

**Waste Isolation Pilot Plant
2001 Site Environmental Report**



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Processing and final preparation of this report was performed by the Waste Isolation Pilot Plant Management and Operating Contractor for the U.S. Department of Energy under Contract No. DE-AC04-01AL66444.

ACKNOWLEDGMENTS

We appreciate the reviews by Harold Johnson of the United States Department of Energy Carlsbad Field Office, the Carlsbad Field Office Technical Assistance Contractor, and Candice Jierree, Joe Harvill, Marsha Beekman, and Jeff Knox of Westinghouse TRU Solutions LLC.

Don Gray of the Environmental Evaluation Group provided radiological data for scientific comparisons in advance of releasing the data in their own report.

Many WTS groups contributed to this report, which would not have been complete and accurate without their assistance. Dirk Roberson provided advice and assistance with the color figures and designed the cover. Steve Offner produced the meteorological graphs.

The WTS Laboratory Group: Mansour Akbarzadeh, Okka Maung, Raymond Neuman, Joseph Ortiz, Randy Randolph, Ginny Waymire, Russ Whiteley, and Ying-Hua Xue provided the gross alpha and gross beta results for the ambient air filters.

The Authorization Basis Group: Anne Strait, Koreen Guillermo, Jim Hollen, Patty Hollen, Steve Travis, and Cindy Woodin, was very helpful throughout the writing of this report.

The WTS Radiation Safety and Emergency Management Group: Dave Kump, Marsha Beekman, Ted Sleeman, and Linda Frank-Supka, provided radiological and dosimetry data.

The WTS Environmental Monitoring Group: Stewart Jones, Mel Balderrama, Wes Boatwright, Mark Crawley, Walter Daszczyszak, Bill Foster, Oscar Garcia, Don Gilbert, Jack Hayes, Dave Hughes, Doug Lynn, Morgan Nail, Ron Richardson, Aurelio Rivas, and Roger Simmons collected samples and provided help when needed. Luann Underwood and Mak Walker reviewed and proofread the entire document. Irene Quintana was invaluable compiling all radiological data and was quick to respond to all queries. Wesley Nance edited and coordinated the writing of this report.

Formatting and editing were performed by Vivian Allen of L&M Technologies, Document Services.

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DOE/WIPP 02-2225

EXECUTIVE SUMMARY

The United States (U.S.) Department of Energy's (DOE) Carlsbad Field Office (CBFO) and Westinghouse TRU Solutions LLC (WTS) are dedicated to maintaining high quality management of Waste Isolation Pilot Plant (WIPP) environmental resources. DOE Order 5400.1, *General Environmental Protection Program*, and DOE Order 231.1, *Environmental, Safety, and Health Reporting*, require that the environment at and near DOE facilities be monitored to ensure the safety and health of the public and the environment. This Waste Isolation Pilot Plant 2001 Site Environmental Report summarizes environmental data from calendar year (CY) 2001 that characterize environmental management performance and demonstrate compliance with federal and state regulations.

This report was prepared in accordance with DOE Order 5400.1, DOE Order 231.1, the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH- 0173T), and the Waste Isolation Pilot Plant Environmental Protection Implementation Plan (DOE/WIPP 96-2199). The above Orders and guidance documents require that DOE facilities submit an annual site environmental report to DOE Headquarters, Office of the Assistant Secretary for Environment, Safety, and Health; and the New Mexico Environment Department (NMED). The purpose of this report is to provide a comprehensive description of operational environmental monitoring activities, to provide an abstract of environmental activities conducted to characterize site environmental management performance to confirm compliance with environmental standards and requirements, and to highlight significant programs and efforts of environmental merit at WIPP during CY 2001.

WIPP received its first shipment of waste on March 26, 1999. In 2001, no evidence was found of any adverse effects from WIPP on the surrounding environment.

Introduction

Located in southeastern New Mexico, WIPP is the world's first underground repository permitted to safely and permanently dispose of transuranic (TRU) radioactive and mixed waste generated through the research and production of nuclear weapons and other activities related to the national defense of the United States. TRU mixed waste is TRU waste mixed with hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA). TRU waste consists of material contaminated with more than 3.7×10^3 Bq/g (becquerels per gram) (100 nCi/g) of alpha-emitting elements having atomic numbers greater than uranium, the heaviest natural element. Most TRU waste is contaminated industrial trash, such as rags, old tools, sludges from solidified liquids; and glass, metal, and other materials from dismantled buildings.

WIPP's legislative mandate is to demonstrate the safe disposal of TRU wastes from national defense activities and programs. To fulfill this mandate, WIPP has been designed to safely handle, store, and dispose of TRU waste in a fully operational disposal facility. When waste arrives at WIPP, it is placed in excavated storage rooms, carved from rock salt, 655 m (2,150 ft) below the earth's surface. The nature of the salt

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is such that after a storage room has been filled, the salt will slowly fill the remaining spaces, thus isolating the waste for thousands of years.

Environmental Program Information

It is the DOE's policy to conduct its operations at WIPP in compliance with all applicable environmental laws and regulations, and to safeguard the integrity of the southeastern New Mexico environment. This is accomplished through a comprehensive management system consisting of radiological and nonradiological environmental monitoring, environmental compliance, and land management programs, which include wildlife monitoring and the WIPP Raptor Program (WRP). The purpose of these programs is to obtain land use permits, implement selected compliance functions such as National Environmental Policy Act (NEPA) compliance, collect data needed to detect and quantify possible impacts WIPP may have on the surrounding environment and to provide technical support to the DOE's Carlsbad Field Office in the fields of environmental science and land management.

Environmental activities at WIPP generally fall into four categories: collecting environmental samples and analyzing them for a variety of contaminants, preparing and publishing documents showing compliance with federal and state regulations, evaluating whether WIPP activities cause any environmental impacts, and taking corrective action when an adverse effect on the environment is identified.

The WIPP Environmental Monitoring Plan (EMP) (DOE/WIPP 99-2194) outlines the programs that monitor the environment on, and immediately surrounding, the WIPP site. It discusses major environmental monitoring and surveillance activities at WIPP and WIPP's quality assurance/quality control (QA/QC) program as it relates to environmental monitoring.

WIPP's effluent monitoring and environmental surveillance programs are designed to determine adequate protection of the public and the environment during DOE operations, and to ensure that operations comply with the DOE and other applicable federal and state radiation standards and requirements. The Environmental Monitoring Program monitors the pathways that radionuclides and other contaminants could take to reach the environment surrounding WIPP. Pathways monitored include air, ground-water, surface water, soils, sediments, vegetation, and game animals. Groundwater quality and wildlife populations are also monitored. The goal of the program is to determine if the local ecosystem has been impacted during the predisposal and disposal phases of WIPP, and, if so, to evaluate the severity, geographic extent, and environmental significance of those impacts. The Environmental Monitoring Program is conducted in compliance with DOE Orders 5400.1 and 5400.5.

Southeastern New Mexico is home to an abundant array of wildlife. Wildlife species are monitored on the WIPP site to document any population changes that may occur as a result of WIPP activities. Species of special concern, including federally listed threatened and endangered species, receive special consideration when planning WIPP activities that may impact wildlife habitat.

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WIPP's Land Management Plan (LMP) was created in accordance with the WIPP Land Withdrawal Act of 1992. This plan identifies resource values, promotes multiple-use management, and identifies long-term goals for the management of WIPP lands. In accordance with its LMP, WIPP follows a land reclamation program and a long-range reclamation plan. WIPP also conducts oil and gas surveillance in the region surrounding the WIPP site to identify new activities associated with oil and gas exploration and production.

Environmental Compliance

WIPP is required to comply with applicable federal and state laws and DOE Orders.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601 et seq) establishes a comprehensive federal strategy for responding to, and establishing liability for, releases of hazardous substances from a facility to the environment. Through December 2001, no release sites have been identified at WIPP that would require cleanup under provisions of CERCLA.

WIPP submitted the Annual Tier II Emergency and Hazardous Chemical inventory form, required by the Superfund Amendments and Reauthorization Act, on February 22, 2002. The Tier II is submitted to the State Emergency Response Commission (SERC), the Local Emergency Planning Committee (LEPC), and the fire departments with which the CBFO maintains a Memorandum of Understanding (MOU).

Federal Acquisition, Recycling, and Pollution Prevention

In 1995, WIPP adopted a systematic and cost-effective affirmative procurement plan (APP) for the promotion and procurement of products containing recovered materials. Affirmative procurement is designed to "close the loop" in the waste minimization recycling process by supporting the market for materials collected through recycling and salvage operations.

WIPP continued its recycling program in 2001. Noteworthy pollution prevention (P2) activities completed:

- Chemical Use Reduction
- Reduction of Office Supplies
- Improvements in the Recycling Center

Resource Conservation and Recovery Act

The RCRA ensures that hazardous wastes are managed from the point of generation through ultimate disposal in a manner that is protective of human health and the environment. The state of New Mexico is authorized by U.S. Environmental Protection Agency (EPA) to implement the provisions of the RCRA in accordance with the New Mexico Hazardous Waste Act. WIPP has a Hazardous Waste Facility Permit (HWFP) from the NMED in accordance with 20.4.1.500 NMAC [New Mexico Administrative Code] and 20.4.1.900 NMAC. The HWFP authorizes the storage of contact-handled (CH) TRU waste in two locations (the Parking Area Unit and Waste Handling Building) and the disposal of CH TRU waste in the three underground Hazardous Waste Disposal Units.

National Environmental Policy Act

The NEPA requires the federal government to use all practicable means to consider potential environmental impacts of proposed federal projects as part of the decision-making process. The NEPA dictates the public shall be allowed to review and comment on proposed projects that have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs, and resources relating to human health and the environment.

Title 10 *Code of Federal Regulations* (CFR) §1021.331 requires, following completion of each Environmental Impact Statement (EIS) and its associated Record of Decision (ROD), that the DOE prepare a mitigation action plan addressing mitigation commitments expressed in the ROD. DOE Order 451.1B requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation. To fulfill this DOE Order requirement, the CBFO issued the 2001 Annual Mitigation Report for the Waste Isolation Pilot Plant on July 2001.

Clean Air Act

The Clean Air Act provides for the preservation, protection, and enhancement of air quality. Under Section 109 of the Clean Air Act, the EPA established the National Ambient Air Quality Standards for six "criteria" pollutants. The initial WIPP emissions inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria pollutants. The air emissions inventory is conducted biennially and compared to baseline data to identify trends and potential emissions problems. The biennial inventory scheduled for CY 1998 was postponed because conditions at the site were unchanged from the previous inventory. The air emissions inventory for CY 1999 was conducted in 2000. Based on the 1999 air emissions inventory, WIPP operations do not exceed the 10-ton-per-year emission limit for any individual pollutant or the 25-ton-per-year limit for any combination of pollutants.

Based on emission estimates generated in the air emissions inventory, the WIPP site is not required to obtain federal Clean Air Act permits.

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WIPP was required to obtain a New Mexico Air Quality Construction Permit for two primary backup diesel generators. During 2001, the generators were operated for approximately 28 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operations that would cause a violation of the permit.

Clean Water Act

Section 402 of the Clean Water Act established provisions for the issuance of permits for discharges into waters of the United States. WIPP has no pollutant discharges from point sources and is currently exempt from obtaining a National Pollutant Discharge Elimination System (NPDES) permit.

A permit for Storm Water Discharge Associated with Industrial Activity was issued in 1998. No sampling is required to demonstrate compliance with this permit unless a release occurs. Operational permit compliance activities are limited to quarterly inspections of retention basins, spill containment devices, reclamations sites, and site housekeeping practices.

Quarterly discharge monitoring reports are submitted to the NMED to demonstrate compliance with inspection, monitoring, and reporting requirements as identified in the WIPP Discharge Plan (DP-831) issued by the NMED. Refer to Section 3.2.6 for detailed information.

Safe Drinking Water Act

The Safe Drinking Water Act of 1974 (SDWA) provides the regulatory strategy for protecting public water supply systems and sources of drinking water. The WIPP water supply is categorized as a nontransient, noncommunity system for reporting and testing requirements. The water supply is sampled ten times every three years for various chemical constituents. Samples were collected in July 2001, and the results were submitted to the NMED. All samples were below action levels as specified by New Mexico monitoring requirements for lead and copper in tap water. The next lead and copper sampling period will be July 2004. Bacterial samples were collected and reported monthly throughout 2001. All results were below SDWA regulatory limits.

National Historic Preservation Act

The National Historic Preservation Act (NHPA) was enacted to protect the nation's cultural resources and establish the National Register of Historic Places. Federal agencies are required to ensure that historic and cultural properties are given proper consideration in the preparation of NEPA-related documents. No new archeological sites were discovered in 2001.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act is one of the major transportation-related statutes that affects WIPP operations. It provides for the safe transportation of hazardous materials, including radioactive materials. DOE Orders establish packaging and transportation criteria and require DOE field offices to conduct their operations in accordance with all applicable international, federal, state, local, and tribal laws, rules, and regulations governing materials transportation. These DOE Orders also require the development of a transportation plan and use of the DOE TRANSCOM (transportation and tracking communications) system to monitor shipments.

Packaging and Transporting Radioactive Materials

The WIPP Land Withdrawal Act requires TRU waste containers destined for WIPP to be shipped using specification packagings certified by the Nuclear Regulatory Commission (NRC). Certified shipping containers for TRU waste satisfy NRC QA requirements. Contact-handled TRU waste will be shipped in TRUPACT-II (Transuranic Package Transporter Model II) and HalfPACT (short Transuranic Package Transporter) containers. Containers for remote-handled waste were certified in 2001.

Environmental Compliance Assessment Program

The Environmental Compliance Assessment Program plays a major role in the overall program for environmental protection activities at WIPP. The program was developed to determine if facility activities protect human health and the environment and if these activities are in compliance with applicable federal, state, and local requirements; with permit conditions and requirements; and with best management practices. During 2001, WTS environmental compliance assessments identified and implemented a number of improvements.

Environmental Management System

The WTS Environmental Management System (EMS) received International Organization for Standardization (ISO) 14001 third-party registration on August 5, 1997. Two third-party surveillance audits were conducted in 2001. No nonconformance or findings were identified during the 2001 surveillance period. The EMS registrar recommended continued registration of the WTS EMS.

Pollution Prevention Committee

WIPP's P2 Committee was formed in 1993. The primary purpose of this committee is to foster recycling activities at WIPP. The committee sponsored activities to raise employee awareness of waste minimization on Earth Day, National America Recycles Day, and during Energy Month (October).

Environmental Training

Environmental training was provided to personnel associated with environmental operations at WIPP. The WIPP training program has been designed to ensure that personnel performing work are capable of performing their assigned task proficiently. Personnel who perform work that requires special skills or abilities are required to meet the qualification requirements for that specific task unless directly supervised by a qualified person. The WTS Technical Training Section maintains a total of fifteen qualification cards, which are reviewed and updated biennially. This insures that proper adequate training is performed regularly.

Environmental Radiological Program Information

Radionuclides present in the environment, whether naturally-occurring or from human-made sources, contribute to radiation doses to humans. Therefore, environmental monitoring around nuclear facilities is imperative for characterizing radiological conditions, and for detecting releases and determining their effects, should they occur. The WIPP Environmental Monitoring Program monitors air, surface and groundwater, soils, and biota to characterize the radiation environment and to detect potential releases from WIPP activities. Plutonium-238, $^{239+240}\text{Pu}$, ^{241}Am , ^{60}Co , ^{90}Sr , ^{137}Cs , ^{234}U , ^{235}U , and ^{238}U are monitored because they are components of TRU waste. Potassium-40 is monitored because of possible enhancement in southeastern New Mexico due to potash mining.

Effluent Monitoring

If radionuclides are released into the environment from WIPP, they would first be detected in airborne effluents. Therefore, WIPP monitors airborne effluents from the facility at three locations. Station A samples unfiltered underground exhaust air, Station B samples unfiltered underground exhaust air in maintenance mode and high efficiency particulate air (HEPA) filtered exhaust air in filtration mode, and Station C samples HEPA filtered air from the Waste Handling Building. Samples were composited monthly or quarterly, in accordance with the Periodic Confirmatory Measurement Protocol for the Waste Isolation Pilot Plant, and analyzed for ^{241}Am , ^{238}Pu , and $^{239+240}\text{Pu}$.

Airborne Gross Alpha/Beta

Gross alpha and beta measurements in airborne particulates are used as screening techniques to provide timely information on levels of radioactivity in the environment around the WIPP site. Airborne particulate samples were collected from seven locations around WIPP on a weekly basis. Analysis of Variance (ANOVA) indicated no statistically significant differences between sampling years 2000 and 2001.

Airborne Particulates

Inhalation of dust particles is the major pathway for the intake of plutonium. Accordingly, plutonium and other radionuclides of interest were determined in air particulate samples around WIPP. There were no statistically significant differences between sampling years 2000 and 2001 for the concentration of any radionuclide in composite air filters.

