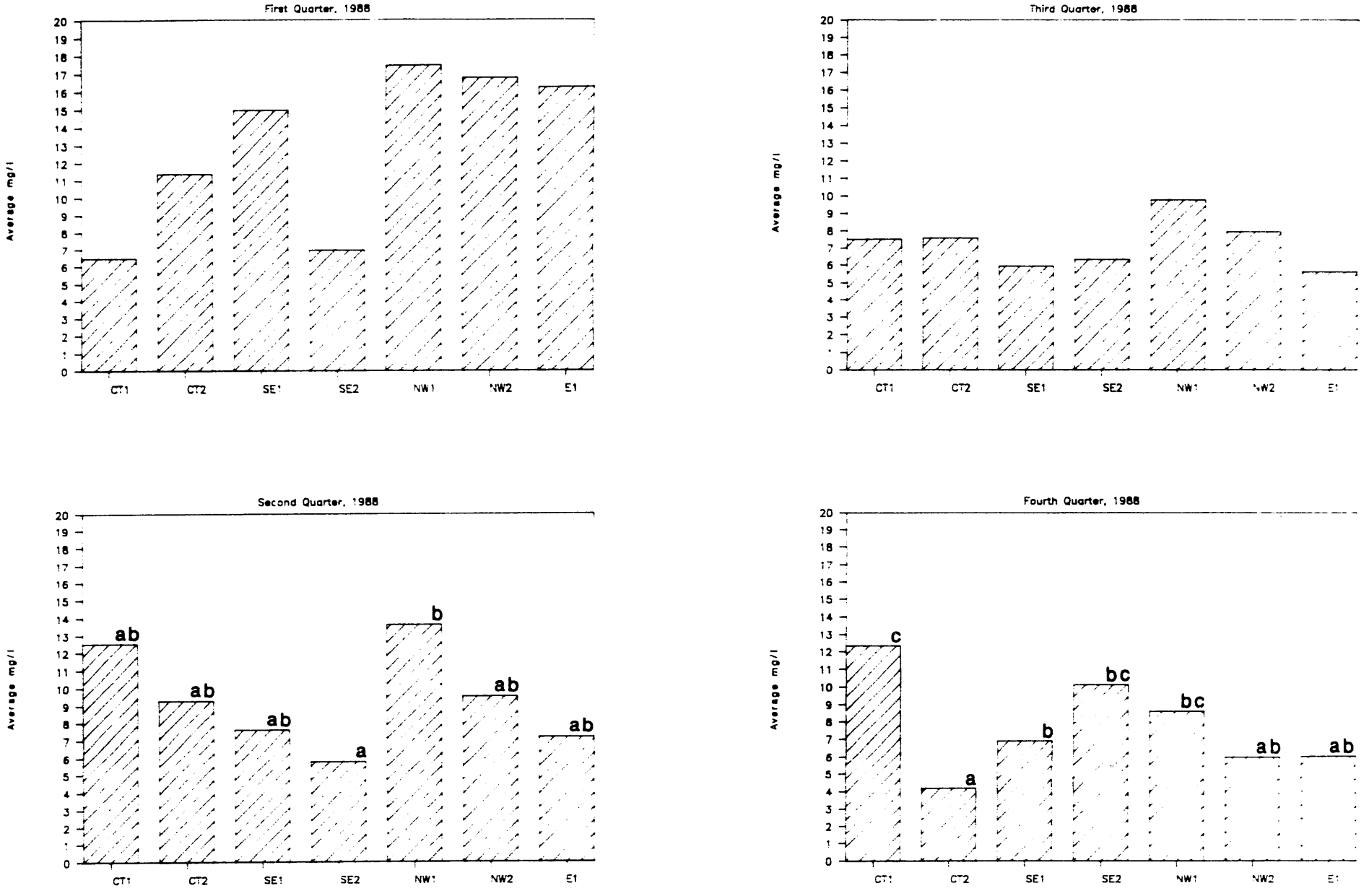

FIGURE 6-22 AVERAGE POTASSIUM CONCENTRATIONS IN THE ECOLOGICAL MONITORING PLOTS IN 1988. SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

Sodium

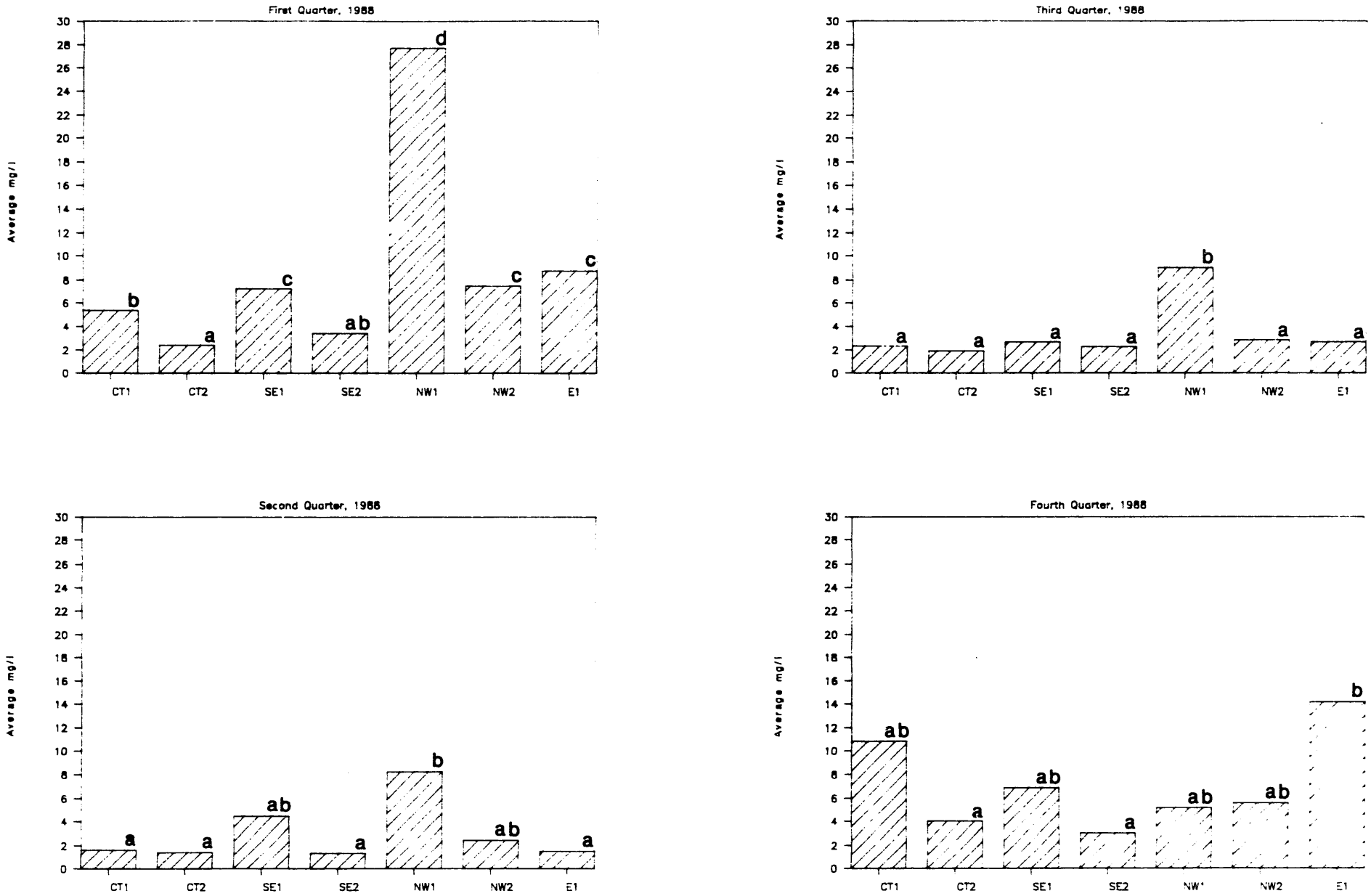

FIGURE 6-23 AVERAGE SODIUM CONCENTRATIONS IN THE ECOLOGICAL MONITORING PLOTS IN 1988. SHARED LETTERS INDICATE PLOT AVERAGES WHICH ARE STATISTICALLY EQUIVALENT.

long as it is dry, but are easily moved down through the soil profile by the percolation of precipitation. Soils are sampled annually at depth to determine whether ions accumulate at any point in the soil profile above the caliche layer.

6.6.2.1 First Quarter, 1988

Average concentrations of chloride and potassium in the near-field and far-field plots do not differ significantly from concentrations in the control plots. Average surface soil pH in the near-field plots is slightly above neutral (neutral = 7.0), but the average falls below neutral in the far-field and control plots. This pattern of relative pH values has been seen consistently in the surface soils through out the monitoring program. Electrical conductivity values are low, averaging less than one millimhos per centimeter in each plot. Plot averages do vary significantly, and soils in the near-field plots and NW2 have higher conductivities than the control plots and SE2. Calcium concentrations in the soil are low, but are higher in the near-field plots than in the far-field and control plots. Again, this pattern of calcium concentration has been documented for most quarterly sampling periods. Magnesium concentrations, though very low (less than 6 milligrams per liter) are elevated in the near-field plots. Sodium concentrations are higher in the near-field plots and in the northwest plots than in the control plots.

6.6.2.2 Second Quarter, 1988

Chloride, magnesium, and potassium concentrations do not differ significantly among plots. Again, pH values are highest in the near-field plots, plot averages range between 5.8 and 7.5. Average electrical conductivity is elevated only in NW1; plot averages are lower in the second quarter than in the first. Calcium concentrations are lower than during the first quarter but show the same relative pattern between plots. Sodium, which averages less than 10 milligrams per liter in all plots, is present in highest concentration in NW1.

6.6.2.3 Third Quarter, 1988

Average pH values range between 6.0 and 7.5, the higher values are found in the near-field plots. Soil conductivity is significantly higher in the NW1 and E1 plots than in the control plots, though conductivity values are lower

than in the second quarter. Calcium concentrations are highest in NW1 and E1, and lowest in the control plots and SE2. Magnesium concentrations, which average less than 4 milligrams per liter, are highest in the NW plots and in E1. Sodium is highest in NW1, but average concentrations are all below 10 milligrams per liter.

6.6.2.4 Fourth Quarter, 1988

Average plot pH values range from 6.3 to 7.7 and are highest in the near-field plots. Electrical conductivity values remain low in all plots but are highest in NW1 and E1. Calcium values, again, are lowest in the control plots, intermediate in the far-field plots, and highest in the near-field plots. Magnesium and sodium concentrations are all equivalent to a control plot averages, and potassium concentrations all fall between the range of control plot averages.

6.6.2.5 Conclusion

Concentration of major cations and chloride in the surface soils remained very low throughout the sampling period. The pattern continues to suggest that windborne caliche and salt are deposited on surface soils immediately adjacent to site activities. The total input of ions is very small, and they are moved down through the soil profile during the rainy period. There is no indication that salts accumulate at the soil surface in any of the monitoring plots.

6.6.3 Subsurface Soil

Intermediate and deep soils have been sampled annually in the ecological monitoring plots to monitor for the possible accumulation of deposited ions at several levels in the soil profile. Table 6-5 includes average concentrations of each parameter in the three surface, intermediate, and deep soil samples collected from each plot in the second sampling quarter. To date, results indicate that materials deposited at the soil surface are leached at least 75 cm through the soil profile. The stabilized dune sand is underlain by a caliche layer at a depth of two to four meters.

6.6.3.1 Intermediate Soil (30 to 45 Centimeters)

During the second quarter sampling period each year, three soil samples are collected 30 to 45 cm below the surface from each plot and are analyzed for

TABLE 6-5

AVERAGE PLOT CONCENTRATIONS OF SOIL PARAMETERS
SURFACE, INTERMEDIATE, AND DEEP SOILS

PARAMETER	PLOT	85	86	87	88
Chloride mg/kg	CT-S	13.8	14.4	27.3	28.3
	FF-S	13.0	10.5	29.4	14.1
	NF-S	14.1	9.7	27.9	11.3
	CT-I	12.2	6.5	25.2	15.3
	FF-I	12.7	10.0	26.7	7.3
	NF-I	14.5	5.0	29.1	10.7
	CT-D	12.8	6.9	34.5	21.3
	FF-D	11.7	6.5	30.7	11.1
	NF-D	13.7	5.5	29.7	15.8
pH	CT-S	6.7	6.6	6.4	6.0
	FF-S	7.2	6.7	6.6	6.5
	NF-S	7.3	7.5	7.4	7.2
	CT-I	6.9	7.0	7.1	6.7
	FF-I	7.2	7.3	7.2	6.7
	NF-I	7.1	7.1	7.0	6.9
	CT-D	7.1	7.0	7.3	6.5
	FF-D	7.3	7.3	7.2	6.6
	NF-D	6.6	7.2	7.0	6.8
EC µmho/cm	CT-S	274.0	191.0	183.0	153.0
	FF-S	234.0	207.0	147.0	176.0
	NF-S	292.0	300.0	246.0	255.0
	CT-I	135.0	130.0	111.0	201.0
	FF-I	272.0	141.0	130.0	145.0
	NF-I	190.0	125.0	139.0	179.0
	CT-D	285.0	127.0	135.0	171.0
	FF-D	223.0	180.0	133.0	146.0
	NF-D	175.0	152.0	122.0	165.0
Ca mg/l	CT-S	17.9	18.0	17.7	17.9
	FF-S	29.6	23.9	18.0	19.4
	NF-S	42.5	42.7	35.3	37.9
	CT-I	14.3	10.8	10.8	22.8
	FF-I	18.2	13.1	15.0	16.2
	NF-I	12.6	9.9	15.5	20.6
	CT-D	15.0	10.5	14.3	21.3
	FF-D	19.2	13.4	16.0	15.3
	NF-D	11.0	9.6	11.6	18.4

TABLE 6-5

AVERAGE PLOT CONCENTRATIONS OF SOIL PARAMETERS
SURFACE, INTERMEDIATE, AND DEEP SOILS
(CONTINUED)

PARAMETER	PLOT	85	86	87	88
Mg	CT-S	2.8	3.4	3.1	2.9
mg/l	FF-S	3.7	3.3	2.6	2.8
	NF-S	3.8	3.9	3.2	3.3
	CT-I	2.8	2.0	1.9	3.7
	FF-I	3.0	2.1	2.5	2.4
	NF-I	2.9	2.2	2.5	2.9
	CT-D	2.9	2.2	2.0	3.5
	FF-D	3.9	2.8	2.5	2.9
	NF-D	3.3	1.8	1.9	2.9
K	CT-S	5.3	6.5	7.4	10.9
mg/l	FF-S	6.6	4.8	6.8	7.7
	NF-S	9.2	4.3	6.5	9.5
	CT-I	6.5	4.5	4.0	7.1
	FF-I	6.6	3.4	5.7	7.0
	NF-I	5.8	5.4	6.7	6.7
	CT-D	6.0	5.2	3.3	6.6
	FF-D	7.4	4.2	5.3	4.8
	NF-D	6.5	3.6	5.3	8.9
Na	CT-S	24.8	7.0	2.8	1.5
mg/l	FF-S	4.0	8.3	3.1	1.9
	NF-S	11.0	7.8	2.7	4.8
	CT-I	5.9	2.2	2.5	2.6
	FF-I	8.8	3.3	2.4	2.6
	NF-I	11.9	6.0	3.4	4.5
	CT-D	36.1	2.9	2.3	2.6
	FF-D	6.3	13.2	3.5	2.3
	NF-D	13.5	13.5	5.7	4.7

Note:
S = 0-2 cm, I = 30-45 cm, D = 60-75 cm
CT = Control, FF = Farfield, NF = Nearfield

the same parameters as the surface samples. The analytical data from the plots have been combined into three data sets which represent increasing distance from the salt piles. These are the near-field plots (SE1, NW1, and E1), the far-field plots (SE2 and NW2), and the control plots (CT1 and CT2). A two-way analysis of variance was calculated for each parameter to determine differences over distance and over time (1985 through 1988 data sets). All data except pH values were lognormally transformed prior to analysis to allow the use of parametric statistics.

Chloride concentrations in the soil vary significantly over time, but not with distance from WIPP activity. Concentrations are low; the highest concentrations were measured in 1987. Chloride in deep soils (60 to 75 centimeters) follow the same pattern for the four-year period.

The pH values in soils of intermediate depth do not vary significantly with distance but do vary between years. Average values are close to neutral and are slightly lower in 1988 than during previous years.

Electrical conductivity varies widely over time, but does not vary statistically with distance from the site. Values are very low (less than one millimho per centimeter) because the relatively coarse soil structure has little clay or organic matter to absorb and retain cations. There is no indication that salts accumulate in the soil; rather, ions which accumulate are quickly flushed from this depth. Conductivity values in the deep soils mirror the pattern of intermediate soils.

Calcium varies significantly with time but not with distance. Average concentrations are very low but have risen slightly in all plots over the last three years.

In surface soils, magnesium and potassium are generally distributed as calcium is distributed over time and distance, though at somewhat lower concentrations. Magnesium, present at this depth at concentrations less than five milligrams per liter, and potassium, present at this depth at concentrations less than ten milligrams per liter, have both increased in concentration slightly over the last three years.

Sodium varies significantly with distance from the site and with time. At this depth, concentrations are slightly higher in the near-field plots than in the far-field and control plots. Concentrations in all plots have decreased since 1985.

6.6.3.2 Deep Soils (60 to 75 Centimeters)

Samples are collected at this depth at the same locations and on the same schedule as the intermediate samples. Analytical results for each annual data set have been combined into control plots, near-field plots, and far-field plots. Two-way analysis of variance was calculated for each parameter to identify significant differences over time (year) and distance from the site (control, far-field, near-field). Soil parameters are discussed separately below.