Groundwater

Groundwater samples, collected twice in 2001 from seven wells around WIPP, were analyzed for gamma-emitting radionuclides, ^{90}Sr , and isotopes of uranium, plutonium, and americium. Isotopes of naturally-occurring uranium were detected in every well. The results for the concentrations of uranium isotopes in water samples collected in 2001 were compared with the results from 2000. There was a notable difference in concentrations of uranium isotopes between groundwater samples collected in 2000 and 2001 because of the laboratory's analytical method and counting duration.

Surface Water

Surface water samples were collected once from each of ten locations around WIPP in 2001. There were no significant differences in concentration of uranium isotopes between years. Large spatial variations in uranium concentrations in surface water are expected because of the different characteristics of the water bodies and the underlying sediments.

Soil Samples

Soil samples were collected from six locations surrounding WIPP. Samples from each location were collected at three different depths. Measurements of radionuclides in depth profiles provide information about their vertical movements in soil systems. There were no statistically significant differences between sampling years for the concentration of any radionuclide.

Sediments

Sediment samples were collected from 12 locations around the WIPP site, mostly from the same water bodies from which the surface water samples were collected. There were no statistically significant differences between sampling years 2000 and 2001 for the concentration of any radionuclide.

Biota

The concentration of radionuclides in plants is an important factor in estimating the intake of individual radionuclides by humans through ingestion. Therefore, rangeland vegetation samples were collected from the same six locations where soil samples were collected. Also collected were muscle tissues from three road-killed deer, two quail, and

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one rabbit; species commonly consumed by humans. Fish samples were taken from three different locations on the Pecos River. The whole fish and the muscle tissue from the deer, quail, and rabbit were analyzed for radionuclides (see Section 4.8).

Environmental Nonradiological Program Information

Nonradiological environmental surveillance programs at WIPP include land management programs (including reclamation of disturbed lands, oil and gas surveillance, and wildlife population monitoring) and meteorological monitoring. In addition to nonradiological environmental surveillance programs, volatile organic compounds (VOCs) were monitored to comply with provisions of WIPP's HWFP, and liquid effluent monitoring was conducted in accordance to WIPP Discharge Plan criteria.

WIPP Raptor Program

The WRP was established in the early 1990s to monitor and protect raptors on the WIPP site, and to educate site workers and the public about these birds. The program presently serves four functions: wildlife monitoring, scientific research, community outreach, and interagency cooperation.

Meteorology

The main function of the WIPP meteorological station is to provide data for atmospheric dispersion modeling. The station measures and records wind speed, wind direction, and temperature at elevations of 2, 10, and 50 m (6.5, 33, and 165 ft). The station records ground-level measurements of barometric pressure, relative humidity, precipitation, and solar radiation.

Volatile Organic Compound Monitoring

The VOC monitoring program is designed to measure VOC concentrations attributable to hazardous waste disposal units (panels), which are either open and are in the process of being filled or which are full and have been closed. This Confirmatory VOC Monitoring Program was implemented as a requirement of the HWFP, Module IV, Section D and Attachment N, and is intended to demonstrate that regulated VOCs are not being emitted by the waste at concentrations in excess of concentrations of concern (see Table 5.7) as prescribed in the permit.

Seismic Activity

Currently, seismicity within 300 km (186 mi) of the WIPP site is being monitored by the New Mexico Institute of Mining and Technology (NMIMT), in Socorro, New Mexico, using data from a seven-station network approximately centered on the site (Figure 5.8). Station signals are transmitted to the NMIMT Seismological Observatory in Socorro. When appropriate, readings from the WIPP network stations are combined with readings from an additional NMIMT network in the central Rio Grande Rift.

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Occasionally, data are also exchanged with the University of Texas at El Paso and Texas Tech University in Lubbock, both of which operate stations in west Texas.

Liquid Effluent Monitoring

The WIPP sewage lagoon system is a zero-discharge facility. The entire facility is lined with 30-mil synthetic liners and is designed to dispose of domestic sewage as well as site-generated brine waters. The facility is operated under the conditions of DP-831, and is managed in accordance with EPA sewage sludge regulations, New Mexico Water Quality Control Regulations, and applicable WIPP controlled procedures.

Groundwater Monitoring

Current groundwater monitoring activities at WIPP are outlined in the *WIPP Groundwater Monitoring Program Plan*. Data obtained by the WIPP Groundwater Monitoring Program supports two major programs at WIPP: (1) the RCRA Detection Monitoring Program, and (2) performance assessments supporting the Compliance Certification Application.

Groundwater monitoring activities during 2001 included groundwater quality sampling and groundwater level monitoring. Groundwater quality data were gathered from six wells in the Culebra member of the Rustler Formation and one well in the Dewey Lake Formation.

Radiological Dose Assessment

The potential radiation dose to members of the public from WIPP operations was calculated to demonstrate compliance with federal regulations and the DOE's policies and objectives of keeping this dose as low as possible.

Dose Limits

For more than 50 years, extensive research has been conducted on the effects of radiation on humans and the environment. Much of this research used standard epidemiological and toxicological approaches to characterize the response of populations and individuals to high radiation doses. From this, a good understanding of the risks associated with high radiation doses was achieved. However, there is still uncertainty as to what risks are incurred from low radiation dose and dose rates, so models are used to predict these risks.

Background Radiation

Radiation is a naturally-occurring phenomenon that has been in the environment since the beginning of time. There are several sources of natural radiation: cosmic and cosmogenic radiation (from outer space and the earth's atmosphere), terrestrial radiation (from the earth's crust), and internal radiation (naturally-occurring radiation in our bodies). In addition to natural radioactivity, small amounts of radioactivity from the

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1986 Chernobyl nuclear accident and above-ground nuclear weapons tests that occurred from 1945 to 1980 are also present in the environment. Together, these sources of radiation are called "background" radiation. Every human is constantly exposed to background radiation. Exposure to radioactivity from weapons testing fallout is quite small compared to natural radioactivity and continually gets smaller as radionuclides decay. The average annual dose received by a member of the public from naturally-occurring radionuclides is about 3 mSv (millisievert) (300 mrem) (NCRP [National Council on Radiation Protection and Measurements], 1987).

Dose from Air Emissions

The National Emission Standards for Hazardous Air Pollutants (NESHAP) issued by the EPA set limits for doses due to radionuclide emissions to air. To determine the potential radiation dose received by members of the public from WIPP, WTS used the computer model CAP88-PC, version 2.0. CAP88 dose calculations are based on the assumption that exposed persons remain at home during the entire year and all vegetables, milk, and meat consumed are home produced. Thus, this dose calculation is a maximum potential dose which encompasses dose from inhalation, plume submersion, deposition, and ingestion of air emitted radionuclides.

Total Potential Dose from WIPP Operations

The potential dose to an individual from the ingestion of WIPP-related radionuclides transported in water is estimated to be nonexistent. Drinking water for communities near WIPP comes from groundwater sources which are too far away to be affected by potential WIPP contaminants. Groundwater and surface water samples collected around WIPP during 2001 did not contain radionuclide concentrations different from those in samples collected prior to WIPP receiving waste.

Game animals sampled during 2001 were mule deer, quail, fish, and rabbit. The only radionuclides detected, were not different from background levels measured prior to commencement of waste shipments to WIPP. Therefore, no dose from WIPP related radionuclides is estimated to have been received by any individual from this pathway during 2001.

The only pathway for which a dose could be estimated was that of air emissions. Air emissions from WIPP were not considered above background ambient air levels. Estimated concentrations of radionuclides in air emissions accounted for the calculable dose from WIPP operations during 2001.

Dose to Nonhuman Biota

DOE Order 5400.5 lists the environmental radiation protection requirements that WIPP must meet to protect aquatic animals. In addition, dose limits below which no deleterious effects on populations of aquatic and terrestrial organisms have been observed, have been discussed by the National Council on Radiation Protection and

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Measurements and the International Atomic Energy Agency. Those absorbed dose limits are:

- Aquatic Animals 10 mGy/d (1 rad/d)
- Terrestrial Plants 10 mGy/d (1 rad/d)
- Terrestrial Animals 1 mGy/d (0.1 rad/d)

The DOE requires discussion of radiation doses to non-human biota in the Annual Site Environmental Report using the DOE Interim Technical Standard, DOE-STD-XXXX-YR, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*. The Interim Technical Standard uses a multiphase approach, including an initial screening phase with conservative assumptions.

This guidance was used to screen radionuclide concentrations observed around WIPP during 2001. The sum of fractions was less than one for all media, demonstrating compliance with the proposed rule. Radiation in the environment surrounding WIPP does not have a deleterious effect on populations of plants and animals.

Quality Assurance

The fundamental objective of a QA program is to ensure high-quality measurements are produced and reported from the analytical laboratory. The defensibility of data generated by laboratories must be based on sound scientific principles, method evaluations, and data verification and validation. Wastren, of Grand Junction, Colorado; Air Toxics, Ltd. of Folsom, California; and Trace Analysis, of Lubbock, Texas, were the contract laboratories that performed the radiological and nonradiological analyses for WIPP environmental samples. WIPP Laboratories performed the radiological analyses on the environmental monitoring samples.

WTS performed assessments and audits to ensure that the quality of the systems, processes, and deliverables was maintained or improved in 2001.

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CHAPTER 1 - INTRODUCTION

WIPP is the world's first underground repository with the necessary permits and certifications for safe and permanent disposal of TRU radioactive and mixed waste generated by defense-related activities. A TRU waste is eligible for disposal at WIPP if it has been generated in whole or in part by one or more of the activities listed in the Nuclear Waste Policy Act of 1982 (41 *United States Code* [U.S.C.] 10101[3]), including naval reactors development, weapons activities, verification and control technology, defense nuclear materials production, defense nuclear waste and materials by-products management, defense nuclear materials security and safeguards and security investigations, and defense research and development.

TRU waste is defined in the WIPP Land Withdrawal Act of 1992 (Public Law [Pub. L.] 102-579) as radioactive waste containing more than 100 nanocuries (3,700 becquerels [Bq]) of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years. A TRU isotope is an isotope of an element with an atomic number greater than uranium (92). There are certain exceptions to the WIPP Land Withdrawal Act definition, including high-level radioactive waste; waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by 40 CFR Part 191 disposal regulations; or waste that the NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. Most TRU waste is contaminated industrial trash, including used protective clothing, rags, tools and equipment, sludges from solidified liquids, and glass, metal, and other materials from dismantled buildings.

The WIPP Project is authorized by the DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164). WIPP's legislative mandate is to demonstrate the safe disposal of TRU wastes from national defense activities and programs. To fulfill this mandate, WIPP has been designed to safely handle, store, and dispose of TRU waste in a fully operational disposal facility. After more than 20 years of scientific study, public input, and regulatory struggles, WIPP received its first shipment of waste on March 26, 1999.

When TRU waste arrives at WIPP, it is transported into the Waste Handling Building. The waste containers are removed from the shipping containers, placed on the waste hoist, and lowered to the repository level of 655 m (2,150 ft; approximately 0.5 mi) below the surface. During the disposal phase, the containers of waste are removed from the hoist and placed in excavated storage rooms in the Salado Formation, a thick sequence of salt beds deposited approximately 250 million years ago (Figure 1.1). Once a disposal area has been filled with waste, specially designed closures will be placed in the excavated disposal rooms, and seals will be placed in the shafts. Salt under pressure is relatively plastic, and mine openings will be allowed to creep closed for final disposal, encapsulating and isolating the waste.

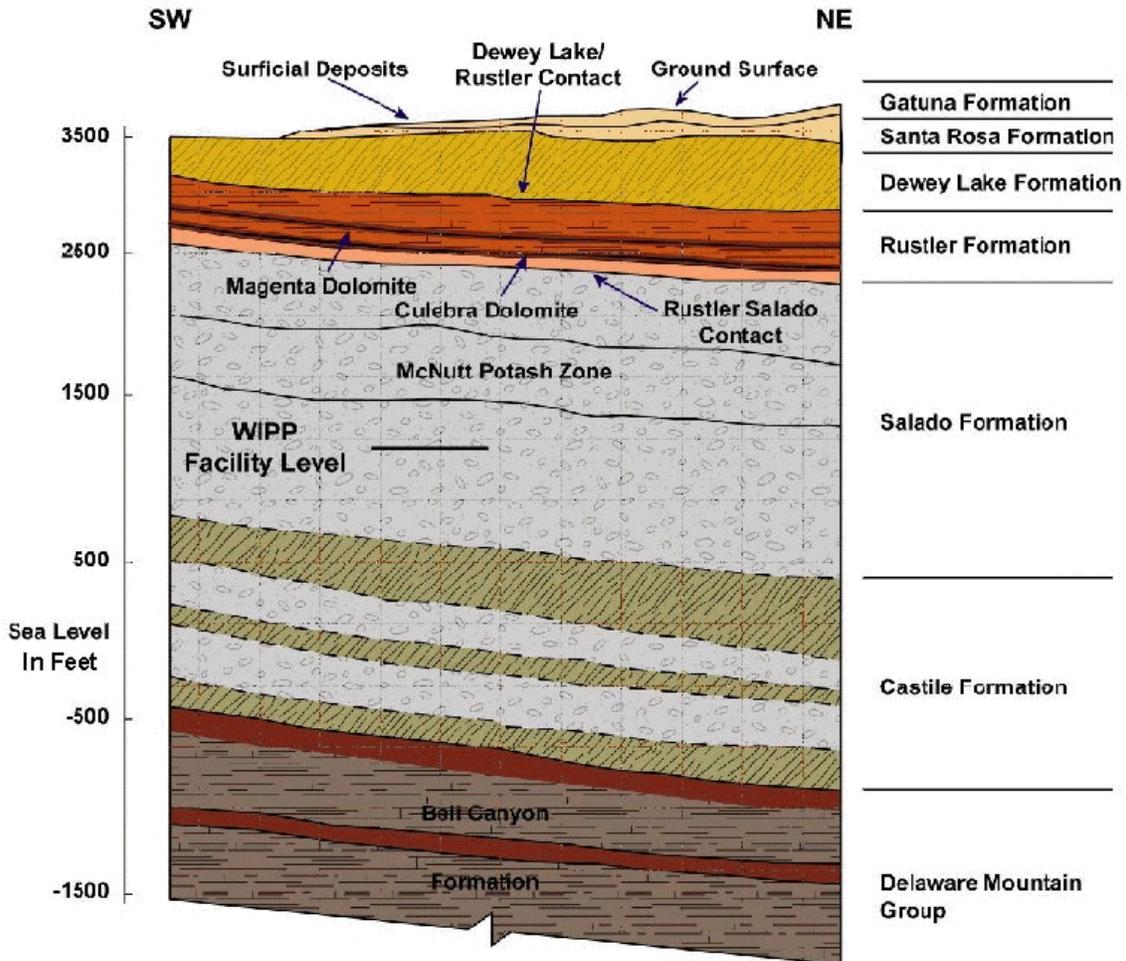


Figure 1.1 - WIPP Stratigraph

1.1 WIPP History

Government officials and scientists initiated the WIPP site selection process in the 1950s. At that time, the National Academy of Sciences conducted a nationwide search for stable geological formations to contain wastes for thousands of years. In 1955, after extensive study, salt deposits were recommended as a promising medium for the disposal of radioactive waste.

Salt was chosen as the material for the planned disposal of nuclear waste for several reasons. Most deposits of salt are found in stable geological areas with very little earthquake activity, assuring the stability of a waste repository. Salt deposits also demonstrate the absence of flowing fresh water that could move waste to the surface. Water, if it had been or were present, would have dissolved the salt beds. In addition,

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salt is relatively easy to mine. Finally, rock salt heals its own fractures because it is relatively plastic. This means salt formations will slowly and progressively move in to fill mined areas and will safely seal radioactive waste from the environment.

Government scientists searched for an appropriate site for the disposal of radioactive waste throughout the 1960s, and finally tested the area of southeastern New Mexico in the early 1970s. Salt formations at WIPP were deposited in thick beds during the evaporation of an ancient ocean, the Permian Sea. These geologic formations consist mainly of sodium chloride, the same substance as table salt. However, at WIPP, the salt is not granular, but is in the form of solid rock. The main salt formation at WIPP is about 610 m (2,000 ft) thick, and begins 259 m (850 ft) below the earth's surface. Formed about 225 million years ago during the Permian Age, the large expanses of uninterrupted salt beds provide a repository that has been stable and free from the disturbances of large earthquakes for more than 200 million years. This proven stability over such a long time span offers the predictability that the salt will remain stable for the comparatively short 10,000-year period that WIPP is mandated to isolate the waste from the human environment.

In 1979, Congress authorized the construction of WIPP, and the DOE constructed the facility during the 1980s. In late 1993, the DOE created the CBFO to lead the TRU waste disposal efforts. The CBFO coordinates the TRU program at waste-generating sites and national laboratories.