At this depth, chloride varied significantly over time but not over distance.

Average pH values at this depth ranged between 6.5 and 7.0 in 1988, but were slightly higher in 1986 and 1987. This parameter does not vary significantly with distance from the site, but does vary significantly between years.

Electrical conductivity values of soil at this depth vary widely between years and over distance, but the differences are not statistically significant. Distribution of values mirrors that seen at the intermediate soil depth.

Unlike the distribution of calcium ions seen in surface soils, calcium in deep soils is found at lower concentrations in the near-field plots than in the control or far-field plots. Although concentrations vary significantly with time and distance from the site, concentrations at this depth do not indicate any impact of WIPP activities.

Magnesium is present at very low concentrations (<five milligrams per liter), the lowest concentrations are found in the near-field plots. Concentration does not appear to be a function of WIPP activities.

Potassium concentration varies significantly over time, but not with location. Average concentrations are low (<ten milligrams per liter), but are slightly higher in 1988 than in previous years.

Sodium concentrations vary significantly over time and with distance from the site. Concentrations over the four years are higher in the near-field than in the far-field or control plots. Along with the analytical results of surface soils, these results indicate that there is input of windblown salt from the salt pile, composed primarily of sodium chloride (NaCl), to adjacent soil, but there is no indication that these salts remain in the soil profile over time.

6.6.3.3 Conclusion

There is no indication that windblown salts generated at WIPP from the salt piles or from traffic are accumulating at any level in the soil profile. Rather, salts deposited at the soil surface are flushed through the soil to the underlying caliche layer. Although intermittent clay layers have been noted in the stabilized dunes which constitute the soil at the site, there is no indication of a build-up of ions in the soil above the caliche layer. If WIPP activities contributed to a long-term accumulation of salts in the soil, there should be progressively greater concentrations of salts at sampling points progressively closer to the salt piles and the site. This has not been demonstrated.

6.7 SOIL MICROBIOTA

The soil microbial sampling subprogram is designed to monitor an important portion of the biological community which can be affected by changes in chemical properties at the soil surface. The normal cycle of microbial activity is generally influenced by climatic factors as well as the physical and chemical nature of the substrate, which in this study is plant litter. Microbial activity levels and the rate at which the surface litter is decomposed by the microbial community in the control plots are compared to those in the near-field and far-field plots to detect any effect of salt deposition on these biologic processes.

6.7.1 Methods

A litter sample is composed of two nylon mesh bags wired together, each containing ten grams of oven-dried oak leaves (Quercus havardii) which are collected soon after leaf fall. In February, 12 sample bags of litter are placed within each of the ecological monitoring plots. The location of each bag within a plot is determined by random selection of a direction and two distance coordinates. Wire is used to secure each litter sample to an oak stem. Each bag is positioned on the soil surface. Three samples are collected from each plot quarterly. The preparation and placement of litter samples has been described in previous reports (Fischer et al., 1985; Reith et al., 1985).

The following parameters are measured for each litter sample collected: (1) the level of microbial activity, and (2) the rate at which organic matter is lost from litter via decomposition. Microbial activity levels are measured indirectly using the fluorescein diacetate hydrolysis assay (FDA) method described by Schnurer and Rosswall (1982). The assayed enzymes are produced in small quantities in dormant organisms and spores relative to the quantity produced by active colonies. Therefore, the optical density of a sample (OD), which is a measure of the amount of breakdown product produced from a known quantity of chemical substrate (fluorescein diacetate), is proportional to total microbial activity in the sample. The optical density value also correlates well with total microbial respiration in the sample. Activity levels measured at a given time are affected by the immediate chemical and physical conditions in the environment, i.e., moisture, temperature, and nutrient availability.

The rate at which plant litter is broken down by microbial action is another indirect measure of a biotic soil process. The amount of organic matter lost from the litter over time is determined using the ashing techniques described by Santos et al. (1984). Decomposition rates reflect, to a greater degree than activity levels, the long-term impacts of the physical and chemical environment.

Results of the FDA assay are analyzed using a one-way analysis of variance (ANOVA). To determine decomposition rates, an arcsine transformation is

applied to percentage decomposition for each sample prior to analysis by one-way ANOVA. When analysis of variance of either data set indicates that statistically significant differences exist between plot means, a Student-Newman-Keuls test is performed to identify homogenous means.

6.7.2 Results and Discussion

Results of the FDA hydrolysis assay for four sampling quarters are included in this report. Decomposition data for two of the four sampling quarters are reported here; the third and fourth quarter decomposition data for 1988 will be included in the next Annual Site Environmental Report.

6.7.2.1 Microbial Activity Levels

Results of the quarterly FDA hydrolysis assay are given in Table 6-6. Average optical density values for the first quarter are relatively low, and the only plot which differs significantly from the controls is SE1, which shows higher microbial activity than the other plots. In general, activity levels are higher in the southeast and east plots than in the northwest and control plots. There is no consistent difference between activity levels in the near-field and far-field plots.

Activity levels in the second and third quarters of the year are approximately two to three times higher than those measured for the first quarter samples. Plot averages during the second quarter do not differ significantly from controls. During the third quarter, microbial activity levels are higher in the near-field and far-field plots than in the controls.

Activity levels during the fourth quarter are higher than those reported for the first three quarters. Again, activity levels are higher in the near and far-field plots than in the controls, although the differences are not statistically significant. In general, there has been no indication over the four years of microbial monitoring that the deposition of salt on the soil surface inhibits the microbial community on surface litter.

6.7.2.2 Microbial Decomposition

Microbial decomposition percentages were were calculated for first and second quarter litter samples, and results are presented in Table 6-7. Third and

TABLE 6-6

AVERAGE OPTICAL DENSITY (MICROBIAL ACTIVITY LEVEL) BY PLOT
1988

QUARTER	CT1	CT2	SE1	SE2	NW1	NW2	E1
1st Quarter	0.088	0.033	0.163	0.096	0.077	0.084	0.139
2nd Quarter	0.242	0.233	0.234	0.227	0.293	0.273	0.266
3rd Quarter	0.236	0.191	0.232	0.250	0.236	0.246	0.286
4th Quarter	0.293	0.311	0.337	0.322	0.370	0.361	0.337

TABLE 6-7

PERCENTAGE MICROBIAL DECOMPOSITION BY PLOT
FIRST AND SECOND QUARTERS OF 1988

FIRST QUARTER, 1988

	CT1	CT2	SE1	SE2	NW1	NW2	E1
A	6.0	6.4	10.2	1.1	9.6	8.8	9.5
B	2.1	3.5	8.2	4.9	2.0	8.4	30.1
C	3.0	5.1	7.6	11.7	2.3	10.6	5.4
$\bar{x}$(1)	3.7	5.0	8.7	5.9	4.6	9.2	15.0
SD(2)	2.0	1.5	1.4	5.4	4.3	1.2	13.2
SE(3)	1.2	0.8	0.8	3.1	2.5	0.7	7.6

SECOND QUARTER, 1988

	CT1	CT2	SE1	SE2	NW1	NW2	E1
A	6.9	7.6	13.4	14.5	15.7	21.2	17.1
B	13.1	9.0	5.9	13.7	16.1	17.3	17.8
C	13.0	9.7	22.4	12.3	15.2	16.1	24.2
$\bar{x}$	11.0	8.8	13.9	13.5	15.7	18.2	19.7
SD	3.6	1.1	8.3	1.1	0.5	2.7	3.9
SE	2.1	0.6	4.8	0.6	0.3	1.5	2.3

(1) Average
(2) Standard Deviation
(3) Standard Error

fourth quarter samples were also collected in 1988, but were not processed as the required laboratory equipment was not available. These samples will be processed in 1989, and results will be presented in the next annual report.

There is no significant difference between average rates of decomposition in the ecological monitoring plots during the first sampling quarter. During the second quarter, rates are elevated in E1. Following patterns seen in previous years, decomposition tends to occur at a slightly higher rate in the near- and far-field plots than in the control plots. There is no indication that microbial activity is inhibited by proximity to the salt storage piles at WIPP.

6.8 VEGETATION MONITORING

The vegetation in each of the seven Ecological Monitoring Plots was measured in June and again in September to assess the effect of proximity to the salt storage piles on plant community structure. Foliar coverage of each species, density of annual species, and species richness are measured using the method described in Fischer (1988). In addition to these parameters, the frequency of each species was also calculated. Frequency was defined as the proportion (as percent) of quadrats containing each species. Summaries of the data for the spring and fall sampling times are presented in Table 6-8 and 6-9, respectively.

6.8.1 Spring 1988

The spring data reflect the relatively poor growing conditions experienced in the Los Medaños area during that season. In particular, the densities of annuals were low compared to 1985 and 1987 data. Annual densities were generally only slightly greater than those measured in the spring of 1986, which was also a period of poor growing conditions. In the spring of 1988 there were 5.4 individuals per square meter observed compared to 2.8 individuals per square meter in the spring of 1986. In comparing the results from 1988, the near-field, far-field and control plots, shrub and perennial forb cover are slightly higher in the near-field plots than the control plots; however, annual forbs and all grasses decrease with proximity to the salt piles. This decrease, particularly in the perennial grasses, results in an overall reduction of total vegetation cover and annual density in the test plots relative to the control plots.

TABLE 6-8

SUMMARY OF VEGETATION DATA FROM SPRING 1988 SAMPLING

SPECIES	CONTROL PLOTS COV[1]	CONTROL PLOTS FREQ[2]	CONTROL PLOTS DENS[3]	FAR FIELD PLOTS COV	FAR FIELD PLOTS FREQ	FAR FIELD PLOTS DENS	NEAR FIELD PLOTS COV	NEAR FIELD PLOTS FREQ	NEAR FIELD PLOTS DENS
SHRUBS									
Shinnery Oak	15.6	75	--[4]	15.4	95	--	17.3	85	--
Sand Sage	1.1	33	--	3.5	58	--	3.3	65	--
Yucca	1.2	13	--	1.0	10	--	0.3	10	--
Croton	0.3	10	--	0.0	5	--	0.1	7	--
Halfleaf Sundrops	0.1	10	--	0.1	3	--	0.1	7	--
Smallhead Snakeweed	0.5	8	--	0.0	0	--	0.0	2	--
Western Soapberry	0.1	3	--	0.0	0	--	0.0	0	--
Hartweg Primrose	0.0	0	--	0.0	0	--	0.0	2	--
Honey Mesquite	5.4	10	--	1.5	5	--	3.0	7	--
PERENNIAL FORBS									
Leaf-Flower	0.1	23	--	0.1	38	--	0.2	27	--
Longlobed Groundsel	0.1	15	--	0.1	10	--	0.2	17	--
Woolly Dalea	0.1	10	--	0.2	10	--	0.1	8	--
Smooth Oxybaphus	0.0	8	--	0.0	3	--	0.0	3	--
Hog Potato	0.0	0	--	0.1	3	--	0.0	3	--
Spiny Yellow Aster	0.1	5	--	0.0	0	--	0.0	2	--
Plains Blackfoot	0.0	3	--	0.0	0	--	0.2	2	--
Cotta	0.1	3	--	0.0	0	--	0.0	2	--
Milkweed	0.0	0	--	0.0	5	--	0.0	0	--
Sensitive Briar	0.0	0	--	0.0	0	--	0.0	2	--
Fendler Beardtongue	0.0	0	--	0.0	0	--	0.0	2	--
Flatsedge	0.0	3	--	0.0	0	--	0.0	0	--
Gaura	0.0	0	--	0.0	3	--	0.0	0	--
Whitemouth Dayflower	0.0	0	--	0.0	0	--	0.0	2	--
Climbing Milkweed	0.0	0	--	0.0	0	--	0.0	2	--
Elegant Nightshade	0.0	3	--	0.0	0	--	0.0	0	--

TABLE 6-8

SUMMARY OF VEGETATION DATA FROM SPRING 1988 SAMPLING
(CONTINUED)

SPECIES	CONTROL PLOTS COV	CONTROL PLOTS FREQ	CONTROL PLOTS DENS	FAR FIELD PLOTS COV	FAR FIELD PLOTS FREQ	FAR FIELD PLOTS DENS	NEAR FIELD PLOTS COV	NEAR FIELD PLOTS FREQ	NEAR FIELD PLOTS DENS
ANNUAL FORBS									
Lace Spurge	0.1	43	0.93	0.1	28	0.60	0.1	42	0.73
Telegraph Plant	0.1	28	0.90	0.0	8	0.08	0.0	7	0.07
Prairie Sunflower	0.1	23	0.70	0.0	13	0.23	0.0	7	0.08
Palafoxia	0.0	15	0.50	0.0	5	0.05	0.0	8	0.08
Annual Buckwheat	0.0	20	0.20	0.0	3	0.00	0.0	3	0.03
Spotted Horsemint	0.0	15	0.18	0.0	5	0.08	0.0	2	0.02
Fetid Marigold	0.0	3	0.03	0.0	3	0.08	0.0	7	0.50
Bluets	0.0	15	0.23	0.0	0	0.00	0.0	0	0.00
White Ragweed	0.1	10	0.05	0.0	3	0.03	0.0	0	0.00
Bindweed Heliotrope	0.0	3	0.03	0.0	8	0.08	0.0	2	0.02
Broomrape	0.0	0	0.00	0.0	0	0.00	0.0	3	0.03
Pigweed	0.2	3	0.40	0.0	0	0.00	0.0	0	0.00
Unknown	0.0	0	0.00	0.0	0	0.00	0.0	2	0.02
PERENNIAL GRASSES									
Three-awn	3.7	75	--	1.7	68	--	1.6	43	--
Fall Witchgrass	2.3	28	--	1.5	58	--	0.4	22	--
Sandbur	0.5	23	--	0.7	45	--	0.2	17	--
Sand Dropseed	0.1	23	--	0.1	25	--	0.1	23	--
Spike Dropseed	0.4	30	--	0.2	20	--	0.1	13	--
Knotgrass	0.4	8	--	0.0	5	--	0.2	8	--
Plains Bristlegrass	0.1	8	--	0.0	3	--	0.1	3	--
Sandhill Grass	0.0	3	--	0.0	3	--	0.0	0	--
Black Grama	0.1	5	--	0.0	0	--	0.0	0	--
Hairy Grama	0.1	3	--	0.0	0	--	0.0	0	--
Big Bluestem	0.0	3	--	0.0	0	--	0.0	0	--

TABLE 6-8

SUMMARY OF VEGETATION DATA FROM SPRING 1988 SAMPLING
(CONTINUED)

SPECIES	CONTROL PLOTS COV	CONTROL PLOTS FREQ	CONTROL PLOTS DENS	FAR FIELD PLOTS COV	FAR FIELD PLOTS FREQ	FAR FIELD PLOTS DENS	NEAR FIELD PLOTS COV	NEAR FIELD PLOTS FREQ	NEAR FIELD PLOTS DENS
ANNUAL GRASSES									
Purple Sandgrass	0.1	38	2.93	0.0	18	0.70	0.0	20	0.43
False Buffalograss	0.0	20	1.03	0.0	18	0.35	0.0	15	0.25
Fluffgrass	0.0	3	0.10	0.0	0	0.00	0.0	3	0.12

	SUMMARY								
CLASS	COV	DENS	No. SPP	COV	DENS	No. SPP	COV	DENS	No. SPP
Shrubs	18.7	--	8	20.1	--	6	21.2	--	8
Perennial Forb	0.5	--	9	0.4	--	7	0.8	--	12
Annual Forb	0.6	4.13	11	0.2	1.20	9	0.2	1.58	9
Perennial Grass	7.6	--	12	4.1	--	9	2.6	--	8
Annual Grass	0.2	4.05	3	0.1	1.05	2	0.0	0.80	3
TOTALS	27.5	8.18	42	24.9	2.25	33	24.8	2.38	40

(1) Cover in percent.
(2) Frequency in percent.
(3) Density in plants per square meter.
(4) Indicates data was not collected.

TABLE 6-9

SUMMARY OF VEGETATION DATA FROM FALL 1988 SAMPLING

SPECIES	CONTROL PLOTS COV[1]	FREQ[2]	DENS[3]	FAR FIELD PLOTS COV	FREQ	DENS	NEAR FIELD PLOTS COV	FREQ	DENS
SHRUBS									
Shinnery Oak	23.3	85	--[4]	17.7	98	--	13.5	88	--
Sand Sage	0.7	25	--	3.4	53	--	8.1	72	--
Yucca	2.1	13	--	1.0	13	--	1.8	20	--
Croton	0.7	18	--	0.0	0	--	0.4	8	--
Smallhead Snakeweed	0.5	5	--	0.2	3	--	0.1	7	--
Halfleaf Sundrops	0.0	0	--	0.1	5	--	0.1	3	--
Southwest Rabbitbrush	0.0	0	--	0.0	0	--	0.0	3	--
Prickly Pear	0.0	0	--	0.0	0	--	0.0	2	--
Honey Mesquite	2.6	10	--	1.8	5	--	0.9	5	--
PERENNIAL FORBS									
Leaf-Flower	0.1	15	--	0.4	50	--	0.2	28	--
Longlobed Groundsel	0.6	20	--	0.3	18	--	0.1	12	--
Woolly Dalea	0.4	15	--	0.2	5	--	0.2	8	--
Smooth Oxybaphus	0.1	8	--	0.0	5	--	0.0	3	--
Hog Potato	0.0	0	--	0.0	3	--	0.1	7	--
Cotta	0.4	5	--	0.0	3	--	0.0	2	--
Flatsedge	0.0	0	--	0.0	3	--	0.1	5	--
Spiny Yellow Aster	0.2	3	--	0.0	0	--	0.0	2	--
Sensitive Briar	0.0	0	--	0.1	3	--	0.0	2	--
Elegant Nightshade	0.0	0	--	0.0	0	--	0.0	3	--
Prairie Stickleaf	0.0	0	--	0.0	3	--	0.0	0	--
Plains Blackfoot	0.0	3	--	0.0	0	--	0.0	0	--
Fendler Beardtongue	0.0	0	--	0.0	0	--	0.0	2	--
Milkweed	0.0	0	--	0.0	0	--	0.0	2	--

TABLE 6-9

SUMMARY OF VEGETATION DATA FROM FALL 1988 SAMPLING
(CONTINUED)

	CONTROL PLOTS			FAR FIELD PLOTS			NEAR FIELD PLOTS		
SPECIES	COV	FREQ	DENS	COV	FREQ	DENS	COV	FREQ	DENS
ANNUAL FORBS									
Lace Spurge	0.7	35	0.45	1.1	40	0.38	0.3	28	0.33
Prairie Sunflower	1.5	40	0.65	0.1	8	0.05	0.3	13	0.15
Palafoxia	0.6	20	0.38	0.1	13	0.13	0.3	10	0.18
Telegraph Plant	0.3	23	0.23	0.3	15	0.23	0.0	3	0.02
Annual Buckwheat	0.1	18	0.33	0.0	10	0.10	0.0	3	0.03
White Ragweed	0.1	10	0.10	0.0	3	0.00	0.0	3	0.02
Gaura	0.0	0	0.00	0.0	0	0.00	0.1	5	0.03
Texas Croton	0.0	3	0.03	0.0	3	0.03	0.0	0	0.00
Russian Thistle	0.0	0	0.00	0.0	0	0.00	0.0	3	0.03
Fetid Marigold	0.0	0	0.00	0.0	0	0.00	0.0	3	0.02
Spotted Horsemint	0.0	3	0.03	0.0	0	0.00	0.0	0	0.00
PERENNIAL GRASSES									
Three-Awn	4.5	83	--	1.6	55	--	1.7	48	--
Sand Dropseed	0.8	50	--	0.6	53	--	1.0	43	--
Sandbur	1.8	50	--	1.9	45	--	1.9	35	--
Fall Witchgrass	1.2	43	--	3.7	48	--	2.0	32	--
Knotgrass	0.8	23	--	0.3	13	--	0.2	10	--
Spike Dropseed	0.1	8	--	0.6	28	--	0.2	10	--
Sandhill Grass	0.8	10	--	0.0	0	--	0.2	3	--
Mexican Lovegrass	0.2	3	--	0.0	3	--	0.0	3	--
Hairy Grama	0.1	5	--	0.0	0	--	0.1	3	--
Black Grama	0.1	5	--	0.0	3	--	0.0	0	--
Lovegrass	0.1	5	--	0.0	0	--	0.0	0	--
Plains Bristlegrass	0.0	3	--	0.0	0	--	0.0	0	--
Intermediate Lovegrass	0.0	0	--	0.0	0	--	0.0	2	--

TABLE 6-9

SUMMARY OF VEGETATION DATA FROM FALL 1988 SAMPLING
(CONTINUED)

SPECIES	CONTROL PLOTS COV	CONTROL PLOTS FREQ	CONTROL PLOTS DENS	FAR FIELD PLOTS COV	FAR FIELD PLOTS FREQ	FAR FIELD PLOTS DENS	NEAR FIELD PLOTS COV	NEAR FIELD PLOTS FREQ	NEAR FIELD PLOTS DENS
ANNUAL GRASSES									
Purple Sandgrass	1.3	38	2.08	1.1	63	1.43	1.0	32	0.92
False Buffalograss	1.0	38	1.23	0.6	45	0.88	0.6	33	0.80

	SUMMARY								
CLASS	COV	DENS	No. SPP	COV	DENS	No. SPP	COV	DENS	No. SPP
Shrubs	27.3	--	6	22.3	--	6	24.1	--	9
Perennial Forb	1.8	--	7	1.0	--	9	0.7	--	12
Annual Forb	3.4	2.18	8	1.7	0.90	7	1.1	0.82	9
Perennial Grass	10.6	--	12	8.7	--	8	7.5	--	10
Annual Grass	2.3	3.30	2	1.7	2.30	2	1.6	1.72	2
TOTALS	45.3	5.48	35	35.5	3.20	32	34.9	2.53	42

(1) Cover in percent
(2) Frequency in percent
(3) Density in plants per square meter
(4) Indicates data not collected

6.8.2 Fall 1988

In the fall sampling data, the coverages of five classes of plants generally increase after spring, while the densities of annual forbs decreased. Of significance in this data set is that all five classes of plants exhibited greater coverage in the control plots and the densities of both annual forbs and annual grasses were greater in the control plots than in the test plots, with values decreasing with proximity to the salt piles.

Although the 1988 vegetation results do not represent a significant change in plant community cover near the salt piles, they do represent the first observation of the type of pattern which would indicate an impact on the surrounding ecosystem by the surface storage of salt. This pattern may have been magnified by the drought conditions experienced during the year which would have resulted in less leaching and less dilution of soil salts. Future monitoring will aid in clarifying the significance of these results.

7.0 GROUNDWATER PROTECTION

The groundwater protection program at the WIPP began with the initiation of the Water Quality Sampling Program in January 1985. The goals of the program, which continued throughout the pre-operational phase of the WIPP, are to collect reproducible and representative groundwater samples from water-bearing zones in the WIPP vicinity. The "WIPP Water Quality Sampling Manual" (WP 07-2) of the Geotechnical and Geosciences Procedure Manual is the governing document for the program. This manual details the wells to be sampled, the sampling schedule, and the analyses required by the program. Procedures detailing sample collection techniques and methods for field analyses are also included in this Manual.

The water quality data obtained by the WQSP supports four major programs at the WIPP: site characterization, performance assessment (in compliance with 40 CFR 191), the Radiological Baseline Program, and the Ecological Monitoring Program. In addition, the State of New Mexico Environmental Evaluation Group is provided with water samples from each sampling location for independent analysis. Each of these programs requires a unique set of analyses and data, but overlap of analytical needs does occur. The particular set of water sample analyses which support a given program are defined by that program and not the WQSP. Groundwater quality data collected for the Radiological Baseline and Ecological Monitoring Programs forms pre-operational radiological and nonradiological water quality baselines against which future data may be compared and any impacts assessed. As the WIPP completes its pre-operational phase, the emphasis of the groundwater protection program will shift from the establishment of baseline conditions to a monitoring role. Operational groundwater monitoring activities are defined by the Operational Environmental Monitoring Plan for the Waste Isolation Pilot Plant (DOE, 1989).

7.1 HYDROGEOLOGIC SETTING

The WIPP is located within the Pecos Valley section of the Southern Great Plains physiographic province (Powers et al., 1978). Geologically, the WIPP is located in the northern portion of the Delaware Basin, the westernmost basin of the sedimentary basins collectively known as the Permian Basin.

The northern Delaware Basin is bounded by the Capitan Limestone, a Permian Age reef which is the only major source of potable groundwater in the basin. Interior to the basin, eight rock units make up the stratigraphic column important to the hydrology at the WIPP. In ascending order, these units are the Delaware Mountain Group (consists of the Brushy Canyon, Cherry Canyon, and Bell Canyon Formations), the Castile Formation, the Salado Formation, the Rustler Formation, the Dewey Lake Red Beds, and the Triassic Dockum Group.

The formations which produce sufficient water for sampling at some locations and that are of interest to the WQSP include, in descending order, the Dockum Group, the Dewey Lake Red Beds, the Magenta Dolomite, and the Culebra Dolomite. Fluids from these formations have been collected by the WQSP during the pre-operational phase at the WIPP, either from WQSP monitoring wells or privately owned wells. A brief description of these geological formations and their hydrology follows.

The Dockum Group is present east of the WIPP and consists of a fine- to coarse-grained sandstone with interbeds of siltstone and mudstone. Thickness of the formation varies up to 54 meters (176 feet). Where it is present, the Dockum Group overlies the Dewey Lake Red Beds, is itself overlain by surface deposits or unsaturated Dockum Group sediments, and contains water under water table to confined conditions. Two privately-owned wells believed to be completed in the Dockum Group were sampled during 1987 and 1988. These wells provide water for livestock.

The Dewey Lake Red Beds is composed of alternating thin, even beds of siltstone and mudstone with lenticular interbeds of fine-grained sandstone. Exploratory drilling did not identify a continuous zone of saturation within the Dewey Lake Red Beds; however, localized permeable zones were detected. A few private wells yield water from the Dewey Lake Red Beds and those wells are thought to be completed in the thin lenticular sands where local groundwater recharge occurs (Mercer, 1983). Several private wells producing from the Dewey Lake Red Beds were sampled in 1987 and 1988. Most of the private wells completed in the Dewey Lake Red Beds provide water for livestock; and one location, Barn Well, is used for human consumption.

The Rustler Formation underlies the Dewey Lake Red Beds and consists of interbedded anhydrite, gypsum, halite, polyhalite, dolomite, and limestone. The Rustler Formation is divided into five lithologic units. These units are, in descending order, the Forty-niner Member, the Magenta Dolomite, the Tamarisk Member, the Culebra Dolomite, and an unnamed lower member consisting of reddish-brown siltstone interbedded with gypsum or anhydrite, and halite. The Forty-niner and Tamarisk Members are primarily anhydrite and include some halite and potash minerals. Where dissolution has occurred, the anhydrite has altered to gypsum and halite salts are absent. The Magenta and Culebra Dolomites are areally extensive and are the significant water-bearing units in the WIPP vicinity. The majority of the WQSP water samples were collected from the Culebra Dolomite during the pre-operational phase at the WIPP.

The Magenta Dolomite is the uppermost significant water-producing horizon in the Rustler Formation, and consists of a clastic carbonate bed with thin laminae of anhydrite. The unit ranges in thickness from 6 to 9 meters (20 to 30 feet) in the WIPP vicinity. Water under confined conditions has been sampled from four wells completed in the Magenta Dolomite. Local utilization of water from the Magenta Dolomite is unknown.

The majority of the waters sampled by the WQSP are from the Culebra Dolomite of the Rustler Formation. The Culebra Dolomite is the first continuous water-bearing unit above the Salado Formation (waste facility horizon) and is the most transmissive hydrologic unit in the WIPP area. In the WIPP vicinity, the Culebra Dolomite ranges from 7.6 to 9 meters (25 to 30 feet) in thickness and is a vuggy, finely crystalline dolomite. The formation contains water of variable density ranging from brackish to brine, under confined conditions. Hydrologic testing has shown the Culebra Dolomite to be a heterogeneous, fractured unit with transmissivities varying locally from 7×10^{-2} to greater than 200 feet^2 per day (Mercer, 1983). The greater transmissivity values in the Culebra have been reported from well locations south and west of the WIPP. In this area the Culebra fluids exhibit relatively low concentrations of total dissolved solids. Wells south of the WIPP site which are completed in the Culebra are used by local ranchers for watering livestock. In areas lying east of the WIPP, transmissivities in the Culebra are quite low and fluid samples show high concentrations of total dissolved solids. Based on

actual formation pressure measurements (Crawley, 1988), estimated regional groundwater flow directions near the site are towards the south and southeast. However, since the water flow in the Culebra Dolomite is affected by fractures, variable fluid densities, and heterogeneity of the rock, the regional flow directions may have little if any relationship to localized flow paths.

7.2 GROUNDWATER MONITORING PROGRAM

Twenty-three wells have been sampled at least once for water quality parameters during the pre-operational period at the WIPP. Additional wells have been sampled occasionally upon request of various WIPP programs. Three rounds of pre-operational sampling on the 23 wells were completed in early 1989.

This report presents water quality data collected during calendar year 1988 from 18 designated WIPP facility monitoring wells and 10 privately-owned wells in the area. Water samples were also collected from within the fourth shaft (Air Intake Shaft) during construction activities. Table 5-9 lists pertinent information regarding the monitoring wells sampled, sampling zone, dates pumped, and types of samples collected during 1988. Table 5-10 details information concerning the private well samplings. Figure 5-13 locates the wells sampled in the WIPP vicinity during 1988.

Comparative radiological data for these wells can be found in several reports, Reith et al. (1986), Banz et al. (1987), Flynn (1988), and in Section 5.0 of this report. Comparative nonradiological water quality data from previous samplings of these wells can be found in Uhland and Randall (1986), Uhland et al. (1987), Randall et al. (1988), and Lyon (1989).

The WQSP water sampling protocol is defined by the "WIPP Water Quality Sampling Manual" (WP 07-2) of the Geotechnical and Geosciences Procedure Manual. The sampling procedure consists of two types of sampling, serial sampling and final sampling. Serial sampling is the sequential sampling and field analysis of representative water quality parameters while the well is being continuously pumped. Serial sampling is performed to ascertain when steady-state conditions of water quality parameters are reached. Ideally, serial sampling leads to the collection of water samples which represent the

actual undisturbed formation water at a particular location. In practice, serial sampling leads to the collection of water samples with reproducible chemistries allowing for alterations to the local groundwater by factors associated with the physical well installation and operation of the downhole pumping and sampling system. Serial sample parameters are generally monitored daily in a mobile field laboratory which is transported to the well head during pumping operations. The parameters most useful in identifying a steady-state condition of the water chemistry include determinations for chloride, divalent cations (hardness), and alkalinity, which are analyzed by titration. Also useful are determinations for total and ferrous iron content which are made by spectrophotometric comparisons with a standard concentrations curve. Other serial sampling parameters analyzed in the field include pH, Eh, temperature, specific conductance, and specific gravity. When field analyses of the serial sampling parameters indicates that steady-state conditions exist, final samples are collected and forwarded to the contracted analytical laboratories for analysis.

Split samples from each well are provided to the State of New Mexico Environmental Evaluation Group (EEG) for independent analysis. Results from radiological analyses for samples collected in 1988 are reported in Section 5.0 of this report. Additional radiological data from groundwater samples collected prior to 1988 which have not previously been published can be found in Appendix A. Nonradiological water quality serial and final sampling analyses results are reported in the Annual Water Quality Data Report for the Waste Isolation Pilot Plant (Lyon, 1989).

Tables 7-1 and 7-2 summarize the nonradiological groundwater quality analyses performed by the ITAS laboratory on WIPP vicinity groundwaters in 1988. Table 7-1 lists the nonradiological, inorganic parameters which were analyzed, and by aquifer shows the number of analyses (wells sampled), n; the number of analytical results less than a limit of the detection, n < LD; the minimum value reported, and the maximum value reported. WQSP monitoring wells, additionally sampled wells, samples from the Air Intake Shaft, and privately owned or operated wells and windmills are included in the tabulation. There are wide ranges of values for most parameters within the individual aquifers as indicated by Table 7-1. For example, of the 20 chloride determinations

TABLE 7-1

SUMMARY OF ITAS LABORATORY INORGANIC GROUND WATER
PARAMETERS - WIPP SITE VICINITY
ALL WELL SAMPLINGS - 1988[a]

PARAMETER	CULEBRA DOLOMITE				MAGENTA DOLOMITE				DEWEY LAKE REDBEDS				DOCKUM GROUP			
	n	n<LD	Min	Max	n	n<LD	Min	Max	n	n<LD	Min	Max	n	n<LD	Min	Max
Alkalinity (HCO_3)	20	0	32[b]	140	4	0	52	74								
Bromide	20	5	LD 2	99	4	1	LD 2	7								
Chloride	20	0	31	135,000	4	0	390	7600	5	0	33	440	2	0	27	50
Cyanide	16	16	LD 0.07[c]	LD 0.02	4	4	LD 0.01	LD 0.02								
Fluoride	20	0	0.2	3.1	4	0	2.0	3.1	5	0	0.7	2.6	2	0	1.5	2.3
Iodide	20	20	LD 2.0	LD 2.0	4	4	LD 2.0	LD 2.0								
Nitrate (NO_3-N)	20	8	LD 0.02	4.4	4	3	LD 0.02	0.02	9	9	1.4	110.0	2	0	5.8	8.4
pH	20	NA	6.47[d]	7.94	4	NA	7.19	7.84	5	NA	6.97	7.69	2	NA	7.26	7.61
Phenolics	18	7	LD 0.005	0.165	4	3	LD 0.005	0.01								
Phosphate, Total (PO_4-P)	20	7	LD 0.01	0.04	4	1	LD 0.01	0.02								
Filterable Residue @ 180 C	20	0	2100	246,000	4	0	4800	23,500	5	0	390	3300	2	0	340	780
Nonfilterable Residue @ 105 C	20	5	LD 4	930	4	1	LD 4	50								
Specific Conductance	20	NA	2450[e]	410,000	4	NA	3860	30,400								
Sulfate	20	0	1300	7500	4	0	2600	8300	5	0	55	1900	2	0	66	310
Total Organic Carbon	20	11	LD 1.0	7.0	4	3	LD 1.0	1.0								
Total Organic Halogen	19	9	LD 0.05	8.2	3	2	LD 0.05	0.18								
Aluminum	20	17	LD 0.1	7.0	4	3	LD 1.0	1.0								
Antimony	20	9	LD 0.2	7.0	4	3	LD 0.5	0.6								
Arsenic	20	18	LD 0.005	0.005	4	4	LD 0.005	LD 0.05	5	3	LD 0.005	0.006	2	2	LD 0.005	0.005