In 1999, WIPP received its first waste shipment. On March 25, the first waste bound for WIPP departed Los Alamos National Laboratory in New Mexico; it arrived at WIPP the following morning, and the first wastes were placed underground later that day. On April 17, WIPP celebrated its official grand opening. Ten days later, on April 27, the first out-of-state shipment arrived at WIPP, from the Idaho National Engineering and Environmental Laboratory. Later in the year, on October 27, the Secretary of the NMED issued a WIPP HWFP, which allows WIPP to manage, store, and dispose of contact-handled TRU mixed waste. Mixed waste is waste contaminated by both hazardous and radioactive substances. "Contact-handled mixed waste" is TRU mixed waste with a surface dose rate less than 200 millirem per hour.

1.2 WIPP's Mission

Current temporary radioactive waste storage facilities at 23 locations across the United States were never intended to provide permanent disposal. WIPP is the nation's first operating underground repository for defense-generated TRU waste and is a critical step toward solving the nation's nuclear waste disposal problem. Its mission is to provide for the safe, permanent, and environmentally sound disposal of TRU radioactive waste left from research, development, and production of nuclear weapons. Over the next 35 years, WIPP is expected to receive about 37,000 shipments of waste from locations across the United States.

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The mission of the CBFO is to protect human health and the environment by opening and operating WIPP for safe disposal of TRU waste and by establishing an effective system for management of TRU waste from generation to disposal.

1.3 WIPP Location

Located in Eddy County in the remote Chihuahuan Desert of southeastern New Mexico (Figure 1.2), the WIPP site encompasses approximately 41.1 km², or 16 mi². The site is 42 km (26 mi) east of Carlsbad in a region known as Los Medaños. This part of New Mexico is relatively flat and is sparsely inhabited, with little surface water. The WIPP site boundary extends a minimum of 1.6 km (1 mi) beyond any of the WIPP underground developments. The WIPP Land Withdrawal Act was signed into law on October 30, 1992, transferring the land from the Department of the Interior to the DOE. With the exception of facilities within the boundaries of the posted 5.7 km² (2.2 mi²) Off-Limits Area, the surface land uses remain largely unchanged from pre-1992 uses, and are managed in accordance with accepted practices for multiple land use. However, mining and drilling for purposes other than those which support WIPP are prohibited within the WIPP site.

The majority of the lands in the immediate vicinity of WIPP are managed by the Department of the Interior's Bureau of Land Management (BLM). Land uses in the surrounding area include livestock grazing; potash mining; oil and gas exploration and production; and recreational activities such as hunting, camping, hiking, and bird watching. The region is home to diverse populations of animals and plants.

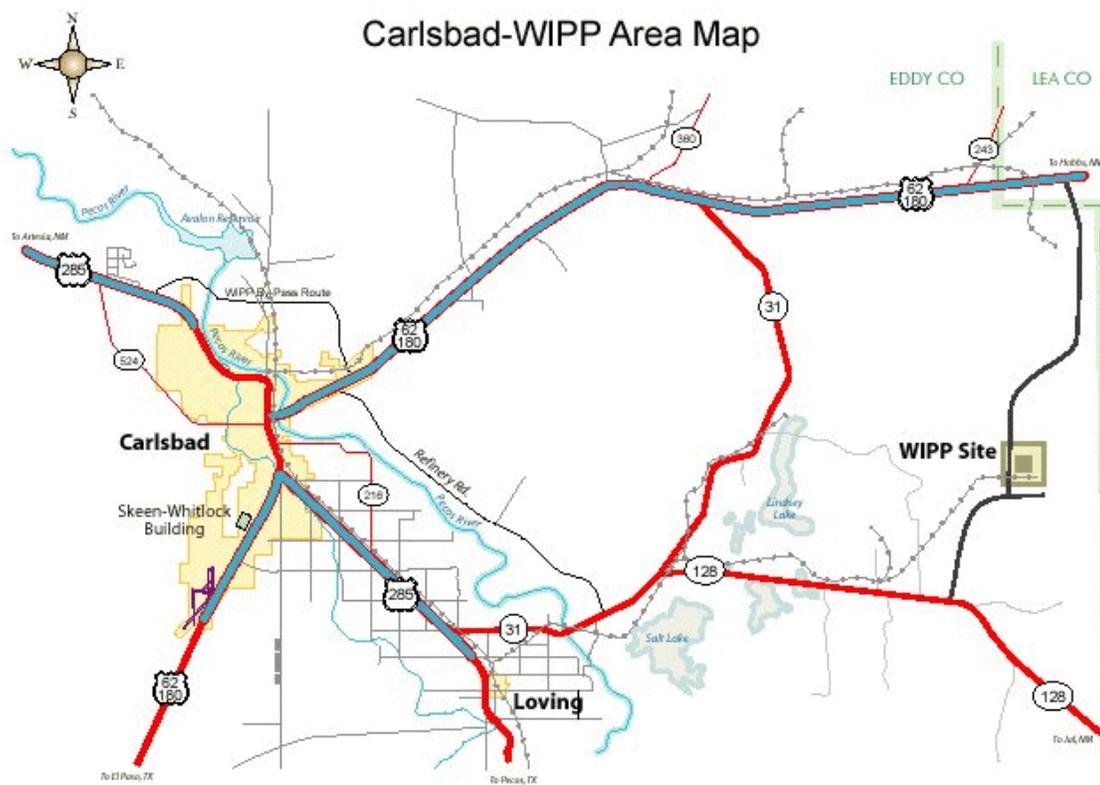


Figure 1.2 - WIPP Location

1.3.1 WIPP Property Areas

Five types of property areas are found within WIPP's boundary (Figure 1.3).

Property Protection Area

The interior core of the facility encompasses approximately 0.129 km² (0.05 mi²) surrounded by a chain link fence. This area is under tight security and uniformed security personnel are on duty 24 hours a day.

Exclusive Use Area

The Exclusive Use Area comprises 1.12 km² (0.432 mi²). It is surrounded by a five-strand barbed wire fence and is restricted exclusively for the use of the DOE and its contractors and subcontractors in support of the project. In addition, this area is defined as the point of closest public access for the purpose of analyzing accident consequences to the general public in the WIPP Safety Analysis Report (DOE/WIPP 95-2065). This area is marked by DOE warning (e.g., "no trespassing")

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signs and is patrolled by WIPP security personnel to prevent unauthorized activities or uses.

Off-Limits Area

Managed as an area where unauthorized entry and introduction of weapons and/or dangerous materials is prohibited, the Off-Limits Area includes 5.7 square kilometers (km²) (2.2 square miles [mi²]). Pertinent prohibitions are posted at consistent intervals along the perimeter. Grazing and public thoroughfare will continue in this area until such time that these activities present a threat to the security, safety, or environmental quality of WIPP. This sector is patrolled by WIPP security personnel to prevent unauthorized activity or use.

WIPP Land Withdrawal Area

The WIPP site boundary delineates the perimeter of the 41.4 km² (16 mi²) WIPP Land Withdrawal Area. This tract includes properties outlying the Property Protection Area, the Exclusive Use Area, and the Off-Limits Area. This sector is designated as a Multiple Land Use Area, and is managed accordingly.

Special Management Areas

Certain properties used in the operation of WIPP (e.g., reclamation sites, well pads, roads) are, or may be, identified as Special Management Areas (SMA). A SMA designation is made due to values, resources, and/or circumstances that meet criteria for protection and management under special management designations. Unique resources of value that are in danger of being lost or damaged, areas where ongoing construction is occurring, fragile plant and/or animal communities, sites of archaeological significance, locations containing safety hazards, or sectors that may receive an unanticipated elevated security status would be suitable for designation as a SMA. Accordingly, the subject sector would receive special management emphasis under this stipulation. Special Management Areas will be posted against trespass and will be safeguarded commensurate with applicable laws governing property protection. WIPP security personnel will patrol these areas to prevent unauthorized access or use.

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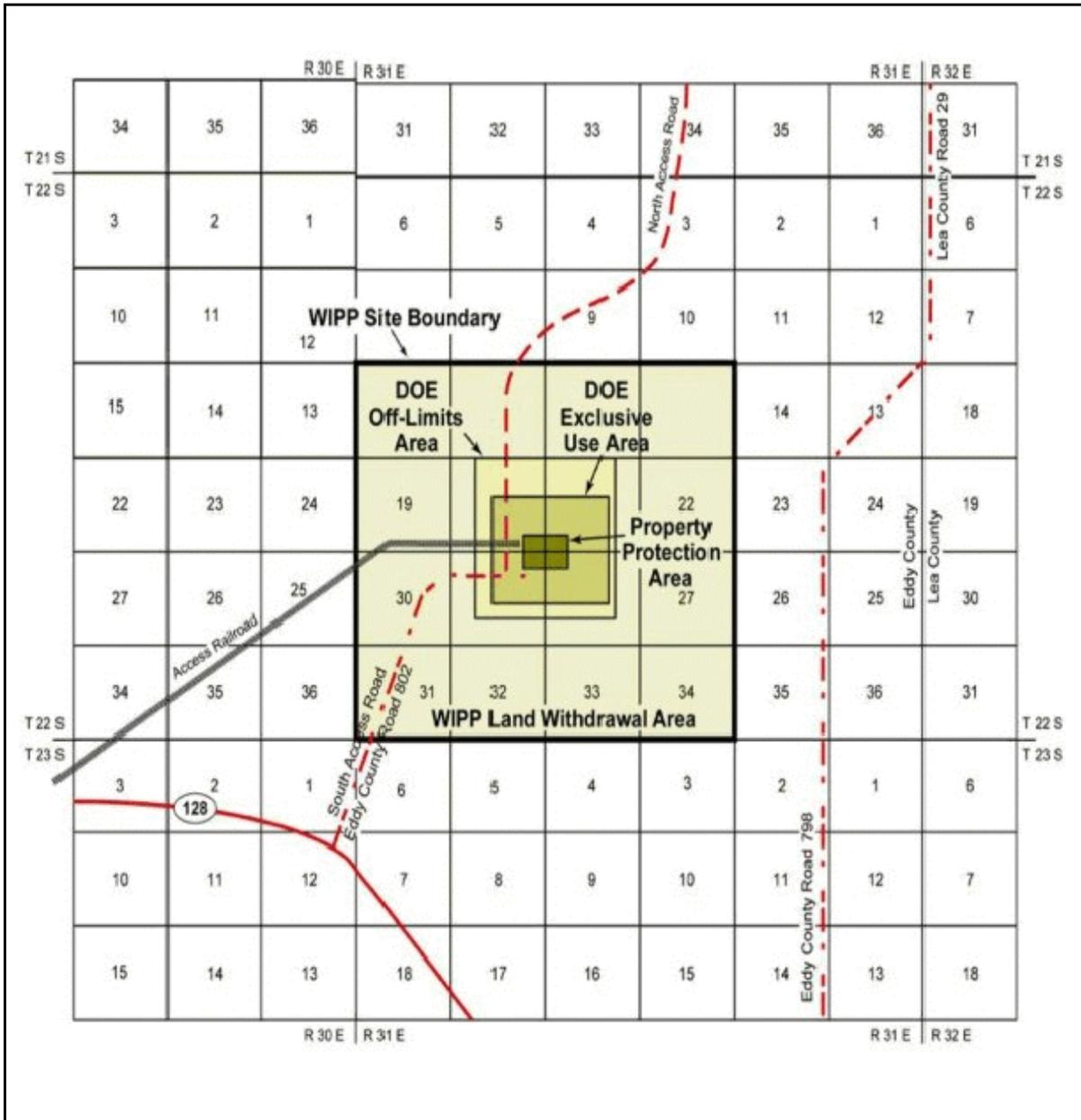


Figure 1.3 - WIPP Property Areas

1.3.2 Population

Approximately 26 residents live within 16 km (10 mi) of the WIPP site. The majority of the local population within 80.5 km (50 mi) of WIPP is concentrated in and around the communities of Carlsbad, Hobbs, Eunice, Loving, Jal, and Artesia, New Mexico. The nearest community is the village of Loving (current estimated population 1,326), 29 km (18 mi) west-southwest of WIPP. The nearest major populated area is Carlsbad, 42 km (26 mi) west of WIPP. The current estimated population of Carlsbad is approximately 25,625. The population within 16 km (10 mi) of WIPP is associated with ranching, oil

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and gas exploration/production, and potash mining. There are two nearby ranch residences (Smith Ranch and Mills Ranch) which are continuously monitored as part of the EMP.

1.4 Environmental Performance

The DOE's Environmental Policy Statement (DOE, 1986) describes the DOE's commitment to environmental protection and pledges to conduct operations "in an environmentally safe and sound manner. . . in compliance with the letter and spirit of applicable environmental statutes, regulations, and standards" (DOE, 1986). The Statement also affirms the DOE's commitment to "good environmental management in all of its programs and at all of its facilities in order to correct existing environmental problems and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or public welfare." Additionally, it states, "It is DOE's policy that efforts to meet environmental obligations be carried out consistently across all operations and among all field organizations and programs. . ." (DOE, 1986).

The DOE used laboratory tests, field tests, and computer models to demonstrate WIPP's expected 10,000 year performance as a permanent disposal site. The EPA certified, in May 1998, WIPP's ability to protect the environment and human health, while assuring continued compliance through periodic recertification.

WTS conducted the Environmental Monitoring Program at WIPP in CY 2001 to monitor for any potential radiological effects of WIPP on people and the environment. Other organizations oversee the WIPP program, including the EPA, which is responsible for certifying whether radioactive material disposal requirements are met; the state of New Mexico, which regulates the handling of the hazardous components of mixed wastes; and the Environmental Evaluation Group (EEG), an independent technical oversight group that participates in and comments on various WIPP issues and activities. The Carlsbad Environmental Monitoring and Research Center conducts a supplementary environmental monitoring program around WIPP. Several other agencies, committees, and panels monitor progress at WIPP and contribute to the project's development through regulation, review, and comment at the state and federal levels.

This Waste Isolation Pilot Plant 2001 Site Environmental Report was prepared in accordance with DOE Order 231.1. This report documents WIPP's radiological, nonradiological, and groundwater monitoring programs and their results for CY 2001.

CHAPTER 2 - ENVIRONMENTAL PROGRAM INFORMATION

The DOE's policy for the management of WIPP is to conduct its operations in a manner commensurate with applicable environmental laws and regulations, and to safeguard the integrity of the southeastern New Mexico environment. This is accomplished through radiological and nonradiological environmental monitoring, environmental compliance, and land management programs, which include monitoring wildlife populations, the WRP, and reclamation of disturbed lands. The purpose of these programs is to obtain land use permits, implement selected compliance functions such as NEPA compliance, collect data needed to detect and quantify possible impacts WIPP may have on the surrounding ecosystem and, when necessary, provide technical support in the disciplines of environmental science and land management to the DOE's CBFO.

Environmental monitoring activities at WIPP generally fall into four categories: collecting environmental samples from various matrices and analyzing them for specific radionuclides; preparing and publishing documents showing compliance with federal, state, and local regulations; evaluating whether WIPP activities cause any environmental impacts; and taking corrective action when an adverse effect on the environment is identified.

2.1 Environmental Monitoring Plan

WIPP's EMP outlines the programs that monitor the environment on, and immediately surrounding, the WIPP site. It discusses major environmental monitoring and surveillance activities at WIPP and reflects the importance of monitoring as a critical element of an effective environmental protection program. The EMP also discusses the WIPP QA/QC program as it relates to environmental monitoring. The purpose of the EMP is to outline the programs that evaluate WIPP's effect on the local ecosystem. Effluent and environmental monitoring also provide the data necessary to demonstrate compliance with applicable environmental protection regulations. The EMP sampling schedule is provided in Table 2.1.

The EMP describes the monitoring of naturally-occurring and specific anthropogenic (human-made) radionuclides. This surveillance includes monitoring worldwide fallout from historic nuclear weapons tests. The geographic scope of radiological sampling is based on projections of potential release pathways from the waste stored at WIPP. Airborne radioactivity is also monitored at Carlsbad, New Mexico, and local ranches.

The EMP also describes monitoring of VOCs, wildlife populations, meteorology, groundwater chemistry, and other nonradiological environmental parameters. In general nonradiological monitoring is conducted within or near the WIPP boundary.

Results and discussions pertaining to the monitoring programs prescribed by the EMP are provided in Chapter 4, "Environmental Radiological Program Information," and Chapter 5, "Environmental Nonradiological Program Information." DOE Order 5400.1

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requires the EMP to be reviewed internally every year and updated every three years. The EMP will be updated in September 2002.

Table 2.1 - The Environmental Monitoring Plan Outlines the Sampling Schedule for the WIPP Environmental Monitoring Program

Type of Sample	Number of Sampling Locations	Sampling Frequency
Liquid effluent	1	Semiannual (oversight)
Liquid effluent	1	Quarterly (DP 831 permit ^a)
Airborne effluent	3	Periodic/Confirmatory
Meteorology	2	Continuous
Atmospheric particulate	7	Weekly
Vegetation	6	Annual
Beef/Deer/Game Birds/Rabbits	Sitewide	Annual
Soil	6	Annual
Surface water	14	Annual
Groundwater	7	Semiannual
Fish	3	Annual
Sediment	12	Annual
Aerial photography	Sitewide	As needed
Volatile organic compounds (VOCs)	2	Semiweekly

^a Monitoring compliance with the Discharge Plan, DP-831.