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TABLE 7-1

SUMMARY OF ITAS LABORATORY INORGANIC GROUND WATER
PARAMETERS - WIPP SITE VICINITY
ALL WELL SAMPLINGS - 1988[a]
(CONTINUED)

PARAMETER	CULEBRA DOLOMITE				MAGENTA DOLOMITE				DEWEY LAKE REDBEDS				DOCKUM GROUP			
	n	n<LD	Min	Max	n	n<LD	Min	Max	n	n<LD	Min	Max	n	n<LD	Min	Max
Barium	20	15	0.011	0.09	4	4	LD 0.01	LD 0.05	5	0	0.007	0.13	2	0	0.013	0.058
Beryllium	20	18	LD 0.005	0.5	4	4	LD 0.05	LD 0.05								
Boron	20	0	0.34	50	4	0	2.4	12.0								
Cadmium	20	16	LD 0.001	0.07	4	4	LD 0.05	LD 0.05	5	5	LD 0.001	LD 0.005	2	2	LD 0.005	LD 0.005
Calcium	20	0	450	3400	4	0	560	640								
Cesium	20	14	LD 0.01	0.4	4	4	LD 0.01	LD 0.06								
Chromium	20	9	LD 0.005	3.0	4	3	LD 0.1	0.2	5	3	LD 0.005	0.04	2	2	LD 0.01	LD 0.01
Cobalt	20	15	LD 0.007	1.0	4	3	LD 0.1	0.1								
Copper	20	11	LD 0.01	2.0	4	4	LD 0.1	LD 0.1	5	2	LD 0.01	0.11	2	2	LD 0.01	LD 0.01
Iron	20	4	LD 0.01	3.0	4	0	0.2	1.0	5	3	LD 0.01	0.08	2	1	LD 0.01	LD 0.02
Lead	20	17	LD 0.005	7.0	4	2	0.18	0.6	5	5	LD 0.005	LD 0.05	2	2	LD 0.05	LD 0.05
Lithium	20	0	0.08	10	4	0	0.22	0.39								
Magnesium	20	0	81	2700	4	0	170	430								
Mercury	20	15	LD 0.0002	0.0015	4	2	LD 0.0002	0.0008	5	3	LD 0.0002	0.0024	2	2	LD 0.0002	LD 0.0002
Molybdenum	20	8	0.008	10	4	1	0.05	0.09								
Nickel	20	16	LD 0.01	0.4	4	4	LD 0.3	LD 0.3								
Potassium	20	0	3.7	1800	4	0	18	99								
Selenium	20	16	LD 0.005	0.022	4	4	LD 0.05	LD 0.5	5	1	LD 0.005	0.055	2	1	LD 0.005	0.065
Silica	20	3	LD 0.4	20	4	0	4.0	5.4								

TABLE 7-1

SUMMARY OF ITAS LABORATORY INORGANIC GROUND WATER
PARAMETERS - WIPP SITE VICINITY
ALL WELL SAMPLINGS - 1988[a]
(CONTINUED)

PARAMETER	CULEBRA DOLOMITE				MAGENTA DOLOMITE				DEWEY LAKE REDBEDS				DOCKUM GROUP			
	n	n<LD	Min	Max	n	n<LD	Min	Max	n	n<LD	Min	Max	n	n<LD	Min	Max
Silver	20	15	LD 0.01	1.0	4	2	0.02	0.2	5	5	LD 0.005	LD 0.01	2	2	LD 0.01	LD 0.01
Sodium	20	0	55	78,900	4	0	640	7100								
Strontium	20	0	4.1	55	4	0	9.4	13								
Thallium	20	20	LD 0.005	LD 5.0	4	4	LD 0.005	LD 5.0								
Titanium	20	10	LD 0.007	0.8	4	2	LD 0.1	0.4								
Vanadium	20	7	0.2	1.0	4	3	LD 0.01	0.2								
Zinc	20	11	LD 0.01	3.0	4	3	LD 0.01	0.1	5	0	0.02	0.31	2	0	0.22	0.44

Abbreviations:

n - Number of analysis values
LD - Limit of Detection
n<LD - Number of analysis values less than a Limit of Detection
Min - Minimum reported value or limit of detection
Max - Maximum reported value or limit of detection
NA - Not Applicable

Notes:

(a) Included WQSP monitoring wells, additional well samplings, samples from the Air Intake Shaft, and privately owned/operated wells and windmills.
(b) Min-Max values in mg/l units unless noted otherwise.
(c) Limit of detection is variable for individual samples within any parameter. Min-Max may reflect the minimum or maximum detection limit reported in 1988.
(d) Min-Max in standard pH units.
(e) Min-Max in µmhos/cm @ 25 °C.

TABLE 7-2

ORGANIC PARAMETERS REPORTED GREATER THAN LIMIT OF DETECTION-
WIPP SITE VICINITY - ALL WELL SAMPLINGS - 1988

WELL	PARAMETER	DATE	ZONE	ROUND	VALUE	VALUE DUPLICATE	BLANK	UNITS
WIPP-19	Acetone	02/12/88	Culebra	2	18.0	NA	LD 10	µg/l
WIPP-19	Acetone	08/29/88	Culebra	3	45.0	33.0	LD 10	µg/l
USGS-1	Chloroform	07/07/88	Culebra	2	1.3	NA	LD 1.0	µg/l
H-12	Methylene Chloride	12/14/88	Culebra	3	5.6	5.3	LD 10	µg/l
H-18	Methylene Chloride	04/07/88	Culebra	2	5.5	NA	5.7	µg/l
H-12	Bis(2-Ethylhexyl)Phathalate	12/14/88	Culebra	3	16.0	NA	NA	µg/l
H-15	Bis(2-Ethylhexyl)Phathalate	01/13/88	Culebra	2	22.0	NA	NA	µg/l
H-15	Bis(2-Ethylhexyl)Phthalate	11/07/88	Culebra	3	44.0	NA	NA	µg/l
WIPP-26	Bis(2-Ethylhexyl)Phthalate	04/14/88	Culebra	3	14.0	NA	NA	µg/l

NA - Not Applicable or Not Analyzed
LD - Limit of Detection

performed for individual well-water samples from the Culebra Dolomite, the minimum value was 31 mg/l and the maximum value was reported at 135,000 mg/l. The corresponding range for dissolved solids (Filterable Residue @ 180 C), 2,100 to 246,000 mg/l, results in variable limits of detection for individual wells and parameters. Consequently, the 'Minimum' column may indicate the lowest reported limit of detection for a parameter when values were reported above and below a detection limit. The 'Maximum' column may indicate the greatest reported limit of detection when all analyses for a particular parameter were reported below a detection limit. There are no constant nor absolute detection limits for any parameter. Rather, the parameter detection limits vary from sample (well) to sample (well) depending upon the dissolved solids content of that sample and the amount of dilution required to facilitate analysis.

Table 7-2 lists the few organic parameters exceeding detection limits for all wells final-sampled by the WQSP in 1988. These parameters include acetone, methylene chloride, chloroform, and BIS (2-Ethylhexyl) Phthalate. All are common laboratory contaminants, either due to their volatilities and use as solvents in the laboratory, or in the case of the phthalates, are leachable components of plastics. In the vast majority of analyses, most organic parameters are reported below detection limits by the ITAS laboratory.

8.0 QUALITY ASSURANCE

Quality Assurance (QA) is composed of all planned and systematic actions (programmed events) undertaken to assure that the results of a monitoring program are valid. QA includes quality control (QC), which is task-specific and which provides a context for assessing the performance of equipment, instruments, and procedures. The QA/QC program for the WIPP environmental programs is established within the framework of the overall Quality Program Manual of the Westinghouse Electric Corporation (WEC, 1986).

A comprehensive QA program has been implemented to assure that the data collected are representative of actual concentrations in the environment. The focus of this program is as follows:

- Extensive environmental data are obtained prior to commencement of operations in order to provide a sound baseline data for comparison with potential impacts of WIPP;
- Samples at all locations are collected according to procedures based on accepted practices, and widely recognized methodologies and criteria;
- Procedures are reviewed and revised, as appropriate, to minimize uncertainty due to sampling error while maintaining comparability and continuity between past and future data; and
- The quality of the data is verifiable by a continuing program of analytical laboratory quality control, including participation in inter-laboratory cross-checks, duplicate sample analysis, and from sample splits provided to the New Mexico EEG for analysis.

8.1 BASELINE DATA

The purpose of the Ecological Monitoring Program for nonradiological environmental surveillance, the Radiological Baseline Program for radiological environmental surveillance, the Salt Impacts Studies, the Cooperative Raptor Research Program, and the Water Quality Sampling Program is to collect baseline data needed to detect and quantify any impacts that construction and operational activities at the WIPP site may have on the surrounding ecosystem. A data base spanning many years before the WIPP project accepts waste for storage can provide evidence of location-specific or cyclic anomolies in the test results.

The following early studies are also important when considering WIPP environmental monitoring efforts since they contribute to the baseline data useful during the construction phase and because they were the predecessor monitoring programs to the current sampling procedures:

- The WIPP Site Characterization Program was instituted in 1976 by Sandia National Laboratories to monitor air quality, background radiation levels, and groundwater quality (Pocalujka et al., 1979, 1980a, b, c, 1981a, b; Powers et al., 1978).
- WIPP Biology Program began in 1975 with baseline studies of climate, soils, vegetation, arthropods, and vertebrates (Best, 1980).
- At the request of DOE, the U.S. Geological Survey conducted investigations of the geohydrology of the site. In addition, the NRC issued a contract to Columbia University to perform a study of radionuclide mobility in the highly saline groundwaters of the Delaware Basin (U.S. Geological Survey, 1983).
- Radiological monitoring of air, water, and biological media was conducted by the Atomic Energy Commission before and after the Project Gnome nuclear detonation (USAEC, 1962a,b,c,d).

8.2 SAMPLE COLLECTION METHODOLOGIES

Sampling procedures are contained and/or described in the following documents:

- WIPP Environmental Procedures Manual (WP-02-03)
- Water Quality Sampling Plan (Colton and Morse, 1985)
- Geotechnical and Geosciences Procedure Manual (WP 07-2)
- Ecological Monitoring Program Semiannual Report (Reith et al., 1985)
- Radiation Safety Manual (WP 12-5), and
- Management and Operating Contractor - WIPP Quality Program Manual (WEC, 1986).

The sampling procedures cover collection and handling procedures, and packaging and shipping of the samples to the laboratory. This includes determination of sampling locations, timing of collection, calibration of equipment, and discrete steps taken to collect the sample, prepare it for analysis or shipment, and the shipment method itself. The Operational Environmental Monitoring Plan (DOE, 1989) provides details on the sampling procedures and which document contains those procedures. The plan also defines the policies

and practices that are applied to provide confidence in the quality of the data generated.

Written procedures provide guidance to field personnel for every sample taken and form the basis of an auditable program. The WEC Quality Assurance Department, Carlsbad, New Mexico, periodically conducts field audits to assure compliance with established collection and handling procedures. Results of each audit are kept on file at WIPP. Westinghouse conducted several audits in 1988, and identified problems were resolved by correcting the sampling techniques of the field personnel or formally refining the sampling procedure.

The sampling procedures also provide protocol for data entry and record-keeping. Standard sample location codes are used for reporting results. Sample splits with the EEG offer another option for detecting sampling or handling problems.

8.3 REVISION OF PROCEDURES

Part of the purpose of a baseline data collection program is to assess the performance of collection and analysis methodologies. The data collected in the baseline environmental monitoring program are statistically analyzed each year. The goal of the statistical analyses is to provide an objective and reliable means for interpreting data in relation to the stated objectives of the data collection program. The WIPP pre-operational data will be compared against a fixed standard and against data collected when WIPP becomes operational. The basic requirements for data analysis are stated in DOE guidance DOE/EH-0023 (Corley et al., 1981) and DOE/EH-XXX (DOE, 1987). Section 8.0 of the Operational Environmental Monitoring Plan (DOE, 1989) discusses in length the procedures used to analyze the data, and by implication, alter procedures if necessary.

In addition, sample collection field procedures, preparation for analysis, and the laboratory analysis methodology itself are continually scrutinized for adequacy. As mentioned above, split samples with EEG could act as a double check that procedures are adequate.

8.4 LABORATORY QUALITY CONTROL

The WIPP has contract analytical support for the Environmental Monitoring Programs and pre-operational monitoring efforts from Waltz Mill Westinghouse Advanced Energy Systems Division (WAESD), Eberline Analytical Corporation, the University of New Mexico, and International Technology Corporation laboratories in Export, Pennsylvania, and in Cerritos, California:

1. Routine calibration of counting instruments
2. Frequent source and background counts (as appropriate)
3. Routine yield determinations of radiochemical procedures
4. Replicate/duplicate analyses to check precision, and
5. Analyses of reagents to ensure chemical purity that could affect the results of the analytical process.

Each laboratory utilized standard analysis methods for the parameter being studied. These methods are listed in detail in the Operational Environmental Monitoring Plan (DOE, 1989).

Participation in inter-laboratory cross-checks can sometimes reveal standardized, previously acceptable lab procedures that are unsuitable or inadequate, and steps are taken to find a better methodology. The three laboratories providing chemical analytical services for the WIPP participated in inter-laboratory cross-checks conducted by the Environmental Protection Agency. The Cerritos laboratory participated in EPA's Water Pollution Performance Evaluation Study 20 with the following results for 1988: 8% of samples were unacceptable, 8% of samples were questionable (a problem may exist), and 84% were acceptable (EPA, 1988d). The Export Laboratory participated in four quarterly Organic Performance Evaluations by EPA utilizing soil matrices and water matrices. One quarter's results were acceptable (EPA, 1988e), one quarter's results were unacceptable (EPA, 1988a), and two quarter's results were acceptable, but required further action by the Laboratory (EPA, 1988b and EPA, 1988c). The WAESD laboratory participated in several intercomparison studies using water matrices (Table 8-1) with the following results: while 61% of the 13 parameters being tested were within the acceptable range for every sampling period, 85% of the total samples taken (several samples being submitted for each parameter) were within the acceptable range (EPA, 1988f). Table 8-2 contains the nominal lower detection limits for radionuclides.

TABLE 8-1

WALTZ MILL INTERLABORATORY COMPARISON PROGRAM RESULTS FOR 1988

ANALYSIS	MONTH	KNOWN VALUE	Control Limits FROM	Control Limits TO	LAB MEASURED
		(μCi/ml)			
Co-60	Feb.	6.90E-08	6.03E-08	7.77E-08	6.90E-08
	April	50.00E-09	41.34E-09	58.66E-09	46.00E-09
	June	1.50E-08	6.34E-09	2.37E-08	1.50E-08
	Oct.	2.50E-08	1.63E-08	3.37E-08	2.30E-08
Cr-51	June	3.02E-07	2.50E-07	3.54E-07	3.20E-07
	Oct.	2.51E-07	2.08E-07	3.94E-07	2.38E-07
Ca-134	Feb.	6.40E-08	5.53E-08	7.27E-08	6.03E-08
	April	7.00E-09	0.00	15.66E-09	6.67E-09
	June	2.00E-08	1.13E-08	2.87E-08	1.87E-08
	Oct.	2.50E-08	1.63E-08	3.37E-08	2.23E-08
Ca-137	Feb.	9.40E-08	8.53E-08	1.03E-07	1.60E-07
	April	8.00E-09	0.00	15.66E-09	7.00E-09
	June	2.50E-08	1.63E-08	3.37E-08	2.63E-08
	Oct.	1.50E-08	6.34E-09	2.37E-08	1.60E-08
Ru-106	Feb.	1.05E-07	8.68E-08	1.23E-07	8.87E-08
	June	1.95E-07	1.60E-07	2.30E-07	1.90E-07
	Oct.	1.52E-07	1.26E-07	1.78E-07	1.19E-07
Zn-65	Feb.	9.40E-08	7.77E-08	1.10E-07	1.06E-07
	June	1.01E-07	8.37E-08	1.18E-07	1.18E-07
	Oct.	1.51E-07	1.25E-07	1.77E-07	1.63E-07
Ra-226	March	7.60E-09	5.63E-09	9.57E-09	4.37E-09
	April	6.40E-09	4.74E-09	8.06E-09	5.73E-09
	June	10.00E-09	7.38E-09	12.62E-09	7.03E-09
Ra-228	March	7.70E-09	5.69E-09	9.71E-09	7.73E-09
	April	5.60E-09	4.15E-09	7.05E-09	7.63E-09
	June	12.40E-09	9.18E-09	15.62E-09	11.43E-09
Sr-89	Jan.	30.00E-09	21.34E-09	38.66E-09	26.67E-09
	April	5.00E-09	0.00	13.66E-09	5.67E-09
	May	20.00E-09	11.34E-09	28.66E-09	27.33E-09
Sr-90	Jan.	15.00E-09	12.40E-09	17.60E-09	14.88E-09
	April	5.00E-09	2.40E-09	7.60E-09	5.00E-09
	May	20.00E-09	17.40E-09	22.60E-09	17.67E-09
Tritium	Feb.	33.27E-11	27.00E-11	39.54E-11	30.82E-11
	June	55.65E-11	46.00E-11	65.30E-11	46.28E-11
	Oct.	23.16E-11	17.10E-11	29.22E-11	20.01E-11

TABLE 8-1

WALTZ MILL INTERLABORATORY COMPARISON PROGRAM RESULTS FOR 1988
(CONTINUED)

ANALYSIS	MONTH	KNOWN VALUE	Control Limits FROM	Control Limits TO	LAB MEASURED
		(μCi/ml)			
Alpha	March	6.00E-09	0.00	14.66E-09	3.00E-09
	April	46.00E-09	26.95E-09	65.05E-09	68.33E-09
	July	15.00E-09	6.34E-09	23.66E-09	9.67E-09
Beta	March	13.00E-09	4.34E-09	21.66E-09	11.33E-09
	April	57.00E-09	48.34E-09	65.66E-09	56.33E-09
	July	4.00E-09	0.00	12.66E-09	5.00E-09
U(Nat)	April	6.00E-09	0.00	16.39E-09	6.00E-09

TABLE 8-2

NOMINAL LOWER DETECTION LIMITS FOR RADIONUCLIDES(1)

	47 MM FILTER (E-09µCi/ composite)	WATER (pCi/L) (E-09µCi/ml)	SOIL AND SEDIMENT (pCi/gram) (E-06µCi/gram)	TISSUE AND VEGETATION (pCi/gram) (E-06µCi/gram)
H-3	---(2)	150	---	---
Be-7	---	---	---	---
K-40	---	---	---	---
Co-60	3	8	0.1	0.5
Sr-90	30	20	2	2
Cs-137	2	5	0.1	0.2
Pb-210	20	---	---	---
Ra-226	5	15	0.2	1
Ra-228	---	---	---	---
Th-228	3	10	0.1	0.4
Th-230	2	1	0.1	0.1
Th-232	2	1	0.1	0.1
U-233	1	1	0.1	0.1
U-234	1	1	0.1	0.1
U-235	---	---	---	---
U-238	1	1	0.1	0.1
Np-237	2	1	0.1	0.1
Pu-238	4	0.4	0.4	0.4
Pu-239/240	2	2	0.2	0.2
Pu-241	100	100	10	10
Am-241	1	1	0.1	0.1
Cm-244	1	1	0.1	0.1
Gross Alpha	0.6(3)	6	---	---
Gross Beta	1.4(3)	14	---	---

(1) Limits set by Waltz Mill WAESD Analytical Laboratory
(2) Not Established
(3) E-09 µCi/ml

There is no cross-check procedure currently available for the soil microbiota analyses conducted at the University of New Mexico in Albuquerque since the process is unique. Inter-laboratory comparison of the accuracy of thermoluminescent dosimeters used for environmental monitoring is provided by Eberline Analytical Corporation's quarterly participation in an intercomparison program conducted through Battelle's Pacific Northwest Laboratory in Richland, Washington and its annual participation in the International Intercomparisons of Environmental Dosimeters Program (conducted through the DOE's Radiological and Environmental Sciences Laboratory at Idaho Falls and Environmental Measurements Laboratory in New York, and supported in part by the Nuclear Regulatory Commission.)