2.2 WIPP Environmental Monitoring Program

It is the policy of the DOE to conduct effluent monitoring and environmental surveillance programs that are appropriate for determining adequate protection of the public and the environment during WIPP operations, and to ensure operations comply with DOE and other applicable federal or state radiation standards and requirements. It is the DOE's objective that all DOE operations properly and accurately measure radionuclides in effluent streams and in the ambient environmental media. The goal of the WIPP Environmental Monitoring Program is to determine if the local ecosystem has been impacted during the predisposal and disposal phases of WIPP, and, if so, to evaluate the severity, geographic extent, and environmental significance of those impacts. The program fulfills DOE Orders 5400.1 (General Environmental Protection Program) and 5400.5 (Radiation Protection of the Public and the Environment).

The Environmental Monitoring Program monitors pathways by which WIPP-related radionuclides and other contaminants could reach the environment surrounding the WIPP site. The pathways measured include air, surface water, groundwater, sediments, soils, and biota (e.g., vegetation, game birds, and fish). In addition, the program monitors groundwater quality and the overall health of the local environment. Nonradiological portions of the program focus on the area immediately surrounding the site while radiological surveillance generally covers a broader geographical area.

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In addition to monitoring for radionuclides contained in WIPP wastes, background radiation (naturally-occurring radioactivity and radioactivity associated with worldwide fallout from historic weapons testing) is also monitored. The geographic scope of radiological sampling is based on projections of potential release pathways for the types of radionuclides in WIPP wastes. Also, Carlsbad, New Mexico, and local ranches are monitored, even though release scenarios involving radiation doses to residents of these population centers are improbable.

The atmospheric pathway, which can lead to the inhalation of radionuclides, has been determined to be the most likely exposure pathway to the public from WIPP. Therefore, airborne particulate sampling for alpha-emitting radionuclides is emphasized. Air sampling results are used to trend environmental radiological levels and determine if there has been a deviation from established baseline concentrations.

Nonradiological environmental monitoring activities at WIPP consist of a comprehensive set of sampling programs designed to detect and quantify impacts of construction and operational activities. The ecological monitoring program focuses on nonradiological effects of WIPP, such as habitat disturbance.

WIPP has collected preoperational radiological and nonradiological environmental data. Baseline conditions were initially characterized by the Radiological Baseline Program. When the first shipment of waste arrived at WIPP, this program became an operational monitoring program.

Preoperational studies must be considered during environmental evaluations. These assessments have contributed to baseline data gathered during the construction phase and provided much of the foundation for long-term monitoring programs. Below are listed examples of such investigations.

- The WIPP Site Characterization Program was instituted in 1976 by Sandia National Laboratories to monitor air quality, background radiation levels, and groundwater quality.
- The WIPP Biology Program began in 1975 with site characterization studies of climate, soils, vegetation, arthropods, and vertebrates.
- Investigations of site geohydrology were conducted by the U.S. Geological Survey at the request of the DOE. 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.
- Radiological monitoring of air, water, and biological media was conducted by the U.S. Atomic Energy Commission before and after the Project Gnome nuclear detonation in 1961.

2.3 Land Management Programs

On October 30, 1992, the WIPP Land Withdrawal Act (Pub. L. 109-579) became law. This act transferred the responsibility for the management of the WIPP Land Withdrawal Area from the Secretary of the Interior to the Secretary of Energy. In accordance with Sections 3(a)(1) and (3) of the act, these lands:

. . . are withdrawn from all forms of entry, appropriation, and disposal under the public land laws . . . and are reserved for the use of the Secretary of Energy . . . for the construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other activities associated with the purposes of WIPP as set forth in Section 213 of the DOE National Security and Military Application of the Nuclear Energy Act of 1980 (Pub. L. 96-164); 93 Stat. 1259, 1265, and this Act.

The DOE developed the LMP (DOE/WIPP 93-004) as required by Section 4 of the Land Withdrawal Act. The LMP was developed to identify resource values, promote multiple-use management, and identify long-term goals for the management of WIPP lands until the culmination of the decommissioning phase. This plan was developed in consultation and cooperation with the BLM and the state of New Mexico. Changes or amendments to the plan require the involvement of the BLM, the state of New Mexico, and affected stakeholders, as appropriate.

Guidelines in the LMP provide for the management and oversight of WIPP lands under the jurisdiction of the DOE. Lands outside the WIPP boundary used in the operation of WIPP (e.g., groundwater surveillance well pads outside the withdrawal area) are also included in the plan. Furthermore, the plan provides for multi-agency involvement in the administration of the DOE land management actions. For example, the BLM is responsible for administering grazing leases through an MOU. The LMP is available to anyone desiring to conduct activities on lands under the jurisdiction of WIPP in addition to those involved in developing or amending existing land management actions.

The LMP encourages direct communication among stakeholders, including federal and state agencies, involved in managing the resources within, or activities impacting the areas adjacent to, the WIPP Land Withdrawal Area. It sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions. Commitments contained in current permits, agreements, or concurrent MOUs with other agencies will be respected when addressing and evaluating land use management activities and future amendments that affect the management of WIPP lands.

The LMP was last reviewed in 2001. It is reviewed on a biennial basis to assess the adequacy and effectiveness of the document, or as may be necessary to address emerging issues potentially affecting WIPP lands. Affected agencies, groups, and individuals may be involved in the review process. Components of the LMP emphasize management protocols for the following issues: administration of the plan, environmental compliance, wildlife, cultural resources, grazing, recreation, energy and

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mineral resources, lands/realty, reclamation, security, industrial safety, emergency management, maintenance, and work control.

2.3.1 Land Use Requests

Parties who wish to conduct activities that may impact lands under the jurisdiction of WIPP, but outside the secured fence area of the facility designated as the Property Protection Area, are required by the LMP to prepare a Land Use Request (LUR). A LUR consists of a narrative description of the project, a completed environmental review, and a map depicting the location of the proposed activity. The LUR, and associated NEPA checklists, are used to determine if applicable regulatory requirements have been met prior to the approval of a proposed project. A LUR may be submitted to the land use coordinator by any WIPP organization or outside entity wishing to complete any construction, right-of-way, pipeline easement, or similar action within the WIPP boundary or on lands used in the operation of WIPP, under the jurisdiction of the DOE. During 2001, six LURs were submitted for review and approval; all met applicable criteria and were approved.

2.3.2 Wildlife Population Monitoring

Southeastern New Mexico is home to diverse populations of plants and wildlife. Shrubs and grasses are the most prominent components of the local flora. Dominant trees include shinnery oak (*Quercus havardii*), honey mesquite (*Prosopis glandulosa*), and western soapberry (*Sapindus drummondii*). Much of the area is composed of combined dune and grassland habitats that include perennial grasses and shrubs.

According to the BLM's Resource Management Plan, 15 percent of the wildlife species identified in the area use the shinnery oak habitat, while 30 percent occupy areas consisting primarily of grasses. The juxtaposition of shinnery oak/dune habitat with grassland habitat has resulted in a diverse wildlife population.

This portion of New Mexico supports an abundant and diverse population of mammals, including black-tailed jackrabbits (*Lepus californicus*), desert cottontails (*Sylvilagus auduboni*), desert mule deer (*Odocoileus hemionus*), coyotes (*Canis latrans*), gray foxes (*Urocyon cinereoargenteus*), badgers (*Taxidea taxus*), and striped skunks (*Mephitis mephitis*).

The habitat heterogeneity of the Los Medaños region also accounts for a wide assortment of bird species. Scaled quail (*Callipepla squamata*), mourning doves (*Zenaida macroura*), loggerhead shrikes (*Lanius ludovicianus*), black-throated sparrows (*Amphispiza bilineata*), Chihuahuan ravens (*Corvus cryptoleucus*), and a unique desert subspecies of the northern bobwhite (*Colinus virginianus*) are but a few examples of the array of avian inhabitants. Due to a scarcity of surface waters in the immediate vicinity of WIPP, migrating or breeding waterfowl are not common.

In addition, this area supports a particularly abundant and diverse population of raptors, or birds of prey. Harris' hawks (*Parabuteo unicinctus*), Swainson's hawks (*Buteo*

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swainsoni), and great horned owls (*Bubo virginianus*) are species commonly found nesting in the area. Northern harriers (*Circus cyaneus*), burrowing owls (*Athene cunicularia*), barn owls (*Tyto alba*), and American kestrels (*Falco sparverius*) are also found around the site.

Reptiles and amphibians are also found in great numbers in southeastern New Mexico. Representative of the no fewer than ten native amphibians are the tiger salamander (*Ambystoma tigrinum*), green toad (*Bufo debilis*), plain's spadefoot toad (*Spea bombifrons*), red-spotted toad (*Bufo punctatus*), and New Mexico spadefoot toad (*Spea multiplicata*). Their significance is seldom recognized until spring or summer rains, at which time they appear in extraordinary numbers.

Reptiles are more conspicuous due to their diurnal nature. Characteristic reptiles in the region include the ornate box turtles (*Terrapene ornata*), side-blotched lizards (*Uta stansburiana*), western whiptails (*Cnemidophorus tigris*), bullsnakes (*Pituophis melanoleucus*), prairie rattlesnakes (*Crotalus viridis*), and Texas horned lizards (*Phrynosoma cornutum*), a federal notice-of-review species listed under the Endangered Species Act (16 U.S.C. 1531-1544).

Birds and mammals compose the upper levels of the food chain in the natural ecosystem around WIPP. These organisms may be affected by noise and human presence as well as by changes in habitat structure due to salt impacts. Population densities are monitored annually to define normal cycles of abundance and to detect major changes in populations or communities which may be due to activities at WIPP.

Beginning in 1985, population density measurements of birds and small nocturnal mammals were performed annually to assess the effects of WIPP surface activities (e.g., construction, salt piles) on wildlife populations. Customary protocol involved comparative data analyses between two outlying or "control" plots and two experimental plots near WIPP operations. No consistent differences were found between the control and experimental plots. A Hantavirus investigation during 1994 prompted the temporary postponement of small nocturnal mammal surveys. Previous years' investigations revealed no detectable detrimental impacts from salt encroachment on the peripheral environment; therefore, annual appraisals of small mammal populations were discontinued indefinitely.

WTS personnel manage several wildlife research projects and conduct a number of general wildlife management activities. Specific wildlife populations are monitored and researched in accordance with applicable laws, agreements, and regulations. Each activity is mandated and/or supported by state and federal guidelines or by way of commitments created through interagency agreements and MOUs. Wildlife within the WIPP Land Withdrawal Area are given consideration by way of the WIPP LUR process during planning stages of projects that may disturb or encroach on wildlife habitat.

In 1979, the DOE consulted with the U.S. Fish and Wildlife Service (USF&WS) and was informed of the presence of threatened or endangered species at or near the WIPP site. However, no critical habitats for endangered species were identified at WIPP. In 1989,

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the DOE again consulted with the USF&WS and was advised of no status changes since 1979.

During 1989, the DOE consulted with the New Mexico Department of Game and Fish (NMDG&F) regarding state-listed endangered species in the vicinity of WIPP. NMDG&F Regulation 657, dated January 9, 1988, listed seven birds and one reptile in one of two endangerment categories that may be present at the site.

In 1995, the USF&WS provided an updated list of threatened and endangered species for Eddy and Lea Counties, New Mexico. Included were 18 species that may be present on WIPP lands. A comprehensive evaluation in support of the second Supplemental Environmental Impact Statement (SEIS-II) (DOE/EIS-0026-S-2) was conducted in 1996 to determine the presence or absence of threatened or endangered species in the vicinity of WIPP and WIPP's effect on these species. Results indicated that activities associated with the operation of WIPP had no impact on any threatened or endangered species. The protection of threatened and endangered species is taken into consideration when planning and administering projects on WIPP lands.

WIPP, and the region surrounding it, is widely recognized for its concentration and diversity of raptors. The area is home to several raptor species of special concern, including Harris' hawks, Swainson's hawks, burrowing owls, and barn owls, as well as other species.

The DOE, the BLM, and other government agencies are keenly aware of the value and importance of protecting and monitoring raptor populations. To assist in this effort at WIPP, the BLM and the DOE established the WRP in the early 1990s to monitor, protect, and educate about raptors on the WIPP site. The WRP is administered by the WIPP Environmental Monitoring Program with input from the BLM and others. Scientific consultation, research direction, and field operations are conducted by scientists from Rocky Mountain College in Billings, Montana.

In CY 2001, research continued on long term studies of productivity and population demographics of the raptor community in and around WIPP. These studies are described in greater detail in Chapter 5.

2.3.3 Reclamation of Disturbed Lands

The DOE recognizes its responsibility pursuant to federal, state, and local environmental regulations to enhance and restore areas affected by WIPP activities, including disturbed lands accepted as part of the land transfer from the BLM.

WIPP reclamation activities are conducted in accordance with DOE Order 5400.1; the DOE Organization Act (42 U.S.C. 7112); the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1751); the WIPP Disposal Phase SEIS-II; the SEIS-I (DOE/EIS-0026-FS); the Final Environmental Impact Statement (FEIS) (DOE/EIS-0026); and all applicable reclamation requirements by federal laws and regulations, Executive Orders, MOUs, DOE Orders, and state and local laws.

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Without an active reclamation program for disturbed areas, the establishment of stable ecological conditions in arid environments may require decades or centuries to achieve stability, depending on the disturbances and environmental conditions present. Reclamation activities are intended to reduce soil erosion, increase the rate of plant colonization and succession, and provide habitat for wildlife in disturbed areas. Reclamation ultimately serves to mitigate the effects of WIPP-related activities on affected plant and animal communities. The objective of the reclamation program is to reclaim lands used in the operation of WIPP that are no longer commissioned for WIPP operations. The DOE will also establish reclamation guidelines for land use requesters on a case-by-case basis.

In accordance with the LMP, WIPP follows a reclamation program and a long-range reclamation plan. As locations are identified for reclamation, WIPP personnel reclaim these areas by using the best acceptable reclamation practices. Seed mixes used reflect those species indigenous to the area with priority given to those plant species which are conducive to soil stabilization, wildlife, and livestock needs.

2.3.4 Oil and Gas Surveillance

The oil and gas industry is well established in southeastern New Mexico. Nearly all phases of oil and gas activities have occurred in the vicinity of WIPP, including seismic exploration, exploratory drilling, field development (comprised of production and injection wells), and other activities associated with hydrocarbon extraction.

The Los Medaños region, where WIPP is located, is part of the Delaware Basin. Although the Delaware Basin accounts for approximately 32 percent of lands in Eddy County, approximately 20 percent of the oil and gas wells are located within its boundaries. During 1995, oil and gas reserves in the immediate vicinity of the WIPP Land Withdrawal Area were evaluated by the New Mexico Bureau of Mines and Mineral Resources. Results from this evaluation were compiled in a report, *Evaluation of Mineral Resources at the Waste Isolation Pilot Plant Site*, March 31, 1996.

One aspect of the WIPP land withdrawal, unique to most DOE facilities, was the intent to maintain a multiple land use concept in the management of the property. However, an exception to a global multiple use strategy was required to reduce likelihood of inadvertent intrusion on the repository and to safeguard the surface infrastructure. Accordingly, all drilling and mining on the WIPP site has been prohibited. Oil and gas activities within 1.6 km (1 mi) of the WIPP boundary are monitored twice monthly to identify new activities associated with oil and gas exploration and production, including:

- Drilling
- Survey staking
- Geophysical exploration
- Pipeline construction
- Work-overs
- Changes in well status
- Anomalous occurrences (e.g., leaks, spills, accidents, etc.)

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During CY 2001, WIPP surveillance teams conducted 24 scheduled surveillances with more than 100 cursory field inspections.

One exception to the prohibition of mining and drilling on the WIPP site involved two mineral leases. Under a provision contained in the Land Withdrawal Act (Public Law 102-579), these two mineral leases, consisting of 129 ha (320 ac) each, were not appropriated in the proceedings. Both tracts, located in Township 22 South, Range 31 East, Section 31, prohibit drilling within the first 1,830 m (6,000 ft) of the surface. In accordance with the WIPP Land Withdrawal Act, existing rights under these leases were not affected unless the Administrator of EPA determined, after consultation with the Secretary of Energy, that the area in question should have been purchased.