8.5 RECORD-KEEPING

Consistent record-keeping of all aspects of the Environmental Monitoring Programs are a part of Quality Assurance requirements. Section 10.0 of the Operational Environmental Monitoring Plan (DOE, 1989) includes a listing of the required records and reports, and the laws, regulations or DOE Orders that contain the requirements.

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APPENDIX A

Pre-1988 RBP Data

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TABLE A-1

RADIONUCLIDE CONCENTRATIONS IN QUARTERLY COMPOSITES
FOURTH QUARTER 1987[1]
(μCi/ml)

LOCATION CODE	Be-7 (E-14)	K-40 (E-15)	Co-60	Sr-90	Cs-137	Pb-210 (E-15)
EUN	16 (.80)	LD[2]	LD	LD	LD	25 (9.0)
CBD	16 (.77)	LD	LD	LD	LD	30 (9.2)
WEE	17 (.96)	8.5 (5.2)	LD	LD	LD	37 (13)
WNW	15 (.81)	LD	LD	LD	LD	29 (8.5)
WSS	15 (.78)	6.6 (3.8)	LD	LD	LD	30 (9.8)
WFF	16 (.82)	4.8 (4.3)	LD	LD	LD	40 (9.6)
MLR	13 (.76)	6.9 (4.3)	LD	LD	LD	27 (8.7)
SMR	15 (.81)	4.9 (3.9)	LD	LD	LD	40 (9.1)

LOCATION CODE	Ra-226	Ra-228	Th-228	U-233	U-234 (E-17)	U-235
EUN	LD	LD	LD	LD	LD	LD
CBD	LD	LD	LD	LD	7.1 (5.1)	LD
WEE	LD	LD	LD	LD	10 (9.7)	LD
WNW	LD	LD	LD	LD	12 (8.4)	LD
WSS	LD	LD	LD	LD	LD	LD
WFF	LD	LD	LD	LD	LD	LD
MLR	LD	LD	LD	LD	9.6 (5.7)	LD
SMR	LD	LD	LD	LD	LD	LD

LOCATION CODE	U-238 (E-17)	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-244
EUN	7.5 (5.3)	LD	LD	LD	LD	LD
CBD	6.6 (4.0)	LD	LD	LD	LD	LD
WEE	11 (8.3)	LD	LD	LD	LD	LD
WNW	7.0 (5.3)	LD	LD	LD	LD	LD
WSS	LD	LD	LD	LD	LD	LD
WFF	LD	LD	LD	LD	LD	LD
MLR	6.0 (3.8)	LD	LD	LD	LD	LD
SMR	10 (5.8)	LD	LD	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parentheses is two standard deviations.
[2] Less Than Detectable (Refer to Table B-2)

TABLE A-2

RADIONUCLIDE CONCENTRATIONS IN 1985 SOIL SAMPLES
SURFACE COLLECTION[1]
(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-08)	Ra-226 (E-08)	Ra-228 (E-08)	Th-228 (E-08)	Th-230 (E-08)	Th-232 (E-08)	U-233
R01	57 (7.6)	LD	LD	LD	26 (11)	LD	19 (7.7)	27 (7.0)	27 (6.4)	LD
R02	32 (5.6)	LD	LD	4.8 (3.3)	15 (4.1)	16 (5.0)	14 (0.5)	---	---	LD
R03	41 (7.0)	LD	LD	9.4 (4.2)	24 (1.3)	16 (8.0)	13.(3.2)	---	---	LD
R04	41 (6.8)	LD	LD	LD	26 (13)	26 (10)	20 (7.5)	---	---	LD
R05	71 (6.6)	LD	LD	21 (3.9)	26 (12)	29 (17)	28 (1.7)	14 (13)	20 (13)	LD
R06	38 (7.3)	LD	LD	5.8 (3.9)	19 (9.2)	26 (17)	15 (8.2)	---	---	LD
R07	36 (6.2)	52 (36)	LD	6.7 (4.3)	21 (4.6)	20 (2.2)	13 (7.2)	---	---	LD
R08	41 (6.9)	LD	LD	8.0 (4.4)	25 (9.7)	LD	15 (10)	---	---	LD
R09	42 (8.1)	LD	LD	LD	21 (10)	35 (18)	15 (11)	---	---	LD
R10	50 (6.8)	LD	LD	6.3 (4.4)	27 (1.0)	28 (7.3)	22 (0.7)	---	---	LD
R11	130 (12)	LD	LD	98 (7.5)	65 (16)	68 (38)	61 (0.9)	---	---	LD
R12	84 (8.2)	LD	LD	25 (5.7)	53 (7.3)	50 (24)	38 (1.9)	---	---	LD
R13	48 (7.6)	LD	LD	19 (5.0)	31 (8.6)	LD	17 (4.0)	49 (10)	50 (9.9)	LD
R14	59 (7.0)	LD	LD	23 (3.8)	29 (6.2)	29 (17)	22 (0.2)	---	---	LD
R15	46 (5.5)	LD	LD	7.6 (3.8)	20 (7.5)	23 (16)	21 (6.9)	45 (10)	36 (8.5)	LD
R16	46 (8.7)	LD	LD	8.8 (7.1)	31 (2.8)	LD	20 (6.0)	---	---	LD
WNE	41 (10)	LD	LD	33 (7.9)	49 (7.3)	51 (24)	40 (0.1)	---	---	LD
WNN	58 (7.7)	LD	LD	22 (5.1)	26 (4.3)	22 (20)	18 (5.4)	---	---	LD
WNW	39 (7.3)	LD	LD	LD	16 (4.1)	27 (16)	11 (1.6)	---	---	LD
WSE	60 (7.3)	LD	LD	12 (4.1)	30 (6.2)	36 (12)	18 (15)	---	---	LD
WSS	50 (6.4)	LD	LD	14 (4.4)	24 (4.7)	27 (16)	16 (3.1)	---	---	LD
WSW	51 (7.4)	LD	LD	LD	29 (3.7)	29 (22)	15 (4.2)	---	---	LD
WWW	68 (10)	LD	LD	16 (7.0)	29 (10)	LD	24 (9.0)	---	---	LD
WEE	59 (11)	LD	LD	19 (7.0)	25 (13)	LD	21 (5.7)	---	---	LD
DRR	70 (7.9)	LD	LD	25 (5.9)	34 (9.6)	37 (22)	36 (4.4)	37 (8.5)	30 (7.2)	LD
GNO	60 (6.9)	LD	LD	18 (4.7)	25 (7.8)	34 (25)	21 (.61)	---	---	LD
HHW	79 (9.9)	LD	LD	36 (8.8)	48 (16)	47 (30)	41 (13)	---	---	LD
MNT	150 (14)	LD	LD	70 (8.4)	130 (29)	110 (7.7)	98 (.29)	21 (9.8)	22 (8.8)	LD

TABLE A-2

RADIONUCLIDE CONCENTRATIONS IN 1985 SOIL SAMPLES
SURFACE COLLECTION[1]

(μCi/g)
(CONTINUED)

LOCATION CODE	U-234 (E-08)	U-235 (E-09)	U-238 (E-08)	Np-237	Pu-238	Pu-239/240	Pu-241 (E-06)	Am-241 (E-08)	Cm-244
R01	20 (5.4)	LD	19 (5.0)	LD	LD	LD	5.3 (3.3)	---	---
R02	LD	LD	21 (14)	---	19 (6.4)	LD	22 (6.8)	9.5 (5.8)	LD
R03	9.2 (7.7)	LD	15 (8.3)	---	30 (8.3)	LD	20 (8.1)	LD	LD
R04	8.2 (5.0)	LD	8.2 (4.2)	---	29 (9.1)	LD	14 (7.8)	7.0 (6.0)	LD
R05	23 (5.5)	LD	19 (4.7)	LD	LD	LD	3.4 (3.2)	---	---
R06	9.8 (5.6)	LD	7.7 (4.2)	---	25 (8.2)	LD	19 (8.2)	LD	LD
R07	7.5 (4.9)	LD	10 (4.7)	---	26 (8.9)	LD	13 (10)	LD	LD
R08	12 (5.6)	LD	13 (4.7)	---	31 (8.9)	LD	LD	LD	LD
R09	14 (6.2)	LD	19 (6.3)	---	LD	LD	3.4 (2.5)	LD	LD
R10	10 (7.0)	LD	19 (8.2)	---	25 (8.1)	LD	LD	5.4 (4.9)	LD
R11	26 (9.6)	57 (43)	13 (6.2)	---	LD	LD	21 (16)	---	---
R12	11 (6.7)	LD	20 (7.7)	---	LD	LD	LD	LD	LD
R13	15 (5.5)	LD	19 (5.5)	LD	LD	LD	3.6 (3.2)	---	---
R14	10 (5.6)	LD	12 (5.2)	---	LD	LD	LD	17 (7.1)	LD
R15	19 (5.1)	LD	20 (4.8)	LD	LD	LD	7.9 (2.9)	---	---
R16	13 (9.3)	LD	14 (8.0)	---	LD	LD	20 (12)	LD	LD
WNE	17 (5.0)	21 (20)	14 (4.4)	---	LD	LD	LD	LD	LD
WNN	20 (6.9)	LD	25 (7.1)	---	LD	LD	LD	LD	LD
WNW	14 (4.6)	LD	13 (4.0)	---	LD	LD	7.4 (2.8)	LD	LD
WSE	12 (4.9)	LD	6.7 (3.8)	---	LD	LD	LD	LD	LD
WSS	18 (6.0)	LD	20 (5.8)	---	LD	LD	6.6 (2.5)	LD	LD
WSW	70 (32)	LD	10 (3.9)	---	LD	LD	LD	LD	LD
WWW	15 (5.6)	LD	21 (6.1)	---	LD	LD	4.6 (3.5)	LD	LD
WEE	19 (5.1)	LD	21 (4.9)	---	LD	LD	2.8 (2.3)	LD	LD
DRR	28 (7.8)	60 (35)	32 (7.4)	LD	LD	LD	3.6 (2.7)	---	---
GNO	20 (7.4)	40 (30)	18 (6.2)	---	LD	LD	LD	---	---
HHW	28 (6.6)	24 (20)	21 (5.4)	---	LD	LD	LD	---	---
MNT	80 (10)	42 (25)	55 (8.5)	LD	LD	LD	LD	---	---

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-3

RADIONUCLIDE CONCENTRATIONS IN 1985 SOIL SAMPLES
INTERMEDIATE COLLECTION[1]
(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90 (E-08)	Cs-137 (E-08)	Ra-226 (E-08)	Ra-228 (E-08)	Th-228 (E-08)	Th-230 (E-08)	Th-232 (E-08)	U-233
R01	48 (9.3)	LD[2]	---[3]	LD	25 (9.9)	LD	18 (2.6)	39 (8.9)	50 (9.5)	LD
R02	37 (5.8)	LD	LD	4.0 (3.4)	20 (5.4)	18 (4.7)	11 (1.4)	---	---	LD
R03	36 (6.2)	LD	LD	11.0 (3.9)	23 (8.8)	36 (7.3)	18 (2.1)	---	---	LD
R04	40 (6.0)	LD	LD	38 (3.8)	21 (4.5)	26 (6.0)	13 (5.4)	---	---	LD
R05	67 (11)	LD	LD	27 (7.7)	23 (4.7)	LD	25 (9.5)	29 (7.5)	17 (5.3)	LD
R06	46 (6.3)	LD	LD	8.8 (3.6)	22 (7.2)	17 (1.3)	19 (15)	---	---	LD
R07	39 (6.9)	LD	LD	LD	22 (6.9)	20 (14)	LD	---	---	LD
R08	47 (6.6)	LD	LD	8.9 (4.1)	24 (4.1)	25 (8.0)	21 (4.8)	---	---	LD
R09	33 (11)	LD	---	17 (7.3)	18 (5.3)	LD	18 (6.0)	---	---	LD
R10	48 (6.4)	LD	LD	5.9 (3.8)	26 (4.8)	28 (11)	21 (3.7)	---	---	LD
R11	120 (10)	LD	49 (44)	90 (8.1)	52 (8.6)	62 (11)	55 (2.1)	---	---	LD
R12	89 (7.3)	18 (14)	LD	24 (4.5)	47 (11)	46 (9.3)	36 (6.1)	---	---	LD
R13	58 (6.5)	LD	LD	19 (3.8)	19 (6.4)	27 (17)	17 (3.1)	---	---	LD
R14	55 (7.4)	LD	LD	16 (4.1)	29 (4.7)	22 (5.6)	27 (1.7)	---	---	LD
R15	48 (6.4)	LD	---	5.1 (3.2)	23 (7.4)	28 (17)	19 (3.7)	---	---	LD
R16	47 (6.2)	LD	LD	7.6 (3.5)	18 (7.7)	24 (2.4)	16 (14)	---	---	LD
WNE	67 (8.0)	LD	LD	18 (5.6)	35 (17)	35 (12)	23 (2.4)	---	---	LD
WNN	56 (12)	LD	---	20 (12)	32 (5.3)	LD	15 (7.4)	83 (12)	79 (12)	LD
WNW	45 (7.3)	LD	---	LD	24 (9.1)	32 (22)	18 (1.7)	81 (14)	76 (13)	LD
WSE	51 (6.9)	LD	LD	11 (4.1)	21 (3.8)	28 (11)	15 (4.9)	---	---	LD
WSS	65 (9.3)	LD	---	21 (5.6)	22 (2.5)	LD	18 (4.0)	85 (11)	82 (11)	LD
WSW	48 (6.8)	LD	LD	LD	25 (10)	27 (9.0)	20 (7.9)	---	---	LD
WWW	57 (6.3)	LD	---	12 (3.4)	24 (8.1)	34 (21)	18 (3.2)	60 (10)	69 (11)	LD
WEE	55 (10)	LD	---	17 (5.8)	23 (7.3)	LD	23 (.96)	---	---	LD
DRR	65 (9.3)	LD	---	13 (5.8)	36 (4.5)	37 (29)	31 (9.7)	---	---	LD
GNO	52 (6.7)	LD	---	19 (4.1)	23 (9.8)	LD	18 (7.6)	98 (14)	90 (13)	LD
HHW	84 (9.3)	LD	---	9.1 (7.9)	48 (6.0)	48 (9.1)	39 (6.1)	---	---	LD
MNT	170 (16)	LD	---	17 (9.7)	120 (19)	110 (55)	110 (9.3)	37 (14)	31 (12)	LD

TABLE A-3
RADIONUCLIDE CONCENTRATIONS IN 1985 SOIL SAMPLES
INTERMEDIATE COLLECTION[1]
(μCi/g)
(CONTINUED)