This determination was made because of the presence of an existing gas well that had been drilled directionally from the adjacent Section 6 of Township 23 South, Range 31 East. During deliberations, it was determined the DOE would condemn (withdraw from public use) the upper 1,830 m (6,000 ft) of Section 31. This action would require operators interested in accessing minerals under the section to stage drilling operations outside the WIPP boundary and directionally drill under Section 31. The condemnation of the upper 1,830 m (6,000 ft) would provide an adequate protective zone for DOE operations while still allowing the legal owner of the minerals to access the reserves. Section 4(b)(5) of the Land Withdrawal Act describes this action as follows:

- (5) *Mining:*
 - (A) *In general. Except as provided in subparagraph (B), no surface or subsurface mining, or oil or gas production, including slant drilling from outside the boundaries of the Withdrawal, shall be permitted at any time (including after decommissioning) on lands on or under the Withdrawal.*
 - (B) *Exception. Existing rights under Federal Oil and Gas Leases No. NMNM 02953 and No. NMNM 02953 shall not be affected unless the Administrator determines, after consultation with the Secretary and the Secretary of the Interior, that the acquisition of such leases by the Secretary is required to comply with the final disposal regulations.*

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CHAPTER 3 - COMPLIANCE SUMMARY

WIPP is required to comply with applicable federal and state laws and DOE Orders. Documentation of requisite federal and state permits, notifications, and applications for approval is maintained by the WTS Environment, Safety, and Health Department. Regulatory requirements are incorporated in facility plans and implementing procedures.

3.1 Compliance Overview

In 2001, WIPP maintained compliance with applicable federal and state environmental regulations. Section 3.2 contains a listing of environmental statutes/regulations applicable to WIPP. Section 3.3 describes significant accomplishments and ongoing compliance activities relative to the regulations most pertinent to WIPP's development. A detailed breakdown of WIPP's compliance with environmental regulations is available in the WIPP Biennial Environmental Compliance Report (DOE/WIPP 99-2171).

3.2 Compliance Status

A summary of WIPP's compliance with major environmental regulations is presented in Table 3.3. Applicable DOE Orders are found in Table 3.4, and a list of WIPP permits appears in Table 3.5.

3.2.1 Comprehensive Environmental Response, Compensation, and Liability Act

No release sites have been identified at WIPP that would require cleanup under the provisions of the CERCLA. CERCLA establishes a comprehensive federal strategy for responding to, and establishing liability for, releases of hazardous substances from a facility to the environment. Any spills of hazardous substances that exceed a reportable quantity must be reported to the National Response Center under the provisions of Section 103 of CERCLA and 40 CFR Part 302. Hazardous substance cleanup procedures are specified in the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300).

In May 2001, a release of lead was reported to the National Response Center, the SERC, and the Eddy County Local Emergency Planning Committee (Follow-On Notification for Reportable Release, dated May 30, 2001). Subsequent analysis of the release determined that it was not reportable under CERCLA, or any other regulations, due to the lead particle size and the containment of the release to the WIPP property. Appropriate remediation of the release was completed. Soil samples showed no elevated lead levels and confirmed completion of clean-up activities. Follow-on reports sent to the three agencies explained the actions taken at the release location and the basis for the nonreportable determination. No further actions are required at this location.

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Superfund Amendments and Reauthorization Act of 1986

WIPP is required by Sections 311 and 312 of the Superfund Amendments and Reauthorization Act (SARA) Title III (also known as the Emergency Planning and Community Right-to-Know Act) to submit (1) a list of chemicals for which a material safety data sheet (MSDS) is required, and (2) an Emergency and Hazardous Chemical Inventory Form (Tier II Form) to the State Emergency Response Commission, the Local Emergency Planning Committee, and the fire departments with jurisdiction over the facility.

The list of chemicals provides external emergency responders with information they may need when responding to a hazardous chemical emergency at WIPP. The Tier II Form, due on March 1 of each year, provides information to the public about hazardous chemicals that a facility has on site at any time during the year above threshold planning quantities. WIPP submits the list of chemicals and the Tier II Form to each fire department with which the CBFO maintains an MOU. WIPP also provides the list of chemicals and the Tier II Form to the LEPC and SERC, as well as the fire departments that have MOUs with WIPP.

Accidental Releases of Reportable Quantities of Hazardous Substances

During 2001, there were no releases of hazardous substances exceeding the reportable quantity limits. The driver for accidental release reporting is Section 304 of SARA (or Section 304 of the Emergency Planning and Community Right-to-Know Act).

3.2.2 Federal Acquisition, Recycling, and Pollution Prevention

In July 1995, WIPP adopted a systematic and cost-effective APP for the promotion and procurement of products containing recovered materials. Affirmative procurement is designed to "close a loop" in the waste minimization and recycling processes by supporting the market for materials collected through recycling and salvage operations.

Affirmative procurement programs are mandated by the RCRA, Section 6002(i), which requires federal procuring departments to establish material preference programs targeted to purchase recycled materials. Executive Order 13101 and the EPA guidelines in 40 CFR Part 247 provides additional guidance for implementing affirmative procurement programs at federal facilities.

Affirmative procurement programs must include four elements: (1) a preference program, (2) a promotion program, (3) an estimation, certification, and verification procedure, and (4) annual review and monitoring procedures. The purchase and use of recycled products at WIPP will help foster markets for recovered materials and reduce the amount of solid waste requiring disposal.

WIPP's Affirmative Procurement Program Plan is defined WP 02-EC.07. In 2001, WTS purchased 99.99 percent of the items identified in the EPA guidelines through this

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program. WTS also purchased numerous items which were not required by the EPA program but, nevertheless, contained recovered materials.

Pollution Prevention Programs

Pollution prevention activities during 2001 included the following Pollution Prevention Opportunity Assessment (PPOA) activities:

- PPOA 2000-01 – Chemical Use Reduction. An assessment was performed in 2001 to evaluate (1) concerns of using similar chemicals for the same tasks, (2) benefits of implementing and expanding an online, electronic MSDS system at WIPP, (3) developing an approved chemicals list, and (4) increasing product substitution. This project was accepted and is currently in progress. Thirty-four hazardous products have been replaced/eliminated by nonhazardous products. Of these 34 products, 25 products were replaced with one product.
- PPOA 2001-02 – Office Supplies. It was determined that implementation of changes to the office supply program, either by an on-site store or a closed book ordering system would reduce costs and the amount of items purchased, ensure only Affirmative Procurement items would be ordered, thus bringing the site in to full compliance with Executive Order 13101, and provide easier tracking of APP items.

Noteworthy P2 activities during 2001 included the following:

- WTS will continue to promote affirmative procurement strategies in the following ways: evaluate ways to improve data collection of affirmative program items on-line, complete bench marking of all successful programs at other DOE sites, and revise the WTS APP to include the 18 additional new items that were added in January 2001.
- Recycling – WIPP continued its mandatory recycling program (Table 3.1).

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Table 3.1 - Materials Recycled at WIPP in 2001

Material	Mass
	Metric Tons
Office and mixed paper	11.33
Aluminum cans	0.37
Cardboard	5.56
Batteries	2.45
Oil	3.17
Scrap metal	132.50
Plastic	0.18
Toner Cartridges	0.85
Ethylene glycol	2.69
Computer equipment	4.71
Fluorescent bulbs and debris	0.11
Solvent (RCRA)	0.16
Miscellaneous items sold at auction 257, avoiding landfill disposal	N/A

3.2.3 Resource Conservation and Recovery Act

The RCRA (42 U.S.C. 321 et seq.) was enacted in 1976. Implementing regulations were promulgated in May 1980. This body of regulations ensures that hazardous wastes are managed and disposed of in a way that protects human health and the environment. The Hazardous and Solid Waste Amendments of 1984 prohibit land disposal of hazardous wastes unless treatment standards are met. The amendments also place increased emphasis on waste minimization activities and serve as a mechanism to enforce RCRA cleanup requirements.

Title 40 CFR Parts 280 and 281 address USTs containing petroleum products or hazardous chemicals. Requirements for UST management pertain to the design, construction, installation, and operation of USTs as well as notification and corrective action requirements in the event of a release and actions required for out-of-service USTs. The NMED was authorized by the EPA to regulate USTs. The annual registration fee for two USTs is submitted by July 1 of each year.

The NMED is authorized by the EPA to implement the RCRA program in New Mexico pursuant to the New Mexico Hazardous Waste Act. The technical standards for treatment storage and disposal facilities are outlined in 20.4.1.500 NMAC (incorporating 40 CFR Part 264). The hazardous waste management permitting program is

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administered through 20.4.1.900 NMAC (incorporating 40 CFR Part 270), which outlines the administrative aspects for processing permit applications and modifications.

WIPP was issued the HWFP on October 27, 1999. The operating conditions set forth in the permit were effective November 26, 1999. The HWFP authorized WIPP to receive, store, and dispose of CH TRU waste. Specifically, two storage units (the Parking Area and Waste Handling Building) and three underground Hazardous Waste Disposal Units are permitted for the management of CH TRU waste.

In the CY 2001, ten groups of HWFP Modifications were submitted to the NMED in accordance with 20.4.1.900 NMAC proposing approximately 27 changes to the HWFP. These modifications were processed to support economic and operational efficiencies at, not only the WIPP facility; but also to facilitate innovative technologies and simplify waste characterization and reduce employee exposure at the DOE TRU waste generator sites.

The NMED conducted an inspection at the WIPP facility on August 10, 2001, focusing on operational procedures for the receipt, management and storage of TRU waste. The inspectors observed no violations and concluded that the facility was in compliance with applicable regulations and permit conditions.

Hazardous Waste Generator Compliance

Nonradioactive hazardous waste is currently generated through normal facility operations, and is managed in Satellite Accumulation Areas and a "less-than-90-day" storage area. In addition, hazardous waste generated at WIPP is characterized, packaged, labeled, and manifested to an off-site treatment, storage, and disposal facilities in accordance with the requirements codified in 40 CFR Part 262.

WIPP Solid Waste Management Units and Areas of Concerns

The NMED issued the WIPP HWFP on October 27, 1999. Module VII of the permit contains the requirements for corrective action for the WIPP Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs). The permit identified fifteen SWMUs requiring a RCRA Facility Investigation (RFI), three SWMUs not requiring a RFI (the Hazardous Waste Management Units), and eight AOCs in the 4,146 hectares (16 mi²) WIPP Land Withdrawal Area.

Solid Waste Management Units

The 15 SWMUs included in the permit that require a RFI are listed below:

- SWMU 001g (H-14/P-1 Mud Pits)
- SWMU 001h (H-15/P-2 Mud Pits)
- SWMU001j (P-3 Mud Pit)
- SWMU 001k (P-4 Mud Pit)
- SWMU 001l (WIPP-12/P-5 Drilling Mud Pits)

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SWMU 001m (P-6 Mud Pit)
SWMU 001n (P-15 Mud Pit)
SWMU 001o (Badger Unit Drilling Mud Pits)
SWMU 001p (Cotton Baby Drilling Mud Pits)
SWMU 001q (DOE-1 Drilling Mud Pits)
SWMU 001s (ERDA 9 Mud Pit)
SWMU 001t (IMC 347 Mud Pit)
SWMU 001x (WIPP-13 Drilling Mud Pits)
SWMU 004a (Portacamp Storage Yard, West Side)
SWMU 007b (SW Evaporation Pond)

Areas of Concern

Following are the eight AOCs included in the permit.

AOC 001r (D-123 Mud Pit)
AOC 001u (IMC-376 Mud Pit)
AOC 001v (IMC-456 Mud Pit)
AOC 001w (IMC-457 Mud Pit)
AOC 001ac (DSP-207 Mud Pit)
AOC 001ae (IMC-377 Mud Pit)
AOC 010b (Waste Handling Shaft Sump)
AOC 010c (Exhaust Shaft Sump)

The SWMU program at WIPP began in 1994 under EPA regulatory authority. The NMED subsequently received regulatory authority from the EPA. A Phase 1 RFI was completed at WIPP during 1996 as part of a Voluntary Release Assessment.

The fifteen SWMUs and eight AOCs identified in the permit are associated with natural resource exploration activities prior to the development of the WIPP, early WIPP mineral assessment and geologic studies to support facility, or facility construction.

Samples were collected at some of the SWMUs as part of a RCRA Facility Assessment performed by WTS Environmental Compliance (NMED/DOE/AIP 94/1 1994). WIPP conducted three rounds of soil sampling at selected SWMUs one in 1995, a second in 1996, and a third in 2001. In the summer of 1995, soil samples were collected for initial characterization by the toxicity characteristic leaching procedure (TCLP). A second round of sampling at the same SWMUs was conducted in the summer of 1996 and involved collecting soil samples for total constituent analyses. A third round of sampling was requested by the NMED in 2001. This sampling event included collecting soil samples for total constituent analyses. SWMUs 001l, 001q, 001x, and 004a were sampled for barium, chromium, lead, and nickel. The NMED sent a representative to the site during soil sampling. He split samples with the sampling team and indicated that sampling was conducted according to the Sampling and Analysis Plan. The sampling event was concluded in August.

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The total constituent analysis data were collected based on a request from the NMED to support the TCLP data collected in the initial sampling round. The NMED reviewed the sampling conducted by WIPP at the SWMUs and defined a list of SWMUs with constituents of concern and AOCs to be included in the permit. These SWMUs/AOCs and constituents of concern for the SWMUs were described in the Technical Support Document, Exclusion/Inclusion of SWMUs and Areas of Concern, Permit Module VII Correction Action for Solid Waste Management Units (NMED 1999).

Program Deliverables and Schedule

As required by Module VII, Table 1 RFI/CMS (Corrective Measures Study) Schedule of Compliance, WIPP is in compliance with the Permit reporting requirements. The key Permit deliverables and their dates of submittal as contained in Module VII, Table 1, include: (1) the first initiating activity occurred in August of 2001; and (2) the first Quarterly Report was submitted in November 2001.

Table 3.2 - WIPP's Key RCRA^a Permit Deliverables and Due Dates

Due Date	Deliverable(s)
August 2001	The NMED approved soil sampling activities. This initiated submittal of quarterly progress reports.
November 2001	Quarterly progress report for SWMU activities was submitted.

^a Resource Conservation and Recovery Act

The Sampling and Analysis Plan addresses the current permit requirements for an RFI of SWMUs and AOCs. It uses the results of previous investigations performed at WIPP and expands the investigations as required by the permit. As an alternative to the RFI specified in Module VII of the permit, current NMED guidance identifies an Accelerated Corrective Action Approach (ACAA) that may be used for any SWMU or AOC. This ACAA is used to replace the standard RFI Work Plan and Report sequence with a more flexible decision-making approach. The ACAA process allows a facility to proceed on an accelerated time line. The ACAA process can be entered either before or after an RFI Work Plan. According to the NMED's guidance, a facility can prepare an RFI Work Plan or ACAA for any SWMU or AOC. The NMED recognized that the facility was using the ACAA in lieu of the standard RFI in 2001.

The Sampling and Analysis Plan has two primary objectives: to define the extent of concentrations of hazardous constituents that exceed background concentrations in soil at specific SWMUs, and to perform a release assessment at specific AOCs to determine if hazardous constituents are present above background concentrations. The scope of this investigation is limited to the SWMUs and AOCs identified in the permit.

3.2.4 National Environmental Policy Act

The NEPA requires the federal government to use all practicable means to consider potential environmental impacts of proposed projects as part of the decision-making process. The NEPA dictates the public shall be allowed to review and comment on proposed projects that have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs, and resources relating to human health and the environment.

NEPA procedural objectives and public involvement requirements are detailed in the Council on Environmental Quality regulations implementing NEPA in 40 CFR Parts 1500 through 1508. The DOE codified its requirements for implementing the council's regulations in 10 CFR Part 1021. Further procedural NEPA compliance guidance is provided in DOE Order 451.1B. Title 10 CFR §1021.331 requires that, following completion of each EIS and its associated ROD, the DOE shall prepare a mitigation action plan that addresses mitigation commitments expressed in the ROD.

Day-to-day operational compliance with NEPA at WIPP is achieved through implementation of the CBFO/WTS National Environmental Policy Act Compliance Plan and the WIPP NEPA compliance procedure. These documents describe the roles and responsibilities of both the DOE NEPA Compliance Officer and the WTS NEPA Coordinator to evaluate the impacts of proposed projects at the site.

On January 29, 2001, the DOE issued an Environmental Assessment and a Finding of No Significant Impact for the proposal to conduct astrophysics and other basic science experiments at the WIPP site (DOE/EA-1340). The experiments would be conducted primarily in the WIPP underground, where the low background radiation would enhance the ability of detectors to identify some of the basic particles that are believed to make up the universe.

3.2.5 Clean Air Act

The Clean Air Act (42 U.S.C. 7401 et seq.) provides for the preservation, protection, and enhancement of air quality, particularly at locations of special interest such as areas of natural, recreational, scenic, or historic value.

Under Section 109 of the Clean Air Act, the EPA established the National Ambient Air Quality Standards for six "criteria" pollutants: sulfur dioxide, total suspended particulates, carbon monoxide, ozone, nitrogen oxides, and lead. These standards establish primary and secondary criteria for ambient air quality that the EPA considers necessary to protect public health and welfare.

The initial 1993 WIPP air emissions inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria pollutants. Based on the current air emissions inventory, WIPP operations do not exceed the 10-ton-per-year emission limit for any individual hazardous air pollutant

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or the 25-ton-per-year limit for any combination of hazardous air pollutant emissions established in Subpart A of NESHAP.

Based on the initial 1993 air emissions inventory, the WIPP site is not required to obtain federal Clean Air Act permits. WIPP, in consultation with the NMED Air Quality Bureau, working in concert with data provided in the first air emissions inventory, was required to obtain a New Mexico Air Quality Control Regulation 702, Operating Permit (recodified in 1997 as 20.2.72 NMAC, "Construction Permits") for two primary backup diesel generators at the site. The only emission points where the WIPP site exceeds state threshold criteria requiring a permit are the backup diesel generators. WIPP completed all necessary requirements for emissions monitoring and sampling required by New Mexico Air Quality Permit 310-M-2. During 2001, the backup diesel generators were operated for approximately 28 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit. Proposed facility modifications are reviewed to determine if they caused new air emissions and require permit applications.

WIPP's normal operations do not involve or entail any planned or expected releases of airborne radioactive materials to the workplace or the environment. Waste containers accepted for disposal at WIPP are required to meet the 10 CFR Part 835 external contamination limits. To ensure compliance, the containers are surveyed both prior to release from the generator sites and as the TRUPACT-II containers are opened at WIPP.

Since radioactive material remains in the waste containers, there are no emissions of radionuclides to the ambient air from DOE facilities during normal WIPP waste handling, and the public is not subjected to radioactivity from the WIPP facility. The WIPP 2001 NESHAP report concluded that WIPP was operated in compliance with the release standards of 40 CFR Part 191, Subpart A, and 40 CFR Part 61, Subpart H.

External doses to workers from the handling of contact-handled waste containers were estimated to be well within the DOE's "as low as reasonably achievable" goals and well below regulatory limits. Similarly, consequences to the public and workers as a result of the release of VOCs during disposal phase normal operations were shown to be many orders of magnitude below health-based limits.

3.2.6 Clean Water Act

Section 402 of the Clean Water Act (33 U.S.C. 1251 through 1376) establishes provisions for the issuance of permits for discharges into waters of the United States. The regulation defining the scope of the permitting process is contained in 40 CFR Part 122, Subpart A, Section (b)(1), and states that ". . . National Pollutant Discharge Elimination System (NPDES) program requires permits for the discharge of 'pollutants' from any 'point source' into waters of the United States."

In August 1997, WIPP submitted to the EPA a Notice of Intent (NOI) for Storm Water Discharges Associated with Industrial Activity under a NPDES Multi-Sector General

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Permit. Permit NMR05A823 was issued February 23, 1998. This permit expired on October 30, 2000, and a NOI was submitted to the EPA on January 29, 2001, for coverage under NPDES Storm Water Multi-Sector General Permit for Industrial Activities.

As a condition of the multi-sector general permit, a P2 plan has been developed and implemented. The plan describes how the Best Management Practices and other requirements of the NPDES storm water regulations are being implemented at WIPP.

No sampling is required to demonstrate compliance with the WIPP Storm Water Permit unless a release occurs. Operational permit compliance activities are limited to quarterly inspections of retention basins, spill containment devices, reclamation sites, and site housekeeping practices. All requirements of the NPDES storm water regulations applicable to WIPP were met during 2001.

The NPDES sewage sludge regulations promulgated in 40 CFR §122.21 require all facilities that generate or dispose of sewage sludge to submit an information package describing sewage sludge management and disposal practices. This information is reviewed by the EPA to determine if a NPDES permit will be required for the disposal of sewage sludge at a facility.

Another implementing regulation under the Clean Water Act applicable to the WIPP project is 40 CFR Part 112, "Oil Pollution Prevention," which includes criteria and guidelines for the preparation and implementation of a facility's Spill Prevention, Control, and Countermeasures (SPCC) Plan (WP 02-EC.09). The WIPP SPCC Plan undergoes annual review and is revised as needed to reflect changes in facility activities and emergency equipment. The WIPP SPCC Plan was issued in November 1988. The revised plan was issued in June 1999.

On February 14, 1994, the DOE submitted an information package to the EPA Water Management Division and requested a written determination of whether a NPDES permit would be required for sewage sludge generated at WIPP. On March 31, 1994, the EPA Region VI Permits Issuance Section notified the DOE that they had received the information package. The agency determined that the information package was complete and, at a future date, would notify the DOE if a full and complete sewage sludge permit application would be required. To date this notification has not been made, indicating an application is not yet required.

On January 16, 1992, the NMED issued the original discharge plan (DP-831) for the WIPP sewage facility. DP-831, as amended through December 2001, allows the disposal of 23,000 gallons per day (gpd) of sewage effluent to the five lagoons; 2,000 gpd of nonhazardous brine water to the north evaporation cell; 8,000 gpd of nonhazardous brine water to the H-19 evaporation pond; and 100 gallons per year of neutralized acid to the domestic wastewater lagoons. Characterization samples are collected to appropriately disposition brines prior to discharge.

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The DOE submits quarterly discharge monitoring reports to the NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan.

DP-831 requires quarterly sampling and analysis of the sewage system influent for nitrate, total Kjeldahl nitrogen, total dissolved solids (TDS), ^{238}Pu , $^{239+240}\text{Pu}$, ^{241}Am , ^{234}U , ^{235}U , ^{238}U , and ^{90}Sr .

3.2.7 Safe Drinking Water Act

The SDWA (42 U.S.C. 300f, et seq.) provides the regulatory strategy for protecting public water supply systems and underground sources of drinking water. The NMED notified WIPP in a September 9, 1992, letter that the WIPP public water supply was categorized as a nontransient, noncommunity system for reporting and testing requirements.

New Mexico water supply regulations mandate that when a public water supply system supplements other systems, that water system is treated as a single system for compliance sampling purposes. The Carlsbad municipal water supply system is contracted to provide raw water to WIPP from city-owned wells 50 km (31 mi) north of the site. Because of this contractual agreement, the city of Carlsbad completes the source, or point-of-entry, samples for the various chemical constituents at each well field source.

In a letter dated August 28, 1996, the NMED set the frequency for sampling lead and copper in the drinking water supply at ten samples every three years. The required samples were collected in July 1999 and the results were submitted to the NMED. All samples were below action levels as specified by New Mexico monitoring requirements for lead and copper in tap water. The next lead and copper sampling period will be in July 2002.

Bacterial samples were collected and reported monthly throughout 2001. All bacteriological/analytical results were below the SDWA regulatory limits.

3.2.8 National Historic Preservation Act

The NHPA (16 U.S.C. 470 et seq.) was enacted to protect the nation's cultural resources and establish the National Register of Historic Places. Federal agencies are required to coordinate NEPA compliance with the responsibilities of the NHPA to ensure that historic and cultural properties are given proper consideration in the preparation of NEPA documentation. Agency obligations under the NHPA, however, are independent from NEPA and must be complied with even when no additional NEPA documentation is required (i.e., for proposed projects not classified as major federal actions with significant environmental impacts, the DOE must still consider impacts to historic properties and sites). Where both NEPA and the NHPA are applicable, Environmental Assessments and EISs must integrate NHPA considerations along with other environmental impact analyses and studies (see 40 CFR §1502.25).

During 2001, one archaeological investigation was conducted to assess cultural resources in an area proposed for a range improvement. No artifacts were encountered.

3.2.9 Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act (49 App. U.S.C.A. 1801 et seq; 49 CFR Parts 106 through 178) is one of the major transportation-related statutes that affects the DOE at WIPP. It provides for safe transportation of hazardous materials, including radioactive materials. The DOE complies with applicable U.S. Department of Transportation (DOT) regulations, corresponding NRC regulations, and DOE Orders for the transportation of hazardous materials. DOE Orders require the development of a transportation plan, and implementing procedures to ensure that the DOT regulations and requirements of each NRC-certified package is met. DOE Orders also require the use of the DOE TRANSCOM system to monitor shipments, shipment inspections, and preshipment notifications to the states.

Other federal transportation regulations applicable to WIPP include:

- Title 10 CFR Part 71, NRC requirements for packaging, preparing, and transporting licensed material,
- Title 40 CFR Part 262, Subpart B, requirements for use of the hazardous waste manifest., and
- Title 49 CFR Part 397, Subpart D, requirements for routing of radioactive materials.

The WTS Shipping Coordination Section implements applicable DOT and EPA regulations and DOE Orders for the transport of hazardous waste and hazardous materials from WIPP through the use of a transportation plan and implementing procedures. These implementing procedures address the classification, labeling, marking, placarding, and the shipping documentation needed to transport these materials in a safe and regulatory compliant manner. In a similar manner, shipping sites implement applicable DOT and EPA regulations and DOE Orders for the transport of TRU waste to WIPP.

3.2.10 Packaging and Transporting Radioactive Materials

Regulations for transportation of radioactive materials, under the authority of the DOT, are found in 49 CFR Parts 171 through 178. If the quantity of radioactive material exceeds certain limits, as determined by 49 CFR §173.431, a Type B shipping container (packaging) must be used. The specific requirements for the shipment of radioactive materials and requirements applicable to the Type B packages to be used to transport waste to the WIPP facility are detailed in 49 CFR Parts 171 through 173, 40 CFR Part 262, and the NRC Certificate of Compliance (C of C) for the package. Regulations for Type B packaging, under the authority of the NRC, are found in

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10 CFR Part 71, "Packaging and Transportation of Radioactive Materials." The WIPP Land Withdrawal Act requires that TRU waste containers shipped to WIPP shall be transported using packages which have had the design certified by the NRC and which have been determined by the NRC to satisfy its QA requirements.

Additional transportation requirements for the mixed waste shipments (i.e., TRU mixed wastes) are detailed in 40 CFR Part 262. The appendix to Part 262 provides an example of a uniform hazardous waste manifest and instructions to waste generators and shippers of hazardous wastes.

Contact-handled TRU waste is shipped in the TRUPACT-II and the HalfPACT. The HalfPACT is a shorter version of the TRUPACT-II; it was designed to transport heavier contact-handled TRU waste containers. The NRC certified the TRUPACT-II container on August 30, 1989. Since 1989, expansion of the TRUPACT-II payload envelope has been accomplished through applications to the NRC for revisions of the TRUPACT-II Safety Analysis Report for Packaging and the C of C, when applicable. The current revision of the TRUPACT-II C of C, No. 11, expires June 30, 2004. The current revision of the HalfPACT C of C, No. 9279, expires October 30, 2005.

Remote handled waste will be shipped in the RH-72B and the CNS 10-160B casks. The current C of C for the RH-72B cask expires February 8, 2005. The current revision of the C of C for the 10-160B expires October 31, 2005.

For the transportation of TRU waste emergency response is addressed by defense in depth. The first line of defense is the packaging itself. The NRC-certified packagings are able to survive "hypothetical" accident conditions without loss of contents. The testing process subjects the package to forces that are more severe than those that would be experienced in a vehicular accident.

The second line of defense rests with the driver. The qualifications for the drivers is set at a high mark. The driver's record is reviewed for at least five years. The driver must be accident free and moving violation free in this time period. In addition to prior skills, the driver must attend and pass WIPP-specified training. To date, WIPP drivers have traveled over miles without a vehicle accident.

In the event an incident should occur, the DOE has trained emergency responders and hospital personnel along the routes in the actions to mitigate the incident. In addition, to the training provided to the first responders, the DOE and the states have conducted "WIPPTREXes" (training exercises) to provide the emergency response personnel the opportunity to put into practice the training they receive. In addition to the training the DOE has an Incident/Accident Response Team that is on standby to respond to an incident to assist the on-scene Incident Commander in the mitigation of the incident.

3.3 Other Significant Accomplishments and Ongoing Compliance Activities

3.3.1 Environmental Compliance Assessment Program

The Environmental Compliance Assessment Program plays a major role in the overall program for environmental protection activities at WIPP. The program was developed to determine if impactive or potentially impactive facility activities protect human health and the environment and if these activities are in compliance with applicable federal, state, and local requirements; with permit conditions and requirements; and with best management practices.

3.3.2 Environmental Management System

WTS has implemented an EMS that conforms to the requirements of ISO 14001. ISO 14001 is the specific standard within the ISO 14000 family of standards that provides specifications for EMSs. The WTS EMS received third-party registration on August 5, 1997, following a comprehensive audit by Advanced Waste Management Systems, Inc. This recognition provided independent verification of the disciplined and systematic approach WTS applies to achieve excellent environmental performance while operating WIPP. The EMS, including environmental aspects, objectives, and targets, is reviewed and updated by WTS senior management at least annually.

Advanced Waste Management Systems, Inc. performed two surveillance audits of the WTS EMS in 2001. There were no nonconformance issues identified during the 2001 surveillance period. Two third-party surveillance audits are scheduled during 2002 as required for continued ISO 14001 registration.

Integration of WIPP's EMS with other WTS, DOE, and EPA programs, such as the Voluntary Protection Program, the Integrated Safety Management System, and the National Environmental Performance Track, is under way. WTS also shares its EMS experience with other interested organizations in both the public and private sectors to achieve even broader positive environmental results.

Additional information, including the WTS Environmental Management Policy, is available to the public via the world-wide-web or by calling the information line at 1-800-336-WIPP.

3.3.3 Pollution Prevention Committee

The P2 Committee was formed in 1993 with a representative from each department. The primary purpose of this committee is to foster recycling activities at WIPP. The committee prepared a waste minimization charter, which outlines the committee's responsibilities.

On Earth Day, 2001, the committee conducted activities to heighten employee awareness of the dangers of household chemicals. Information was also provided to

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WIPP employees on nonhazardous substitutions for hazardous household cleaning products.

The WIPP P2 Committee celebrated America Recycles Day in November 2001, using a display describing the "Trail of Trash." This display demonstrated how much trash is generated by the average New Mexico family, how it is disposed of either in the landfill or by recycling, and how the items that are recycled are made into useable products.

During October 2001, Energy Month was celebrated with posters being hung around site emphasizing the importance of saving energy.

3.3.4 Environmental Training

Environmental training was provided to personnel associated with environmental operations at WIPP. Training courses included technical topics (e.g., RCRA sampling), EMS, basic environmental safety and health training, and general sitewide training such as the required General Employee Training module. These courses were conducted both on-site by WIPP personnel and off-site by various contractors.

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Table 3.3 - Activities Associated with Major Environmental Regulations Applicable to the WIPP Project

Statute/Regulation	Related Activity
Atomic Energy Act of 1954 (42 U.S.C. 2278a) and 40 CFR Part 191, Subpart A	WIPP was authorized by the DOE and the EPA to open. Monitoring/reporting began upon first receipt of waste, March 26, 1999.
Clean Air Act	Monitoring/reporting began upon first receipt of waste, March 26, 1999.
Clean Water Act	Quarterly inspections of best management practices to comply with (storm water retention basins) NPDES storm water general permit (NMR05A823).
Comprehensive Environmental Response, Compensation, and Liability Act/SARA	No CERCLA site cleanup required. Reports filed as required under SARA for hazardous substances are maintained on site.
Endangered Species Act of 1973	In November 1996, WIPP completed the 1996 Threatened and Endangered Species Survey. The survey is part of the analysis required for the SEIS-II. There were no threatened or endangered species located on WIPP land. Individual permits to collect biological samples and to band nonendangered species of raptors are maintained. Consultation with federal and state agencies is not required.
Federal Land Policy and Management Act	An MOU between the DOE and the BLM was issued in July 1994. This MOU outlines the responsibilities the BLM and the DOE have with regard to land use management for the withdrawal area.
Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136-136y)	All pesticides must be approved by Industrial Safety and Hygiene.
Hazardous Materials Transportation Act	Appropriate shipping papers accompany hazardous materials and hazardous wastes shipped off-site to ensure compliance with the act.
National Environmental Policy Act (as supplemented by DOE Order 451.1B, and 10 CFR Part 1021)	The 2001 Annual Mitigation Report for the Waste Isolation Pilot Plant (NEPA ID# WIP:00:001) was issued July 2001, in accordance with the requirement of DOE Order 451.1B, <i>National Environmental Policy Act Compliance Program</i> . This order requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action nonsignificant or that is made in the ROD.
	The Environmental Assessment for Conducting Astrophysics and Other Basic Science Experiments at the WIPP Site (DOE/EA-1340) was issued in January 2001. This Environmental Assessment was required to support a congressional directive to make maximum use of existing WIPP facilities to further the scientific missions assigned to the DOE by Congress.