LOCATION CODE	U-234 (E-08)	U-235 (E-09)	U-238 (E-08)	Np-237	Pu-238	Pu-239/240 (E-09)	Pu-241 (E-06)	Am-241 (E-08)	Cm-244 (E-08)
R01	11 (4.9)	LD	8.4 (3.4)	LD	LD	LD	3.4 (2.7)	---	---
R02	11 (4.3)	LD	7.1 (3.6)	LD	LD	LD	LD	LD	LD
R03	6.9 (3.3)	LD	7.2 (3.5)	---	LD	LD	15 (12)	LD	LD
R04	11 (4.3)	LD	9.7 (4.2)	---	LD	LD	LD	LD	LD
R05	22 (6.3)	LD	23 (5.9)	LD	LD	LD	LD	---	---
R06	18 (5.2)	LD	13 (4.6)	---	LD	LD	LD	7.0 (4.3)	LD
R07	11 (4.2)	LD	14 (4.5)	---	LD	LD	LD	LD	LD
R08	15 (5.4)	LD	12 (4.4)	---	LD	LD	32 (12)	LD	LD
R09	13 (3.9)	LD	12 (3.2)	---	LD	LD	LD	---	---
R10	10 (40)	LD	15 (4.6)	---	LD	LD	LD	LD	LD
R11	27 (6.4)	LD	23 (5.8)	---	LD	LD	LD	LD	LD
R12	17 (5.5)	LD	17 (5.1)	---	LD	43 (40)	37 (11)	LD	LD
R13	1.7 (3.7)	LD	6.0 (3.3)	---	LD	LD	LD	LD	LD
R14	15 (5.6)	LD	11 (4.4)	---	LD	LD	LD	LD	LD
R15	18 (5.2)	LD	16 (4.3)	---	LD	LD	LD	LD	LD
R16	21 (12)	86 (52)	13 (7.9)	---	LD	LD	LD	LD	LD
WNE	14 (4.9)	LD	15 (4.5)	---	LD	140 (37)	LD	LD	LD
WNN	18 (4.6)	LD	18 (4.5)	LD	LD	LD	LD	14 (13)	LD
WNW	21 (5.4)	LD	17 (4.6)	LD	LD	LD	4.4 (3.6)	LD	LD
WSE	13 (5.4)	LD	21 (6.2)	---	LD	LD	9.8 (8.8)	LD	LD
WSS	8.3 (4.4)	LD	11 (3.8)	LD	LD	LD	5.3 (3.0)	LD	6.9 (5.9)
WSW	14 (5.4)	LD	16 (5.4)	---	LD	LD	LD	LD	LD
WWW	14 (4.8)	LD	12 (4.1)	LD	LD	LD	LD	LD	5.9 (5.5)
WEE	8.0 (5.1)	LD	13 (4.7)	---	LD	LD	LD	---	---
DRR	18 (5.4)	LD	15 (4.4)	---	LD	LD	LD	---	---
GNO	12 (6.8)	LD	20 (7.2)	LD	LD	LD	LD	---	---
HHW	20 (6.4)	LD	24 (6.3)	---	LD	LD	LD	---	---
MNT	44 (12)	LD	63 (13)	LD	LD	LD	6.6 (2.8)	---	---

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-4
RADIONUCLIDE CONCENTRATIONS IN 1985 SOIL SAMPLES
DEEP COLLECTION[1]
(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-08)	Ra-226 (E-08)	Ra-228 (E-08)	Th-228 (E-08)	Th-230 (E-07)	Th-232 (E-07)
R01	43 (7.9)	LD[2]	LD	2.2 (4.1)	20 (2.5)	LD	19 (8.6)	---	---
R02	39 (6.8)	LD	LD	LD	20 (8.5)	30 (0.9)	15 (3.7)	---	---
R03	54 (7.3)	LD	LD	14 (4.2)	27 (16)	19 (4.9)	19 (6.4)	---	---
R04	44 (6.4)	LD	LD	LD	23 (4.4)	34 (7.6)	20 (8.1)	---	---
R05	62 (9.6)	LD	---[3]	16 (6.4)	27 (9.9)	46 (30)	19 (11)	---	---
R06	53 (7.7)	LD	LD	LD	24 (10)	26 (15)	18 (1.0)	---	---
R07	35 (7.0)	LD	LD	LD	26 (6.0)	37 (6.2)	26 (3.4)	---	---
R08	53 (8.7)	LD	LD	11 (6.5)	31 (10)	37 (19)	24 (5.4)	---	---
R09	49 (11)	LD	LD	8.7 (9.0)	20 (12)	37 (33)	15 (8.4)	---	---
R10	16 (5.1)	LD	LD	LD	21 (9.1)	23 (6.6)	11 (3.0)	---	---
R11	110 (18)	LD	LD	21 (11)	77 (11)	130 (18)	72 (10)	---	---
R12	44 (8.3)	LD	LD	7.0 (4.8)	36 (12)	38 (21)	27 (1.1)	---	---
R13	54 (8.4)	LD	---	13 (6.9)	32 (12)	LD	26 (8.7)	---	---
R14	68 (8.9)	LD	LD	LD	39 (15)	50 (20)	43 (15)	---	---
R15	47 (7.3)	LD	---	11 (4.6)	24 (4.8)	23 (18)	21 (3.4)	---	---
R16	32 (8.3)	LD	LD	11 (4.0)	25 (13)	26 (9.8)	19 (2.6)	---	---
WNE	72 (7.5)	LD	LD	9.8 (4.1)	32 (17)	34 (7.3)	27 (1.2)	---	---
WNN	50 (9.6)	LD	---	20 (5.1)	24 (5.2)	29 (9.3)	16 (1.2)	---	---
WNW	41 (7.0)	LD	---	5.5 (4.2)	22 (8.9)	34 (19)	17 (3.2)	---	---
WSE	28 (8.6)	LD	LD	5.7 (4.6)	25 (5.8)	32 (1.3)	17 (5.0)	---	---
WSS	57 (6.4)	LD	---	19 (4.4)	22 (13)	23 (14)	19 (7.3)	7.1 (1.7)	7.0 (1.7)
WSW	62 (7.8)	LD	LD	LD	29 (7.9)	32 (16)	22 (8.2)	---	---
WWW	61 (8.7)	LD	LD	6.4 (3.8)	23 (8.0)	22 (12)	20 (2.1)	2.3 (1.2)	1.5 (1.1)
WEE	56 (11)	LD	---	23 (8.8)	31 (16)	LD	22 (10)	---	---
DRR	71 (11)	LD	---	LD	39 (17)	46 (13)	33 (5.8)	---	---
GNO	49 (7.5)	LD	---	20 (5.1)	18 (4.6)	LD	23 (3.8)	9.2 (1.2)	8.8 (1.2)
HHW	80 (7.7)	LD	---	6.9 (5.2)	41 (10)	46 (16)	37 (2.3)	---	---
MNT	150 (15)	LD	---	11 (8.8)	120 (21)	LD	94 (1.2)	22 (5.5)	21 (5.5)

TABLE A-4
RADIONUCLIDE CONCENTRATIONS IN 1985 SOIL SAMPLES
DEEP COLLECTION[1]
(μCi/g)
(CONTINUED)

LOCATION CODE	U-233	U-234 (E-08)	U-235 (E-09)	U-238 (E-08)	Np-237	Pu-238	Pu-239/240 (E-08)	Pu-241 (E-06)	Am-241 (E-08)	Cm-244 (E-08)
R01	LD	20 (7.1)	LD	25 (7.3)	---	LD	LD	LD	LD	LD
R02	LD	8.1 (4.0)	LD	13 (4.3)	---	LD	30 (26)	LD	---	---
R03	LD	14 (10)	LD	17 (9.0)	---	LD	36 (26)	LD	14 (10)	LD
R04	LD	9.7 (4.0)	LD	11 (3.7)	---	LD	LD	LD	15 (9.4)	LD
R05	LD	19 (5.2)	LD	19 (4.8)	---	LD	LD	LD	LD	LD
R06	LD	15 (6.2)	LD	12 (4.9)	---	LD	LD	LD	17 (11)	LD
R07	LD	11 (4.4)	LD	15 (4.5)	---	LD	LD	LD	LD	LD
R08	LD	9.2 (4.1)	LD	19 (4.7)	---	LD	LD	LD	LD	LD
R09	LD	11 (3.6)	LD	14 (3.4)	---	LD	LD	LD	LD	LD
R10	LD	9.3 (4.4)	LD	17 (4.8)	---	LD	LD	LD	LD	LD
R11	LD	25 (6.5)	LD	28 (6.4)	---	LD	LD	LD	LD	LD
R12	LD	19 (8.2)	LD	31 (9.6)	---	LD	LD	LD	LD	LD
R13	LD	13 (4.8)	22 (18)	22 (5.2)	---	LD	LD	3.8 (3.0)	20 (14)	LD
R14	LD	23 (8.9)	LD	9.0 (5.2)	---	LD	LD	LD	7.7 (6.4)	LD
R15	LD	14 (4.2)	LD	17 (4.5)	---	LD	LD	LD	LD	LD
R16	LD	8.3 (6.2)	LD	11 (6.6)	---	LD	LD	LD	LD	LD
WNN	LD	13 (4.4)	LD	18 (4.4)	---	LD	LD	LD	---	---
WNE	LD	16 (5.4)	LD	14 (4.9)	---	LD	LD	LD	---	---
WEE	LD	7.6 (5.6)	LD	11 (5.1)	---	LD	LD	LD	---	---
WSE	LD	14 (6.5)	LD	15 (6.5)	---	LD	LD	LD	---	---
WSS	LD	8.6 (5.1)	LD	16 (5.1)	LD	LD	LD	LD	14 (13)	6.6 (6.2)
WSW	LD	15 (6.0)	LD	21 (7.0)	---	LD	LD	LD	---	---
WWW	LD	12 (4.1)	LD	16 (4.6)	LD	LD	LD	5.9 (3.8)	---	---
WNW	LD	15 (6.1)	LD	16 (5.6)	---	LD	LD	12 (4.1)	LD	LD
DRR	LD	19 (5.5)	LD	21 (5.1)	---	LD	LD	LD	---	---
GNO	LD	7.4 (7.2)	LD	11 (5.9)	LD	LD	LD	LD	LD	LD
HHW	LD	22 (6.4)	LD	26 (6.3)	---	LD	LD	4.6 (4.2)	LD	LD
MNT	LD	62 (14)	LD	53 (12)	LD	LD	LD	LD	---	---

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)
[3] Indicates Not Analyzed

TABLE A-5

RADIONUCLIDE CONCENTRATIONS IN 1987 SOIL SAMPLES

SURFACE COLLECTION[1]

(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-08)	Ra-226 (E-07)	Ra-228 (E-07)	Th-228 (E-08)	Th-230 (E-07)	Th-232 (E-07)
R01	110 (6.7)	LD[2]	LD	17 (3.4)	4.1 (1.5)	4.7 (1.8)	38 (5.7)	3.8 (2.1)	4.4 (2.2)
R02	28 (6.7)	LD	LD	5.8 (4.1)	1.6 (1.5)	LD	11 (7.8)	1.4 (.50)	1.1 (.43)
R03	44 (7.6)	LD	LD	7.5 (3.7)	2.3 (1.7)	3.3 (2.4)	22 (7.7)	2.8 (.61)	2.7 (.50)
R04	41 (5.5)	LD	LD	3.2 (2.4)	1.7 (1.4)	2.1 (1.4)	17 (5.9)	2.6 (1.2)	2.6 (1.1)
R05	43 (7.8)	LD	LD	LD	2.7 (1.2)	3.4 (2.1)	21 (11)	LD	4.9 (2.9)
R06	36 (9.2)	LD	LD	13 (7.5)	2.3 (1.1)	5.3 (2.1)	20 (10)	1.4 (1.2)	1.3 (.69)
R07	50 (10)	LD	LD	9.8 (7.4)	2.9 (2.2)	LD	19 (15)	LD	2.8 (1.1)
R08	40 (7.4)	LD	LD	9.0 (5.2)	2.8 (2.0)	2.9 (2.7)	30 (11)	2.5 (1.8)	3.5 (.89)
R09	37 (9.2)	LD	LD	LD	2.3 (1.6)	LD	15 (7.3)	1.8 (.47)	2.0 (.49)
R10	57 (9.6)	LD	LD	18 (9.1)	4.2 (1.5)	4.4 (2.1)	31 (13)	LD	LD
R11	100 (9.3)	LD	LD	52 (6.0)	5.7 (2.0)	5.4 (2.4)	51 (8.8)	LD	3.1 (1.2)
R12	130 (17)	LD	LD	23 (12)	8.8 (3.8)	8.7 (4.8)	82 (19)	5.3 (.80)	3.5 (.66)
R13	59 (8.3)	LD	LD	14 (4.4)	2.7 (1.5)	3.6 (2.3)	23 (8.0)	LD	LD
R14	68 (12)	LD	LD	26 (9.2)	4.3 (1.6)	5.9 (3.1)	35 (17)	LD	LD
R15	51 (5.8)	LD	LD	13 (3.2)	3.1 (1.5)	3.3 (1.4)	27 (6.0)	---[3]	---
R16	46 (9.0)	LD	LD	8.7 (6.4)	3.3 (1.1)	3.9 (3.0)	34 (12)	---	---
WNE	55 (6.0)	LD	LD	7.2 (2.9)	2.0 (1.5)	2.2 (1.3)	17 (5.7)	---	---
WNN	53 (6.0)	LD	LD	11 (3.4)	2.6 (1.4)	2.6 (1.6)	17 (6.1)	---	--
WNW	58 (6.2)	LD	LD	6.7 (3.8)	2.2 (1.4)	2.5 (1.6)	16 (5.4)	---	---
WSE	62 (6.3)	LD	LD	14 (3.8)	2.6 (1.5)	3.8 (1.6)	28 (6.1)	---	---
WSS	47 (9.2)	LD	LD	15 (6.6)	2.5 (2.1)	LD	25 (7.9)	---	---
WSW	58 (8.5)	LD	LD	14 (4.3)	2.0 (2.0)	2.9 (1.9)	24 (7.1)	---	---
WWW	64 (8.7)	LD	LD	12 (6.7)	3.1 (2.0)	4.6 (3.3)	20 (10)	---	---
WEE	56 (9.4)	LD	LD	LD	3.4 (2.1)	LD	33 (9.4)	---	---
ANR	140 (12)	LD	LD	58 (6.6)	8.5 (2.6)	8.8 (3.0)	81 (11)	---	---
ART	130 (20)	LD	LD	LD	9.2 (5.5)	7.2 (5.0)	83 (23)	---	---
CBD	42 (8.7)	LD	LD	5.5 (3.9)	2.9 (2.1)	3.4 (1.9)	20 (8.4)	---	---
DRR	67 (12)	LD	LD	11 (7.6)	4.2 (2.3)	3.7 (3.2)	39 (14)	---	---
EUN	43 (10)	LD	LD	21 (7.3)	3.3 (1.2)	4.3 (2.4)	19 (11)	---	---
GNO	67 (6.7)	LD	LD	19 (3.3)	3.0 (1.5)	3.8 (1.9)	24 (6.2)	---	---
HBS	62 (8.2)	LD	LD	39 (4.3)	4.3 (1.8)	6.0 (2.1)	38 (7.8)	---	---
HHW	73 (13)	LD	LD	39 (8.9)	5.2 (3.3)	LD	44 (14)	---	---
JAL	59 (10)	LD	LD	41 (7.5)	5.6 (2.5)	5.6 (2.6)	38 (11)	---	---
LVG	97 (9.8)	LD	LD	5.9 (5.8)	4.8 (2.6)	4.4 (2.6)	40 (9.3)	---	---
MNT	140 (8.6)	LD	LD	11 (3.7)	11 (2.0)	11 (2.3)	91 (8.5)	---	---
NMP	90 (9.3)	LD	LD	15 (7.8)	4.6 (2.6)	2.9 (2.4)	38 (13)	---	---
PCA	60 (11)	LD	LD	12 (8.3)	4.4 (2.6)	5.1 (3.3)	27 (13)	---	---

TABLE A-6

RADIONUCLIDE CONCENTRATIONS IN 1987 SOIL SAMPLES

INTERMEDIATE COLLECTION[1]

(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-08)	Ra-226 (E-07)	Ra-228 (E-07)	Th-228 (E-08)	Th-230 (E-07)
WEE	52 (6.1)	LD[2]	LD	4.0 (2.8)	2.5 (1.6)	3.3 (1.5)	19 (5.4)	---[3]
R01	110 (76)	LD	LD	8.0 (3.8)	3.4 (1.6)	4.5 (1.8)	36 (6.5)	6.4 (1.3)
R02	36 (6.0)	LD	LD	7.7 (3.1)	LD	2.0 (1.5)	13 (5.9)	1.3 (.59)
R03	48 (6.1)	LD	LD	3.7 (2.9)	2.3 (1.5)	2.4 (1.7)	22 (5.2)	LD
R04	46 (7.3)	LD	LD	LD	2.7 (1.8)	LD	23 (11)	4.3 (.95)
R05	55 (8.4)	LD	LD	12 (4.2)	2.1 (1.5)	2.7 (2.1)	19 (7.3)	3.0 (2.6)
R06	40 (7.7)	LD	LD	11 (7.0)	2.7 (1.9)	LD	31 (12)	.70 (.44)
R07	44 (8.8)	LD	LD	LD	2.4 (1.1)	LD	23 (10)	LD
R08	50 (7.9)	LD	LD	8.7 (3.7)	2.9 (1.7)	3.0 (1.8)	19 (8.7)	3.4 (1.9)
R09	45 (7.8)	LD	LD	LD	2.5 (1.1)	LD	16 (9.6)	2.6 (.58)
R10	54 (9.0)	LD	LD	17 (7.2)	3.0 (1.6)	5.1 (2.4)	34 (11)	LD
R11	87 (10)	LD	LD	36 (8.4)	6.3 (2.5)	5.9 (3.5)	56 (12)	LD
R12	130 (17)	LD	LD	20 (4.0)	7.4 (1.9)	7.9 (2.1)	58 (7.7)	2.1 (.79)
R13	62 (5.7)	LD	LD	12 (3.1)	2.7 (1.1)	3.1 (1.4)	24 (5.6)	2.6 (.55)
R14	70 (6.6)	LD	LD	19 (3.6)	3.0 (1.6)	3.8 (1.7)	28 (5.8)	2.7 (1.0)
R15	55 (6.4)	LD	LD	12 (4.0)	2.8 (1.5)	3.1 (1.8)	24 (6.7)	---
R16	52 (6.4)	LD	LD	8.4 (3.6)	2.4 (1.6)	2.6 (1.6)	20 (5.3)	---