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Table 3.3 - Activities Associated with Major Environmental Regulations Applicable to the WIPP Project

Statute/Regulation	Related Activity
National Historic Preservation Act	Activities requiring excavation in previously undisturbed areas are surveyed by licensed, permitted archaeologists. Required reports are submitted to the New Mexico State Historic Preservation Officer.
New Mexico Air Quality Control Act (NMSA 1978 §74-2)	During 2001, the backup diesel generators were operated for approximately 28 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit.
New Mexico Water Quality Act	The NMED has issued a ground water discharge plan (DP-831) to WIPP for the disposal of site generated wastewater. The DOE submits quarterly discharge monitoring reports to the NMED Groundwater Quality Bureau to comply with the requirements of DP-831.
New Mexico Wildlife Conservation Act	See "Endangered Species Act."
Resource Conservation and Recovery Act	Hazardous-waste generator compliance: All site generated hazardous wastes were transported offsite within the 90-day accumulation period. Permit compliance: NMED granted RCRA permit NM4890139088 effective November 26, 1999. Underground Storage Tanks: Annual registration fee paid.
Toxic Substances Control Act (15 U.S.C. 2301 et seq)	Procurement of asbestos- or PCB-containing materials not allowed. Other portions of the Toxic Substances Control Act are not applicable.
Safe Drinking Water Act	The WIPP public water system is characterized as a nontransient, noncommunity system (NMED, September 9, 1992). Drinking water is piped from the Carlsbad, New Mexico, municipal system and the city of Carlsbad is responsible for compliance.

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Table 3.4 - Primary DOE Orders Affecting the WIPP Environmental Program

Order No.	Title	Annotation
DOE Order 5400.1 Paragraphs 2B, 4B, and 4C of Chapter II, and 2D and 3B of Chapter III were canceled and replaced by DOE O 231.1	General Environmental Protection Program	Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with federal and state environmental protection laws and regulations, federal executive orders, and internal department policies.
DOE Order 5400.5 Paragraph 1A(3)(A) of Chapter II is canceled by DOE O 231.1	Radiation Protection of the Public and the Environment	Establishes standards and requirements for operations of the DOE and DOE contractors with respect to protection of the public and the environment against undue risk from radiation.
DOE O 231.1, Change 2	Environmental, Safety, and Health Reporting	Ensures collecting and reporting on environment, safety, and health information.
DOE O 225.1A, cancels DOE O 225.1	Accident Investigation	Prescribes requirements for conducting investigations of accidents and preventing recurrence of such accidents.
DOE O 414.1A	Quality Assurance	Promotes effective management through performance requirements and technical standards.
DOE O 435.1	Radioactive Waste Management	Promotes radioactive waste management in a manner that is protective of workers, public health and safety, and the environment.
DOE O 451.1B	National Environmental Policy Act Compliance Program	Establishes DOE policy for implementation of the NEPA of 1969 (Pub. L. 91-190).
DOE O 460.1A	Packaging and Transportation Safety	Establishes safety requirements for the proper packaging and transporting of DOE offsite shipments and onsite transfers of hazardous materials and for model transportation.
DOE 5480.23	Nuclear Safety Analysis Reports	Establishes uniform requirements for the preparation and review of safety analyses of DOE operations that include the following: identification of hazards, their elimination or control, assessment of risk, and documented management authorization of their operation.
DOE O 151.1	Comprehensive Emergency Management System	Establishes requirements for comprehensive planning, preparedness, response, and recovery activities of emergency management programs for the DOE and for programs requiring DOE assistance.
DOE O 430.1A	Life-Cycle Assessment Management	Establishes procedures to plan, acquire, operate, maintain, and dispose of physical assets as valuable national resources.

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**Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant (as of December 31, 2001)
(Does Not Include RCRA Permits)**

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
Department of the Interior, BLM	Right-of-Way for Water Pipeline	NM53809	08/17/83	In Perpetuity	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for the North Access Road	NM55676	08/24/83	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Railroad	NM55699	09/27/83	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Dosimetry and Aerosol Sampling Sites	NM63136	07/31/86	07/31/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Seven Subsidence Monuments	NM65801	11/07/86	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Aerosol Sampling Site	NM77921	08/18/89	08/18/19	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Two Survey Monuments	NM82245	12/13/89	12/13/19	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Telephone Cable	NM46029	07/03/90	09/04/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for SPS Powerline	NM43203	02/20/96	10/19/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for South Access Road	NM46130	09/26/94	08/17/31	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Duval Telephone Line	NM60174	11/06/96	03/08/15	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Wells AEC-7 and AEC-8	NM300603-SLU-12	07/23/75	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for ERDA-6	NM300605-SLU-29	05/12/75	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Monitoring Wells C-2752 (ERDA-9) and C-2765 (H-1)	NM0606-SLU-34	03/31/76	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for ERDA 11	NM0607-LUP-63	08/19/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for ERDA-13	NM0606-SLU-38	07/15/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for ERDA-14	NM0607-TUP-62	06/29/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE

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(Does Not Include RCRA Permits)**

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
Department of the Interior, BLM	Right-of-Way for Monitoring Wells C-2762 (H-2) and C-2764 (H-3)	NM0606-SLU-41	07/14/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Wells P-1, P-2, P-3, and P-4	NM060-SLU-48	05/16/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Wells P-5, P-6, and P-7	NM060-SLU-50	05/16/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Wells P-8, P-9, P-12, P-13, P-20, and Monitoring Wells C-2637 (P-14), C-2686 (P-15), C-2756 (P-18)	NM060-SLU-52	05/16/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Wells P-10, P-11, P-16, P-19, P-21, and Monitoring Well C-2774 (P-17)	NM0606-SLU-54	11/08/76	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Archaeological Clearance for Wells P-5 - P-21	NM-6-5 Cooperative Agreement	05/19/81	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Access Road for Monitoring Wells C-2639 (WIPP-12) and C-2748 (WIPP-13)	NM-6-5 Cooperative Agreement	04/19/78	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Meteorological Tower	NM060-SLU-43	02/04/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Aerosol Sampler	NM067-LUP-221	05/25/85	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for North Access Road Batch Plant	NM060-LUP-212	10/09/84	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Construction Landfill	NM067-LUP-219	12/08/95	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Monitoring Well C-2664 (Cabin Baby)	NM0606-SLU-40	07/14/76	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Seismic Monitoring Station	NM85426	09/23/91	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE

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**Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant (as of December 31, 2001)
(Does Not Include RCRA Permits)**

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
Department of the Interior, BLM	Right-of-Way for Monitoring Wells C-2684 (WIPP-18), C-2755 (WIPP-19), C-2754 (WIPP-21) and Well WIPP-22	NM-6-5 Cooperative Agreement	03/02/78	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Well WIPP-15	NM-6-5 Cooperative Agreement	01/19/78	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Wells C-2725 (H-4A), C-2775 (H-4B), and C-2776 (H-4C)	NM-6-5 Cooperative Agreement	04/27/78	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Monitoring Wells C-2723 (WIPP-25), C-2724 (WIPP-26), C-2722 (WIPP-27), C-2636 (WIPP-28), C-2743 (WIPP-29), and C-2727 (WIPP-30)	NM-6-5 Cooperative Agreement	06/14/78	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Monitoring Well C-2748 (WIPP-13)	NM-6-5 Cooperative Agreement	05/03/78	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Well WIPP-11	NM-6-5 Cooperative Agreement	12/19/77	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Dosimetry and Aerosol Sampling Sites	NM63136	07/31/86	07/31/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way for Aerosol Sampling Sites	NM77921	10/03/89	08/18/19	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Right-of-Way easement for accessing state trust lands in Eddy and Lea Counties	NM25430	02/29/00	09/28/04	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
Department of the Interior, BLM	Free-Use Caliche Extraction Permit	NM105004	10/12/00	10/12/01	Inactive Will be renewed when required	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE

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Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
U.S. Department of the Interior, Fish and Wildlife Service	Concurrence that WIPP construction activities will have no significant impact on federally listed threatened or endangered species	None	05/29/80	None	Active	Environmental Monitoring	N/A	N/A
U.S. DOT Research and Special Programs Administration	Hazardous materials transporter registration	082801 002021J	8/31/01	6/30/02	Active	Shipping Coordination	R. White, Transportation Engineer 6/5/01	WTS
U.S. EPA	National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit issued for use in the State of New Mexico	NMR05A823	01/29/01	09/29/05	Active	Environmental Compliance	Ines Triay, Manager, DOE/CBFO	DOE/CBFO
New Mexico Commissioner of Public Lands	Right-of-Way for High Volume Air Sampler	RW-22789	10/03/85	10/03/20	Active	Environmental Monitoring	Stewart Jones, Manager Environmental Monitoring	WTS
NMED Groundwater Bureau	Discharge Permit	DP-831	07/03/97	07/03/02	Active	Environmental Compliance and Facility Operations	G. E. Dials, Manager 12/16/96	DOE
NMED Air Quality Bureau	Operating Permit for two backup diesel generators	310-M-2	12/07/93	None	Active	Environmental Compliance and Facility Operations	A. E. Hunt Project Manager 06/18/93	DOE
NMDG&F	Concurrence that WIPP construction activities will have no significant impact on state-listed threatened or endangered species	None 07/25/83	05/26/89	None	Active	Environmental Monitoring	N/A	N/A
NMED UST Bureau	Underground Storage Tanks	NMED1198 (Number changes annually)	07/01/01	06/30/02	Active	Environmental Compliance and Facility Operations	V. Daub, Deputy Project Site Manager 06/18/92	DOE
NMED Solid Waste Bureau	Solid Waste Hauler Registration	006655	12/01/99	None	Active	N/A – Issued to Cast Trucking and Tri-State Motor Transit	N/A	N/A
NMED Solid Waste Bureau	Solid Waste Hauler Registration	040889	01/16/01	None	Active	N/A – Issued to Tri-State Motor Transit Co.	N/A	N/A

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Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2801	02/23/01	None	Active	Environmental Compliance and Geotechnical Engineering	H. E. Johnson, DOE	DOE
New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2802	02/23/01	None	Active	Environmental Compliance and Geotechnical Engineering	E. K. Hunter, Asst. Manager ONTWO 09/10/97	DOE
New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2803	02/23/01	None	Active	Environmental Compliance and Geotechnical Engineering	E. K. Hunter, Asst. Manager ONTWO 09/10/97	DOE
New Mexico State Engineer Office	Appropriation: WQSP-1 Well	C-2413	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96 DOE	DOE
New Mexico State Engineer Office	Appropriation: WQSP-2 Well	C-2414	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96	DOE
New Mexico State Engineer Office	Appropriation: WQSP-3 Well	C-2415	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96	DOE
New Mexico State Engineer Office	Appropriation: WQSP-4 Well	C-2416	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96	DOE
New Mexico State Engineer Office	Appropriation: WQSP-5 Well	C-2417	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96	DOE
New Mexico State Engineer Office	Appropriation: WQSP-6 Well	C-2418	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96	DOE

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New Mexico State Engineer Office	Appropriation: WQSP-6a Well	C-2419	10/21/96	None	Active	Environmental Compliance and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/96	DOE
New Mexico State Engineer Office	Monitoring Well AEC-7	C-2742	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well AEC-8	C-2744	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well Cabin Baby	C-2664	07/30/99	None	Active	Environmental Monitoring	Richard A. Jepson, SNL 07/29/99	DOE
New Mexico State Engineer Office	Monitoring Well D-268	C-2638	01/12/99	None	Active	Environmental Monitoring	G. T. Basabilvaso, DOE 12/10/98	DOE
New Mexico State Engineer Office	Monitoring Well DOE-1	C-2757	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well DOE-2	C-2682	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well ERDA-9	C-2752	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-1	C-2765	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-2A	C-2762	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-2B1	C-2758	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-2B2	C-2763	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-2C	C-2759	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-3B1	C-2764	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-3B2	C-2760	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-3B3	C-2761	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-3D	pending	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE

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Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
New Mexico State Engineer Office	Monitoring Well H-4A	C-2725	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-4B	C-2775	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-4C	C-2776	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-5A	C-2746	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-5B	C-2745	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-5C	C-2747	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-6A	C-2751	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-6B	C-2749	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-6C	C-2750	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-7A	C-2694	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-7B1	C-2770	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-7B2	C-2771	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-7C	C-2772	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-8A	C-2780	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-8B	C-2781	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-8C	C-2782	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-9A	C-2785	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-9B	C-2783	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE

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New Mexico State Engineer Office	Monitoring Well H-9C	C-2784	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-10A	C-2779	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-10B	C-2778	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-10C	C-2695	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-11B1	C-2767	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-11B2	C-2687	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-11B3	C-2768	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-11B4	C-2769	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-12	C-2777	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-14	C-2766	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-15	C-2685	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-16	C-2753	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-17	C-2773	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-18	C-2683	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well H-19B0	C-2420	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well H-19B1	C-2420	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well H-19B2	C-2421	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE

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New Mexico State Engineer Office	Monitoring Well H-19B3	C-2422	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well H-19B4	C-2423	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well H-19B5	C-2424	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well H-19B6	C-2425	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well H-19B7	C-2426	01/25/95	01/31/98	Inactive Renew when necessary	Environmental Monitoring	Harold F. Klaus, Jr. DOE 11/09/94	DOE
New Mexico State Engineer Office	Monitoring Well P-14	C-2637	01/02/99	None	Active	Environmental Monitoring	G. T. Basabilvaso, DOE 11/17/98	DOE
New Mexico State Engineer Office	Monitoring Well P-15	C-2686	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well P-17	C-2774	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well P-18	C-2756	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-12	C-2639	01/12/99	None	Active	Environmental Monitoring	G. T. Basabilvaso, DOE 11/17/98	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-13	C-2748	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-18	C-2684	04/17/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-19	C-2755	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-21	C-2754	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-25	C-2723	07/26/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-26	C-2724	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE

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New Mexico State Engineer Office	Monitoring Well WIPP-27	C-2722	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 07/24/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP28	C-2636	01/12/99	None	Active	Environmental Monitoring	G. T. Basabilvaso, DOE 11/17/98	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-29	C-2743	11/06/00	None	Active	Environmental Monitoring	D. C. Lynn, WTS Land Use Coordinator, 10/23/00	DOE
New Mexico State Engineer Office	Monitoring Well WIPP-30	C-2727	08/04/00	None	Active	Environmental Monitoring	G. T. Basabilvaso, DOE 07/31/00	DOE

CHAPTER 4 - ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

Radionuclides present in the environment, whether naturally-occurring or human-made, contribute to radiation doses to humans. Therefore, environmental monitoring around nuclear facilities is imperative to characterize radiological conditions, detect releases, and determine their effects, should they occur. Because of this, the DOE requires an environmental monitoring program for nuclear facilities (DOE Order 5400.1).

The WIPP Environmental Monitoring Program monitors air, surface and groundwater, soils, and biota to characterize the radiation environment and to detect potential releases from WIPP activities. This program is carried out in accordance with the EMP. This chapter summarizes the results of radiological monitoring during CY 2001.

The radiological environment near WIPP includes natural radioactivity, global fallout and, potentially, radioactive contamination from the Project Gnome. A nuclear device was detonated underground in bedded salt on December 10, 1961. The test site for Project Gnome was located about 20 km (13 miles) southwest of the WIPP site. The Project Gnome shot vented into the drift and up the shaft to the atmosphere. Therefore, most environmental samples are expected to contain small amounts of natural radioactivity and fission products.

Throughout this chapter, radionuclides were considered "detected" in a sample if the measured concentration or activity minus 2 x total propagated uncertainty (TPU) exceeded the minimum detectable concentration (MDC). The MDC was determined by the different analytical laboratories based on the natural background radiation, the analytical technique, and inherent characteristics of the analytical equipment. The MDC represents the minimum concentration of a radionuclide detectable in a given sample using the given equipment and techniques.

Total propagated uncertainty is an estimate of the uncertainty in the measurement due to all sources, including counting error, measurement error, chemical recovery error, detector efficiency, randomness of radioactive decay and any other sources of uncertainty.

Comparisons of radionuclide concentrations were made between years and locations using the statistical procedure, ANOVA. When this, or another statistical test, was used, the value of p, the probability of obtaining the value of the test statistic by chance alone, was reported. In many cases, scientists have accepted a value of $p < 0.05$ as indicative of a difference between samples. However, interpretation of p requires some judgment on the part of the reader; individual readers may choose to defend higher or lower values of p as their cutoff value. For this report, $p < 0.05$ was used.

4.1 Effluent Monitoring

If radionuclides are released into the environment from WIPP, they would first be detected in airborne effluents. Thus, WIPP monitors airborne effluents at three locations, effluent monitoring Stations A, B, and C. Station A samples the unfiltered

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underground exhaust air. Station B samples the underground exhaust air after HEPA filtration and, sometimes, nonfiltered air during maintenance. Station C samples the air from the Waste Handling Building after HEPA filtration. Each station employs one or more fixed air samplers, collecting particulates from effluent air stream and a Versapore filter.

During 2001, 411 samples were collected from Station A for a total air volume sampled of 26,697.5 m³ (942,707 ft³). Because only a small fraction of the air released through Station A is sampled, the activity on the filter is normalized to the total air flow through Station A using an EPA-approved methodology. Fifty-six samples were collected from Station B for a total air volume sampled of 29,735.8 m³ (1,049,994 ft³), and 53 samples were collected from Station C for a total air volume sampled of 8,312.9 m³ (293,533 ft³). Samples were composited each quarter for stations B and C. Because of the large number of samples from Station A, these samples were composited monthly. Samples were analyzed radiochemically for ²⁴¹Am, ²³⁸Pu, and ²³⁹⁺²⁴⁰Pu, the components of the contact handled waste at WIPP expected to produce 98 percent of the potential dose to humans.