LOCATION CODE	Th-232 (E-07)	U-233 (E-08)	U-234 (E-08)	U-235 (E-09)	U-238 (E-08)	Np-237	Pu-238	Pu-239/240	Pu-241
WEE	---	---	---	---	---	---	LD	LD	LD
R01	4.7 (1.1)	LD	29 (7.9)	LD	29 (2.7)	LD	LD	LD	LD
R02	1.7 (.63)	LD	6.8 (3.4)	LD	12 (4.9)	LD	LD	LD	LD
R03	LD	LD	14 (4.5)	LD	8.8 (3.8)	LD	LD	LD	LD
R04	3.8 (.90)	LD	16 (5.8)	LD	11 (5.3)	LD	LD	LD	LD
R05	3.8 (2.6)	4.0 (35)	16 (5.2)	LD	18 (4.8)	LD	LD	LD	LD
R06	1.1 (.45)	LD	9.0 (3.3)	LD	12 (3.6)	LD	LD	LD	LD
R07	2.4 (1.3)	LD	13 (2.5)	LD	13 (2.5)	LD	---	---	LD
R08	2.0 (1.4)	LD	12 (3.2)	LD	13 (3.3)	LD	---	---	LD
R09	2.6 (.57)	LD	19 (4.7)	25 (22)	14 (4.0)	LD	---	---	LD
R10	LD	LD	11 (4.2)	LD	17 (5.0)	LD	---	---	LD
R11	6.1 (4.8)	LD	32 (7.3)	LD	25 (6.4)	LD	---	---	LD
R12	LD	LD	36 (7.9)	LD	38 (8.0)	LD	---	---	LD
R13	2.7 (.55)	LD	10 (3.0)	LD	15 (3.5)	LD	---	---	LD
R14	2.1 (.90)	LD	15 (3.1)	LD	12 (2.8)	LD	---	---	LD
R15	---	LD	17 (3.2)	LD	15 (3.0)	---	LD	LD	LD
R16	---	LD	41 (20)	LD	19 (13)	---	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-7

RADIONUCLIDE CONCENTRATIONS IN 1987 SOIL SAMPLES

DEEP COLLECTION[1]

(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-08)	Ra-226 (E-07)	Ra-228 (E-08)	Th-228 (E-08)
R01	110 (11)	LD[2]	LD	8.1 (6.9)	4.4 (1.4)	48 (35)	48 (7.6)
R02	25 (8.1)	LD	LD	9.0 (5.8)	2.2 (1.1)	LD	10 (5.1)
R03	52 (8.2)	LD	LD	7.6 (7.0)	2.3 (1.2)	31 (25)	22 (9.8)
R04	47 (9.0)	LD	LD	LD	2.8 (1.8)	LD	19 (8.4)
R05	43 (12)	LD	LD	LD	3.6 (2.5)	63 (30)	19 (8.8)
R06	45 (8.2)	LD	LD	10 (4.1)	2.0 (1.7)	27 (25)	14 (8.5)
R07	47 (8.0)	LD	LD	11 (6.1)	2.2 (1.0)	LD	17 (10)
R08	45 (10)	LD	LD	10 (7.3)	2.7 (1.1)	LD	26 (12)
R09	44 (11)	LD	LD	LD	2.5 (1.1)	LD	27 (14)
R10	---[3]	---	LD	---	---	---	---
R11	---	---	LD	---	---	---	---
R12	---	---	LD	---	---	---	---
R13	---	---	LD	---	---	---	---
R14	---	---	LD	---	---	---	---
R15	---	---	LD	---	---	---	---
R16	---	---	LD	---	---	---	---

LOCATION CODE	Th-230 (E-07)	Th-232 (E-07)	Np-237	U-233	U-234 (E-08)	U-235 (E-09)	U-238 (E-08)
R01	3.5 (1.3)	5.2 (1.5)	LD	LD	31 (8.1)	LD	25 (7.2)
R02	2.4 (.53)	2.3 (.50)	LD	LD	8.2 (3.7)	LD	8.7 (3.7)
R03	3.1 (.88)	2.7 (.82)	LD	LD	11 (5.5)	LD	9.5 (5.5)
R04	2.2 (1.1)	2.2 (1.1)	LD	LD	12 (4.5)	LD	17 (5.6)
R05	LD	1.3 (1.1)	LD	LD	12 (3.0)	LD	12 (3.0)
R06	LD	2.2 (1.1)	LD	LD	16 (3.1)	LD	14 (2.8)
R07	LD	3.7 (1.7)	LD	LD	20 (3.7)	27 (20)	16 (3.4)
R08	3.3 (.75)	2.9 (.71)	LD	LD	19 (4.7)	LD	12 (3.6)
R09	LD	LD	LD	LD	20 (4.3)	LD	13 (3.5)
R10	.75 (.34)	.70 (.33)	LD	LD	18 (7.0)	41 (36)	17 (6.4)
R11	1.2 (.99)	1.1 (.94)	LD	LD	27 (5.7)	LD	29 (6.0)
R12	4.9 (.91)	3.6 (.79)	LD	LD	35 (9.1)	36 (32)	31 (8.2)
R13	LD	LD	LD	LD	17 (4.0)	LD	15 (3.5)
R14	3.0 (1.1)	3.6 (1.2)	LD	LD	19 (3.7)	LD	17 (3.4)
R15	---	---	---	LD	19 (4.0)	LD	14 (3.5)
R16	---	---	---	LD	31 (6.2)	LD	15 (4.3)

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less than Detectable (Refer to Table B-2)

[3] Indicates Not Analyzed

TABLE A-8

RADIONUCLIDE CONCENTRATIONS IN SURFACE WATER SAMPLES

DECEMBER 1985[1]

(μCi/ml)

LOCATION CODE	H-3	K-40 (E-07)	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228 (E-09)
LGS	LD[2]	210 (5.2)	LD	LD	LD	LD	LD
TUT	LD	LD	LD	LD	LD	LD	LD
RDT	LD	LD	LD	LD	LD	LD	LD
UPP	---[3]	LD	LD	LD	LD	LD	29 (26)
LMC	LD	LD	LD	LD	LD	LD	LD
PCN	LD	LD	LD	LD	LD	LD	LD
CBD	LD	LD	LD	LD	LD	LD	LD
INT	LD	LD	LD	LD	LD	22 (3.1)	LD

LOCATION CODE	Th-228 (E-10)	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Pu-238	Pu-239/240
LGS	32 (18)	LD	210 (27)	70 (56)	110 (19)	LD	LD
TUT	LD	LD	24 (6.5)	LD	4.6 (3.0)	LD	LD
RDT	LD	LD	LD	LD	LD	LD	LD
UPP	LD	LD	82 (10)	LD	24 (5.6)	LD	LD
LMC	LD	LD	28 (7.1)	44 (31)	19 (5.3)	LD	LD
PCN	LD	LD	65 (6.3)	20 (14)	27 (4.2)	LD	LD
CBD	LD	LD	30 (5.7)	LD	15 (4.0)	LD	LD
INT	130 (120)	LD	10 (6.3)	LD	LD	LD	LD

LOCATION CODE	Pu-241 (E-09)	Np-237	Th-230 (E-10)	Th-232	Am-241	Cm-244
LGS	LD	---	---	---	LD	LD
TUT	38 (12)	---	LD	LD	---	---
RDT	LD	LD	LD	LD	---	---
UPP	LD	---	26 (19)	LD	---	---
LMC	28 (15)	LD	LD	LD	LD	LD
PCN	LD	LD	LD	LD	---	---
CBD	LD	LD	LD	LD	---	---
INT	LD	LD	---	---	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-9

RADIONUCLIDE CONCENTRATIONS IN SURFACE WATER SAMPLES

APRIL 1986[1]

(μCi/ml)

LOCATION CODE	H-3	K-40 (E-07)	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228
CBD	LD[2]	LD	LD	LD	LD	LD	LD
INT	LD	LD	LD	LD	LD	8.0 (1.3)	LD
LGS	LD	310 (5.5)	LD	LD	LD	5.6 (4.2)	LD
LMC	LD	LD	LD	LD	LD	LD	LD
PCN	LD	LD	LD	LD	LD	7.7 (0.5)	LD
RDT	LD	LD	LD	LD	LD	12 (4.4)	LD
TUT	---[3]	7.4 (4.3)	LD	LD	LD	LD	LD
UPP	LD	LD	LD	LD	LD	LD	LD
WEF	LD	LD	LD	LD	LD	LD	---
WIN	LD	LD	LD	LD	LD	13 (5.7)	LD

LOCATION CODE	Th-228 (E-10)	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Pu-238	Pu-239/240
CBD	LD	LD	25 (3.6)	LD	11 (2.4)	LD	LD
INT	LD	LD	LD	LD	1.8 (1.4)	LD	LD
LGS	LD	LD	73 (7.0)	LD	39 (5.1)	LD	LD
LMC	LD	LD	26 (5.1)	12 (11)	14 (3.6)	LD	LD
PCN	35 (24)	LD	41 (5.1)	LD	19 (3.5)	LD	LD
RDT	LD	LD	2.0 (1.7)	LD	2.0 (1.7)	LD	LD
TUT	LD	LD	2.3 (1.4)	LD	2.0 (1.3)	LD	LD
UPP	LD	LD	37 (5.0)	LD	19 (3.6)	LD	LD
WEF	LD	LD	4.1 (2.7)	LD	3.4 (2.3)	LD	LD
WIN	LD	LD	6.0 (2.5)	LD	1.7 (1.3)	LD	LD

LOCATION CODE	Pu-241 (E-09)	Np-237	Th-230 (E-10)	Th-232	Am-241 (E-11)	Cm-244
CBD	89 (55)	LD	LD	LD	LD	LD
INT	LD	---	3.4 (3.1)	LD	LD	LD
LGS	LD	---	---	---	LD	LD
LMC	LD	LD	LD	LD	LD	LD
PCN	LD	LD	LD	LD	LD	LD
RDT	LD	LD	LD	LD	LD	LD
TUT	LD	---	LD	LD	LD	LD
UPP	LD	LD	LD	LD	LD	LD
WEF	LD	LD	LD	LD	---	---
WIN	LD	LD	LD	LD	29 (23)	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-10
RADIONUCLIDE CONCENTRATIONS IN SURFACE WATER SAMPLES
OCTOBER 1986[1]
(µCi/ml)

LOCATION CODE	H-3	K-40 (E-07)	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228 (E-09)
CBD	LD[2]	LD	LD	LD	LD	LD	LD
HLT	LD	5.5 (4.3)	LD	LD	LD	120 (54)	LD
INT	LD	LD	LD	LD	LD	LD	LD
LGS	LD	200 (10)	LD	LD	LD	8.2 (7.8)	LD
LMC	LD	LD	LD	LD	LD	3.7 (0.53)	20 (16)
NOT	LD	LD	LD	LD	LD	23 (5.3)	LD
PCN	LD	LD	LD	LD	LD	LD	20 (12)
RDT	LD	LD	LD	LD	LD	LD	LD
TUT	LD	LD	LD	LD	LD	LD	27 (20)
UPP	LD	LD	LD	LD	LD	LD	LD

LOCATION CODE	Th-228 (E-10)	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Pu-238	Pu-239/240 (E-10)
CBD	LD	LD	18 (5.1)	LD	11 (4.2)	LD	34 (26)
HLT	LD	LD	LD	LD	LD	LD	LD
INT	LD	LD	LD	LD	2.4 (2.2)	LD	LD
LGS	LD	LD	63 (6.0)	16 (10)	30 (4.1)	LD	LD
LMC	23 (21)	LD	23 (3.1)	12 (7.5)	10 (2.0)	LD	LD
NOT	LD	LD	1.6 (0.90)	LD	0.76 (0.62)	LD	LD
PCN	LD	LD	44 (5.7)	15 (14)	22 (4.0)	LD	LD
RDT	LD	LD	2.5 (1.6)	LD	LD	LD	LD
TUT	LD	LD	LD	LD	LD	LD	LD
UPP	LD	LD	28 (6.4)	LD	13 (4.2)	LD	LD

LOCATION CODE	Pu-241 (E-09)	Np-237	Th-230	Th-232	Am-241	Cm-244
CBD	LD	LD	LD	LD	---[3]	---
HLT	68 (49)	LD	LD	LD	LD	LD
INT	LD	LD	LD	LD	LD	LD
LGS	LD	LD	LD	LD	---	---
LMC	LD	LD	LD	LD	LD	LD
NOT	60 (53)	LD	LD	LD	---	---
PCN	LD	LD	LD	LD	LD	LD
RDT	LD	LD	LD	LD	---	---
TUT	LD	LD	LD	LD	LD	LD
UPP	LD	LD	LD	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-11

RADIONUCLIDE CONCENTRATIONS IN SURFACE WATER SAMPLES
1987[1]
(μCi/ml)

LOCATION CODE	H-3	K-40 (E-07)	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228	Th-228 (E-09)	Th-230 (E-10)
INT	LD[2]	LD	LD	LD	LD	LD	LD	LD	LD
HLT	LD	LD	LD	LD	LD	17 (9.8)	LD	LD	4.5 (3.4)
LGS	LD	290 (12)	LD	LD	LD	LD	LD	LD	LD
NOT	LD	3.9 (3.8)	LD	LD	LD	LD	LD	LD	LD
NOT-DUP	LD	LD	LD	LD	LD	---[3]	---	---	LD
RDT	LD	LD	LD	LD	LD	LD	LD	LD	LD
TUT	LD	LD	LD	LD	LD	LD	LD	LD	LD
BLANK SAMPLE	LD	LD	LD	LD	LD	LD	LD	12 (11)	LD

LOCATION CODE	Th-232	U-233 (E-10)	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-237	Pu-238	Pu-239/240	Pu-241
INT	LD	LD	LD	LD	LD	LD	LD	LD	LD
HLT	LD	LD	LD	10 (9.2)	LD	LD	LD	LD	LD
LGS	LD	7.8 (5.6)	160 (16)	27 (24)	77 (11)	LD	LD	LD	LD
NOT	LD	LD	LD	LD	LD	LD	LD	LD	LD
NOT-DUP	LD	LD	9.9 (3.4)	LD	7.1 (3.0)	LD	LD	LD	LD
RDT	LD	LD	LD	LD	LD	LD	LD	LD	LD
TUT	LD	LD	LD	LD	LD	LD	LD	LD	LD
BLANK SAMPLE	LD	LD	LD	LD	LD	LD	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

WIP:8905-TA-11

TABLE A-12

RADIONUCLIDE CONCENTRATIONS IN SEDIMENT SAMPLES
1987[1]
(μCi/g)

LOCATION CODE	K-40 (E-07)	Co-60 (E-09)	Sr-90	Cs-137 (E-08)	Ra-228 (E-07)	Th-228 (E-08)	Ra-226 (E-07)
HLT	200 (15)	LD[2]	LD	25 (8.1)	10 (3.6)	71 (12)	7.2 (3.0)
INT	170 (15)	LD	LD	68 (7.2)	11 (3.5)	85 (13)	8.5 (2.9)
NOT	180 (9.2)	LD	LD	11 (3.5)	6.0 (1.8)	61 (8.6)	5.2 (2.0)
NOT-DUP.	170 (14)	LD	LD	LD	7.7 (4.6)	62 (14)	6.0 (2.7)

LOCATION CODE	U-233 (E-08)	U-234 (E-09)	U-235 (E-08)	U-238 (E-08)	Pu-238	Pu-239/240	Pu-241
HLT	LD	40 (8.3)	LD	41 (8.4)	LD	LD	LD
INT	LD	44 (8.4)	LD	57 (9.3)	LD	LD	LD
NOT	LD	38 (8.8)	LD	41 (9.1)	LD	LD	LD
NOT-DUP.	LD	32 (6.4)	28 (24)	29 (6.1)	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

TABLE A-13
RADIONUCLIDE CONCENTRATIONS IN GROUNDWATER SAMPLES
1985[1]
(µCi/ml)

LOCATION CODE	K-40 (E-08)	Co-60	Sr-90	Cs-137	Ra-226 (E-09)	Ra-228 (E-09)	Th-228 (E-10)	Th-230 (E-10)
H-03b3	LD[2]	LD	LD	LD	130 (27)	30 (19)	85 (75)	21 (17)
DOE-2	LD	LD	LD	LD	160 (30)	18 (5.8)	100 (62)	27 (11)
H-11b3	LD	LD	LD	LD	120 (25)	40 (8.4)	84 (69)	LD
H-03b1	LD	LD	LD	LD	24 (12)	LD	LD	LD
H-04b	19 (12)	LD	LD	LD	69 (22)	24 (5.0)	31 (25)	7.6 (6.9)
H-05b	92 (56)	LD	LD	LD	290 (65)	46 (8.4)	120 (11)	LD
H-06b	30 (8.1)	LD	LD	LD	LD	LD	LD	LD
H-09b	LD	LD	LD	LD	10 (1.3)	LD	LD	84 (22)
WIPP-29	2100 (45)	LD	LD	LD	11 (8.5)	LD	LD	71 (33)

LOCATION CODE	Th-232 (E-10)	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-137	Pu-238	Pu-239/240	Pu-241 (E-09)
H-03b3	LD	LD	150 (11)	LD	24 (4.2)	---[3]	LD	LD	LD
DOE-2	LD	LD	290 (23)	35 (29)	46 (9.1)	---	LD	LD	LD
H-11b3	LD	LD	130 (9.8)	16 (13)	25 (4.3)	---	LD	LD	120 (67)
H-03b1	LD	LD	LD	50 (9.7)	LD	---	LD	LD	LD
H-04b	LD	LD	170 (10)	14 (12)	25 (4.0)	---	LD	LD	LD
H-05b	LD	LD	LD	LD	LD	LD	LD	LD	55 (34)
H-06b	LD	LD	72 (7.3)	LD	23 (3.9)	---	LD	LD	LD
H-09b	LD	LD	210 (11)	56 (23)	100 (7.9)	---	LD	LD	LD
WIPP-29	LD	LD	180 (25)	LD	69 (15)	---	LD	LD	170 (160)

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable

[3] Indicates Not Analyzed (Refer to Table 8-2)

TABLE A-14

RADIONUCLIDE CONCENTRATIONS IN GROUNDWATER SAMPLES

1986[1]

(µCi/ml)

LOCATION CODE	H-3	K-40 (E-08)	Co-60	Sr-90	Cs-137 (E-08)	Ra-226 (E-08)	Ra-228 (E-09)	Th-228 (E-10)	Th-230 (E-10)
P-14	---[2]	LD[3]	LD	LD	LD	45 (10)	LD	54 (50)	LD
H-7b	LD	LD	LD	LD	LD	28 (16)	LD	LD	LD
H-2a	---	LD	LD	LD	LD	38 (15)	LD	LD	LD
H-03b3	LD	LD	LD	LD	LD	120 (20)	24 (1.0)	LD	LD
H-05b	LD	120 (55)	LD	LD	LD	280 (19)	60 (15)	110 (4.6)	LD
H-11b3	LD	76 (34)	LD	LD	LD	127 (23)	LD	LD	LD
RANCH	LD	LD	LD	LD	LD	LD	13 (0.63)	LD	LD
H-06b	LD	LD	LD	LD	6.3 (4.5)	LD	LD	LD	LD
DOE-2	LD	61 (42)	LD	LD	LD	150 (23)	LD	65 (2.3)	LD
H-03b1	LD	LD	LD	LD	LD	27 (4.8)	LD	LD	LD
H-06c	---	LD	LD	LD	LD	13 (6.0)	LD	LD	LD
H-05c	LD	LD	LD	LD	LD	1.2 (.83)	LD	LD	2.5 (2.2)
H-04c	LD	LD	LD	LD	LD	2.9 (2.2)	LD	LD	LD
H-04b	LD	LD	LD	LD	LD	6.0 (2.4)	LD	LD	LD

LOCATION CODE	Th-232 (E-10)	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-137	Pu-238	Pu-239/240	Pu-241 (E-09)
P-14	LD	LD	50 (8.2)	LD	33 (6.6)	LD	LD	LD	LD
H-7b	LD	LD	78 (8.9)	21 (16)	28 (5.3)	LD	LD	LD	LD
H-2a	LD	LD	95 (15)	LD	17 (6.2)	LD	LD	LD	73 (63)
H-03b3	LD	LD	110 (14)	LD	24 (6.7)	LD	LD	LD	LD
H-05b	LD	LD	17 (4.4)	LD	LD	LD	LD	LD	LD
H-11b3	LD	LD	88 (5.7)	7.5 (7.1)	16 (2.5)	LD	LD	LD	LD
H-03b1	LD	LD	LD	LD	LD	LD	LD	LD	LD
H-06c	LD	LD	120 (8.0)	24 (12)	31 (4.0)	LD	LD	LD	LD
H-05c	1.6 (1.5)	LD	LD	LD	LD	LD	LD	LD	LD
H-04c	LD	LD	4.1 (3.1)	LD	LD	LD	LD	LD	LD
H-04b	LD	LD	140 (10)	LD	20 (4.0)	LD	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Indicates Not Analyzed

[3] Less Than Detectable (Refer to Table 8-2)

TABLE A-15

RADIONUCLIDE CONCENTRATONS IN GROUNDWATER SAMPLES
1987[1]
(µCi/ml)

LOCATION CODE	H-3	K-40 (E-07)	Co-60	Sr-90 (E-10)	Cs-137	Ra-226 (E-09)	Ra-228 (E-08)
H-12	---[2]	9.9 (4.4)	LD[3]	LD	LD	190 (26)	4.2 (2.3)
H-09b	---	LD	LD	LD	LD	LD	LD
WIPP-13	LD	LD	LD	LD	LD	84 (22)	2.0 (1.9)
H-07b	LD	LD	LD	LD	LD	LD	LD
WIPP-29	LD	170 (8.4)	LD	LD	LD	LD	LD
H-15	LD	12 (4.5)	LD	LD	LD	290 (31)	3.6 (3.1)
H-14	LD	LD	LD	LD	LD	76 (25)	LD
P-14	LD	16 (3.2)	LD	54 (36)	LD	37 (19)	2.2 (2.1)
WIPP-19	LD	6.3 (1.5)	LD	LD	LD	130 (32)	4.6 (2.5)
H-02a [4]	LD	LD	LD	LD	LD	38 (27)	4.1 (2.3)
H-02a	LD	LD	LD	LD	LD	LD	1.6 (1.5)
H-03b3	LD	LD	LD	LD	LD	110 (23)	2.4 (2.0)
H-03b1	LD	LD	LD	LD	LD	25 (18)	LD
H-11	LD	6.3 (1.6)	LD	LD	LD	130 (22)	LD
H-04b	LD	4.1 (4.1)	LD	LD	LD	63 (15)	2.2 (2.2)
H-04c	LD	LD	LD	LD	LD	39 (22)	LD
P-17	LD	9.0 (4.9)	LD	LD	LD	83 (21)	2.6 (1.7)
H-17	LD	10 (1.7)	LD	LD	LD	170 (25)	2.8 (2.1)
H-06c	LD	LD	LD	LD	LD	22 (12)	LD
H-18	LD	LD	LD	LD	LD	79 (21)	LD
H-06b	LD	6.5 (4.5)	LD	LD	LD	LD	LD

TABLE A-15

RADIONUCLIDE CONCENTRATIONS IN GROUNDWATER SAMPLES
1987
(µCi/ml)
(CONTINUED)

LOCATION CODE	Th-228 (E-09)	Th-230	Th-232	U-233 (E-10)	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)
H-12	LD	LD	LD	LD	5.2 (1.9)	LD	1.2 (.93)
H-09b	LD	LD	LD	LD	160 (13)	57 (30)	74 (8.9)
H-08b	LD	---	---	---	---	---	---
WIPP-13	LD	LD	LD	LD	93 (9.4)	16 (13)	18 (4.2)
H-07b	LD	LD	LD	LD	74 (5.9)	18 (9.8)	27 (3.5)
WIPP-29	LD	LD	LD	1.1 (1.1)	250 (8.8)	55 (15)	120 (6.0)
WIPP-26	---	---	---	---	---	---	---
WIPP-25	---	---	---	---	---	---	---
H-15	6.2 (4.6)		LD	LD	110 (10)	44 (24)	4.0 (2.2)
H-14	LD	LD	LD	LD	97 (5.6)	LD	12 (2.0)
P-14	LD	LD	LD	LD	41 (5.2)	LD	16 (3.2)
WIPP-19	LD	LD	LD	LD	160 (11)	LD	23 (4.3)
DOE-1	---	---	---	---	---	---	---
H-02a[4]	LD	LD	LD	LD	120 (9.6)	20 (17)	16 (3.4)
H-02a	LD	LD	LD	LD	LD	LD	LD
H-03b3	LD	LD	LD	LD	120 (9.6)	LD	14 (3.2)
H-03b1	LD	LD	LD	LD	LD	LD	LD
H-11	4.7 (4.5)	LD	LD	LD	88 (6.2)	LD	17 (2.7)
H-04b	LD	LD	LD	LD	110 (7.5)	LD	17 (3.0)
H-04c	LD	LD	LD	LD	51 (8.1)	LD	5.3 (2.8)
P-17	LD	LD	LD	LD	LD	LD	LD
H-17	LD	LD	LD	LD	110 (8.7)	LD	18 (3.5)
H-06c	LD	LD	LD	LD	130 (9.4)	14 (11)	30 (4.6)
H-18	LD	LD	LD	LD	92 (20)	170 (87)	23 (9.2)
H-06b	LD	LD	LD	LD	60 (7.7)	23 (16)	15 (3.9)

TABLE A-15

RADIONUCLIDE CONCENTRATIONS IN GROUNDWATER SAMPLES
1987
(μCi/ml)
(CONTINUED)

LOCATION CODE	Np-237	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-244
H-12	LD	LD	LD	LD	---	---
H-09b	LD	LD	LD	LD	LD	LD
H-08b	---	---	---	---	---	---
WIPP-13	LD	LD	LD	LD	---	---
H-07b	LD	LD	LD	LD	---	---
WIPP-29	LD	LD	LD	LD	---	---
WIPP-26	---	---	---	---	---	---
WIPP-25	---	---	---	---	---	---
H-15	LD	LD	LD	LD	---	---
H-14	LD	LD	LD	LD	---	---
P-14	LD	LD	LD	LD	---	---
WIPP-19	LD	LD	LD	LD	---	---
DOE-1	---	---	---	---	---	---
H-02a[4]	LD	LD	LD	LD	---	---
H-02a	LD	LD	LD	LD	---	---
H-03b3	LD	LD	LD	LD	---	---
H-03b1	LD	LD	LD	LD	---	---
H-11	LD	LD	LD	LD	---	---
H-04b	LD	LD	LD	LD	---	---
H-04c	LD	LD	LD	LD	---	---
P-17	LD	LD	LD	LD	---	---
H-17	LD	LD	LD	LD	---	---
H-06c	LD	LD	LD	LD	LD	LD
H-18	LD	LD	LD	LD	LD	LD
H-06b	LD	LD	LD	LD	---	---

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Indicates Not Analyzed

[3] Less Than Detectable (Refer to Table 8-2)

[4] Two samples taken at this location

TABLE A-16

RADIONUCLIDE CONCENTRATIONS IN PRIVATE WELLS
1987[1]
(µCi/ml)

WELL NAME	H-3	K-40	Co-60	Sr-90	Cs-137	Ra-226	Ra-228 (E-09)	Th-228 (E-09)	Th-230 (E-10)	Th-232
Mobley Well	LD[2]	LD	LD	LD	LD	LD	LD	LD	LD	LD
Comanche Well	LD	LD	LD	LD	LD	LD	LD	LD	LD	LD
Clifton Well	LD	LD	LD	LD	LD	LD	LD	9.6 (7.8)	LD	LD
Barn Well	LD	LD	LD	LD	LD	LD	2.8 (2.5)	LD	LD	LD
Fairview Windmill	LD	LD	LD	LD	LD	LD	LD	LD	---[3]	LD
Unger Windmill	LD	LD	LD	LD	LD	LD	LD	LD	LD	LD
Engle Windmill	LD	LD	LD	LD	LD	LD	LD		3.6 (3.0)	LD
Poker Trap Windmill	LD	LD	LD	LD	LD	LD	LD	7.8 (6.9)	LD	LD
Ranch Well	LD	LD	LD	LD	LD	LD	LD	LD	LD	LD

WELL NAME	U-233	U-234 (E-10)	U-235 (E-11)	U-238 (E-10)	Np-237	Pu-238	Pu-238/240	Pu-241	Am-241	Cm-244
Mobley Well	LD	67 (9.5)	LD	31 (6.4)	LD	LD	LD	LD	---	---
Comanche Well	LD	52 (5.6)	LD	29 (4.2)	LD	LD	LD	LD	---	---
Clifton Well	LD	230 (16)	62 (28)	120 (11)	LD	LD	LD	LD	---	---
Barn Well	LD	29 (4.1)	LD	14 (2.8)	LD	LD	LD	LD	LD	LD
Fairview Windmill	LD	21 (3.4)	10 (8.6)	11 (2.4)	LD	LD	LD	LD	---	---
Unger Windmill	LD	40 (5.2)	14 (10)	21 (3.7)	LD	LD	LD	LD	---	---
Engle Windmill	LD	11 (4.2)	100 (17)	2.9 (2.2)	LD	LD	LD	LD	---	---
Poker Trap Windmill	LD	31 (7.1)	28 (25)	17 (5.2)	LD	LD	LD	LD	---	---
Ranch Well	LD	8.9 (8.8)	19 (18)	28 (5.0)	LD	LD	LD	LD	---	---

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] Less Than Detectable (Refer to Table 8-2)

[3] Indicates Not Analyzed

TABLE A-17

RADIONUCLIDE CONCENTRATIONS IN BIOTIC SAMPLES
1986[1]
(µCi/g)

SAMPLE CODE[2]	Be-7 (E-05)	K-40 (E-07)	Co-60	Sr-90	Cs-137 (E-07)	Ra-226 (E-08)	Pu-238	Pu-239/240
BR-HLT	---[3]	280 (29)	LD[4]	LD	LD	55 (22)	LD	LD
BQ-HLT	---	290 (34)	LD	LD	LD	LD	---	---
BF-LMC	---	500 (74)	LD	LD	LD	LD	LD	LD
BV-HO6	11 (5.2)	910 (49)	LD	---	4.0 (1.9)	150 (73)	LD	LD
BV-WFF	LD	990 (58)	LD	---	4.8 (2.9)	150 (87)	LD	LD
BV-RO7	LD	520 (56)	LD	---	4.3 (3.5)	210 (90)	LD	LD
BB-STR-1.1	---	100 (15)	LD	LD	LD	LD	LD	LD
BB-STR-1.2	---	LD	LD	LD	LD	33 (23)	LD	LD
BB-SMR-1.1	---	82 (13)	LD	LD	LD	LD	LD	LD
BB-SMR-1.2	---	9.2 (5.8)	LD	LD	LD	33 (9.9)	LD	LD

SAMPLE CODE	Pu-241	Ra-228 (E-07)	Th-228 (E-08)	U-233	U-234 (E-08)	U-235 (E-08)	U-238 (E-08)
BR-HLT	LD	LD	25 (20)	LD	LD	LD	LD
BQ-HLT	---	LD	LD	LD	LD	LD	LD
BF-LMC	LD	LD	LD	LD	16 (7.4)	LD	15 (6.5)
BV-HO6	LD	13 (8.3)	53 (16)	LD	LD	LD	LD
BV-WFF	LD	LD	97 (48)	LD	LD	LD	1.5 (1.0)
BV-RO7	LD	22 (9.8)	100 (52)	LD	2.8 (1.8)	LD	3.4 (1.8)
BB-STR-1.1	LD	LD	LD	LD	LD	LD	LD
BB-STR-1.2	LD	5.1 (3.5)	23 (11)	LD	LD	LD	LD
BB-SMR-1.1	LD	LD	LD	LD	LD	LD	LD
BB-SMR-1.2	LD	2.5 (2.2)	14 (7.2)	LD	LD	LD	LD

(1) Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.
(2) BB = Beef Sample BV = Vegetation Sample
BR = Rabbit Sample BQ = Quail Sample
(3) Indicates Not Analyzed
(4) Less Than Detectable (Refer to Table 8-2)

TABLE A-18

RADIONUCLIDE CONCENTRATIONS IN BIOTIC SAMPLES
1987[1]
(µCi/g)

SAMPLE CODE [2]	Be-7 (E-05)	K-40 (E-07)	Co-60 (E-07)	Sr-90 (E-08)	Cs-137 (E-07)	Ra-226 (E-08)	Ra-228 (E-07)
BV-R07	5.7 (1.3)	860 (29)	LD[3]	---[4]	.82 (.81)	70 (48)	9.4 (5.2)
BV-WFF	11 (1.7)	1200 (41)	LD	---	LD	260 (71)	31 (10)
BV-H06	---	670 (51)	LD	---	LD	160 (110)	18 (11)
BQ-2.3	---	110 (21)	LD	LD	LD	LD	LD
BQ-WFF-2.3	---	110 (29)	LD	LD	LD	LD	LD
BF-CBD-2.3	---	180 (27)	LD	LD	LD	LD	LD
BR-WFF-2.3	---	91 (21)	LD	LD	LD	LD	LD

SAMPLE CODE	Th-228 (E-08)	U-233	U-234 (E-08)	U-235	U-238 (E-08)	Pu-238	Pu-239/240	Pu-241
BV-R07	27 (18)	LD	LD	LD	LD	LD	LD	LD
BV-WFF	81 (23)	LD	LD	LD	LD	LD	LD	LD
BV-H06	74 (34)	LD	2.9 (2.3)	LD	3.6 (1.9)	LD	LD	LD
BQ-2.3	LD	LD	LD	LD	LD	LD	LD	LD
BQ-WFF-2.3	LD	LD	LD	LD	LD	LD	LD	LD
BF-CBD-2.3	LD	LD	LD	LD	LD	LD	LD	LD
BR-WFF-2.3	LD	LD	LD	LD	LD	LD	LD	LD

[1] Data Presentation Format: Numbers are to the exponent at the top of the column; number in parenthesis is two standard deviations.

[2] BF = Fish Sample BV = Vegetation Source
BR = Rabbit Sample BQ = Quail Sample

[3] Less than detectable (Refer to Table 8-2)

[4] Indicates Not Analyzed

END

DATE
FILMED
9/2/93