Out of 60 total composite samples, only one sample had detectable radioactivity (Table 4.1). For the remaining 59 samples WIPP Laboratories reported an activity less than the MDC. For the 59 composite samples where there was no activity detected, it was conservatively assumed that the actual activity was equal to the MDC for the WIPP 2001 Annual Periodic Confirmatory Measurement Compliance Report (40 CFR Part 61, Subpart H), and for other effluent reporting requirements.

The sample filter containing the detectable radioactivity, ²⁴¹Am, was collected from Station A during October 2001 (Table 4.1). In addition, during February 2001 at Station A, and during the third quarter at Station B, the reported activity of ²⁴¹Am was greater than the MDC. However, in both of these cases, the reported activities were less than two times the TPU, indicating the samples did not likely contained ²⁴¹Am.

In reference to Table 4.1, the WIPP Laboratories reports the radionuclide results in units of picoCurie/sample (pCi/sample). The laboratory results are converted from pCi/sample to becquerels (Bq). The laboratory results are converted to Bq by multiplying the laboratory results by 0.037.

There was no significant difference in the concentration of any radionuclide at Stations B and C between the years 2000 and 2001. It was not possible to compare results from Station A across years, because the composition frequency changed from quarterly to monthly from year 2000 to year 2001.

Results from Stations A, B, and C were used as input for the dose assessment presented in Chapter 7.

Additional sampling was routinely performed in the underground using fixed air samplers and continuous air monitors. Evaluation of the samples from both indicate there were no detectable releases above background activity from the WIPP facility.

4.2 Airborne Gross Alpha/Beta

Gross alpha and beta measurements in airborne particulates are used as a screening technique to provide timely information on levels of radioactivity in the environment around the WIPP site. Airborne particulate samples were collected from seven different locations around WIPP: Southeast Control (SEC), Carlsbad (CBD), J. C. Mills Ranch (MLR), Smith Ranch (SMR), WIPP East (WEE), WIPP South (WSS), and WIPP Far Field (WFF) (Figure 4.1).

Each week at each station, approximately 600 m³ (21,200 ft³) of air was filtered through a 4.7-cm (1.85-in) diameter glass microfiber filter using a low-volume continuous air sampler. The samples were collected at a height of 1.5-2 m (5-6.5 ft) to closely match the height at which air is inhaled by humans. Filters were counted for gross alpha and beta only after being stored for five to seven days in the laboratory to make sure the short-lived radon progeny had decayed.

Blank filters were also counted for gross alpha and beta activities so that background corrections (activities present in the blank filters) could be made in the gross alpha and beta measurements of the air samples. Blanks were counted weekly along with the samples. The gross alpha and beta activities per cubic meter of air were then determined by dividing the total activity of gross alpha and beta found in each weekly sample by the amount of air pulled through each sample. The results are given in Appendix D. The mass and volume of air collected each week are reported in Appendix E.

As expected, weekly gross alpha activity concentrations measured in 2001 varied by an order of magnitude throughout the year at each location (Figure 4.2). Measured concentrations ranged from a minimum of $1.15 \times 10^{-5} \pm 1.72 \times 10^{-5}$ Bq/m³ ($3.11 \times 10^{-4} \pm 4.65 \times 10^{-4}$ pCi/m³) to a maximum of $1.52 \times 10^{-4} \pm 4.27 \times 10^{-5}$ Bq/m³ ($4.11 \times 10^{-3} \pm 1.15 \times 10^{-3}$ pCi/m³) (Table 4.2). However, the annual mean concentrations of gross alpha activities found at all locations were similar, ranging from $5.26 \times 10^{-5} \pm 3.97 \times 10^{-5}$ to $6.16 \times 10^{-5} \pm 5.28 \times 10^{-5}$ Bq/m³ ($1.42 \times 10^{-3} \pm 1.07 \times 10^{-3}$ to $1.66 \times 10^{-3} \pm 1.43 \times 10^{-3}$ pCi/m³). ANOVA indicated no statistically significant difference between sampling stations ($p = 0.989$).

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**Table 4.1 - Activity (Bq) of Quarterly Composite Air Samples from
Effluent Monitoring Stations A, B, and C**

Nuclide	Station A			Station B			Station C		
	Activity	2 × TPU ^a	MDC ^b	Activity	2 × TPU	MDC	Activity	2 × TPU	MDC
1st Quarter									
²⁴¹ Am				3.11×10 ⁻⁴	7.62×10 ⁻⁴	1.45×10 ⁻³	0.00×10 ⁰	0.00×10 ⁰	5.03×10 ⁻⁴
²³⁸ Pu	See below ^c			0.00×10 ⁰	0.00×10 ⁰	1.07×10 ⁻³	1.05×10 ⁻⁴	3.65×10 ⁻⁴	7.70×10 ⁻⁴
²³⁹⁺²⁴⁰ Pu				1.15×10 ⁻⁴	2.31×10 ⁻⁴	3.11×10 ⁻⁴	1.05×10 ⁻⁴	2.10×10 ⁻⁴	2.83×10 ⁻⁴
2nd Quarter									
²⁴¹ Am				0.00×10 ⁰	0.00×10 ⁰	5.07×10 ⁻⁴	-3.63×10 ⁻⁴	5.22×10 ⁻⁴	1.69×10 ⁻³
²³⁸ Pu	See below			6.07×10 ⁻⁵	2.11×10 ⁻⁴	4.44×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁻⁴	4.88×10 ⁻⁴
²³⁹⁺²⁴⁰ Pu				0.00×10 ⁰	0.00×10 ⁰	1.64×10 ⁻⁴	6.62×10 ⁻⁵	1.33×10 ⁻⁴	1.79×10 ⁻⁴
3rd Quarter									
²⁴¹ Am				1.21×10 ⁻³	1.42×10 ⁻³	1.09×10 ⁻³	1.10×10 ⁻⁴	6.59×10 ⁻⁴	1.32×10 ⁻³
²³⁸ Pu	See below			-1.09×10 ⁻⁴	2.19×10 ⁻⁴	7.99×10 ⁻⁴	-2.11×10 ⁻⁴	4.26×10 ⁻⁴	1.13×10 ⁻³
²³⁹⁺²⁴⁰ Pu				1.08×10 ⁻⁴	2.18×10 ⁻⁴	2.94×10 ⁻⁴	2.10×10 ⁻⁴	2.99×10 ⁻⁴	2.85×10 ⁻⁴
4th Quarter									
²⁴¹ Am				0.00×10 ⁰	0.00×10 ⁰	1.39×10 ⁻³	2.18×10 ⁻⁴	4.37×10 ⁻⁴	8.03×10 ⁻⁴
²³⁸ Pu	See below			0.00×10 ⁰	0.00×10 ⁰	1.03×10 ⁻³	0.00×10 ⁰	0.00×10 ⁰	7.62×10 ⁻⁴
²³⁹⁺²⁴⁰ Pu				0.00×10 ⁰	0.00×10 ⁰	3.77×10 ⁻⁴	2.07×10 ⁻⁴	2.95×10 ⁻⁴	2.81×10 ⁻⁴
Station A 1st Quarter Monthly^c									
	January			February			March		
²⁴¹ Am	5.88×10 ⁻⁴	7.25×10 ⁻⁴	1.08×10 ⁻³	6.07×10 ⁻⁴	6.18×10 ⁻⁴	4.11×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	1.50×10 ⁻³
²³⁸ Pu	1.34×10 ⁻⁴	2.69×10 ⁻⁴	3.61×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	7.51×10 ⁻⁴	-1.22×10 ⁻⁴	4.26×10 ⁻⁴	1.13×10 ⁻³
²³⁹⁺²⁴⁰ Pu	4.00×10 ⁻⁴	5.99×10 ⁻⁴	9.81×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	2.76×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	3.30×10 ⁻⁴
Station A 2nd Quarter Monthly									
	April			May			June		
²⁴¹ Am	1.51×10 ⁻⁴	3.02×10 ⁻⁴	5.55×10 ⁻⁴	-3.10×10 ⁻⁴	3.85×10 ⁻⁴	1.02×10 ⁻³	6.40×10 ⁻⁴	8.07×10 ⁻⁴	1.28×10 ⁻³
²³⁸ Pu	0.00×10 ⁰	0.00×10 ⁰	4.33×10 ⁻⁴	-6.07×10 ⁻⁵	1.22×10 ⁻⁴	4.44×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	4.81×10 ⁻⁴
²³⁹⁺²⁴⁰ Pu	5.88×10 ⁻⁵	2.04×10 ⁻⁴	4.33×10 ⁻⁴	-6.03×10 ⁻⁵	1.21×10 ⁻⁴	4.44×10 ⁻⁴	6.55×10 ⁻⁵	1.31×10 ⁻⁴	1.77×10 ⁻⁴
Station A 3rd Quarter Monthly									
	July			August			September		
²⁴¹ Am	3.29×10 ⁻⁴	4.70×10 ⁻⁴	4.44×10 ⁻⁴	2.21×10 ⁻⁴	6.25×10 ⁻⁴	1.19×10 ⁻³	7.22×10 ⁻⁴	6.29×10 ⁻⁴	7.59×10 ⁻⁴
²³⁸ Pu	0.00×10 ⁰	0.00×10 ⁰	3.43×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	2.99×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	3.10×10 ⁻⁴
²³⁹⁺²⁴⁰ Pu	0.00×10 ⁰	0.00×10 ⁰	9.32×10 ⁻⁴	2.21×10 ⁻⁴	3.14×10 ⁻⁴	2.99×10 ⁻⁴	-2.29×10 ⁻⁴	3.26×10 ⁻⁴	1.06×10 ⁻³
Station A 4th Quarter Monthly									
	October			November			December		
²⁴¹ Am	1.86×10 ⁻³	1.41×10 ⁻³	1.52×10 ⁻³	-2.39×10 ⁻²	4.81×10 ⁻⁴	1.29×10 ⁻³	2.71×10 ⁻⁴	3.85×10 ⁻⁴	3.67×10 ⁻⁴
²³⁸ Pu	2.20×10 ⁻⁴	4.40×10 ⁻⁴	8.07×10 ⁻⁴	-2.78×10 ⁻⁴	5.59×10 ⁻⁴	1.49×10 ⁻³	1.37×10 ⁻⁴	2.74×10 ⁻⁴	3.69×10 ⁻⁴
²³⁹⁺²⁴⁰ Pu	1.10×10 ⁻⁴	2.19×10 ⁻⁴	2.97×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	1.02×10 ⁻³	-1.36×10 ⁻⁴	2.73×10 ⁻⁴	1.00×10 ⁻³

^a Total propagated uncertainty.

^b Minimum detectable concentration.

^c Station A were composited monthly due to the large number of samples.

In 2001, the weekly gross beta concentrations also varied throughout the year at each station (Figure 4.3). Stations tended to vary together, showing a strong annual pattern.

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Concentrations ranged over almost an order of magnitude, from a minimum of $4.71 \times 10^{-4} \pm 7.88 \times 10^{-5} \text{ Bq/m}^3$ ($1.27 \times 10^{-2} \pm 2.13 \times 10^{-3} \text{ pCi/m}^3$) to a maximum of $1.70 \times 10^{-3} \pm 2.04 \times 10^{-4} \text{ Bq/m}^3$ ($4.59 \times 10^{-2} \pm 5.51 \times 10^{-3} \text{ pCi/m}^3$) (Table 4.2). However, the annual mean concentrations of gross beta activities found at all locations were similar, ranging from $8.37 \times 10^{-4} \pm 4.17 \times 10^{-4}$ to $9.28 \times 10^{-4} \pm 1.86 \times 10^{-3} \text{ Bq/m}^3$ ($2.26 \times 10^{-2} \pm 1.13 \times 10^{-2}$ to $2.51 \times 10^{-2} \pm 5.03 \times 10^{-2} \text{ pCi/m}^3$). There was no significant difference between sampling stations (ANOVA, $p = 0.565$).

Gross alpha and gross beta activity concentrations in 2000 and 2001 were compared using ANOVA to determine whether they had increased since waste began to be received at WIPP (Figure 4.4). There was no significant difference in measured gross alpha ($p = 0.241$) or gross beta ($p = 0.094$) activity concentration between years.

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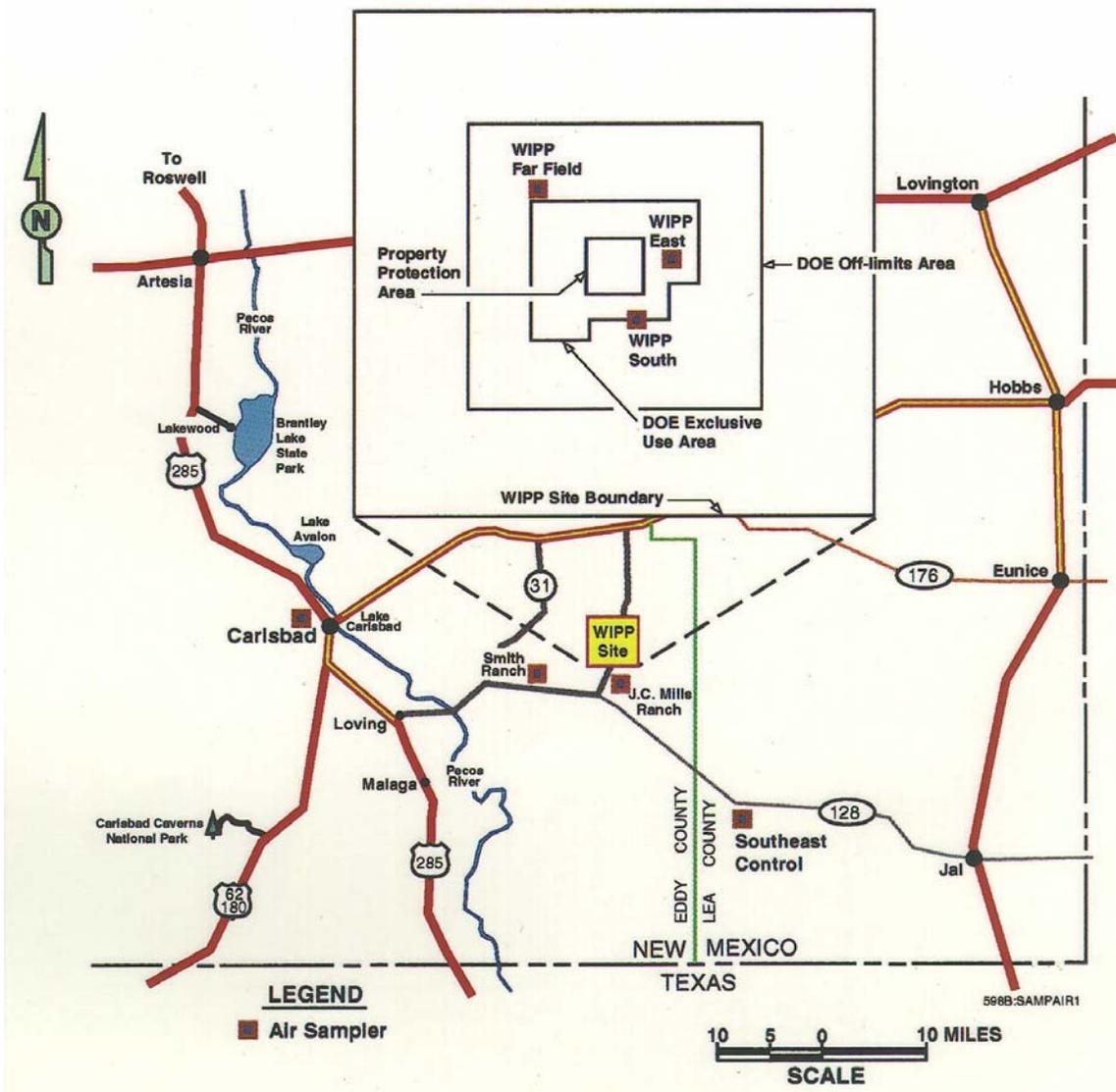


Figure 4.1 - Air Sampling Locations on and Near the WIPP Facility

One duplicate sample was collected every quarter by rotating the portable sampler from one location to another: WEE in the first quarter, WSS in the second quarter, MLR in the third quarter, and SMR in the fourth quarter. The samples were collected by both samplers in identical conditions at all four locations. Duplicate samples were collected and analyzed for the QC of (1) air sampling technique, (2) determination of gross alpha and beta activities, and (3) analysis of the individual radionuclides in airborne particulate. Relative Error Ratios (RER) (see Appendix C) was exceeded once in the weekly gross alpha (RER value 1.03) and were less than one in all of the weekly gross beta measurements. An RER less than one indicates good agreement between duplicates. The duplicate data are provided in Appendix D.

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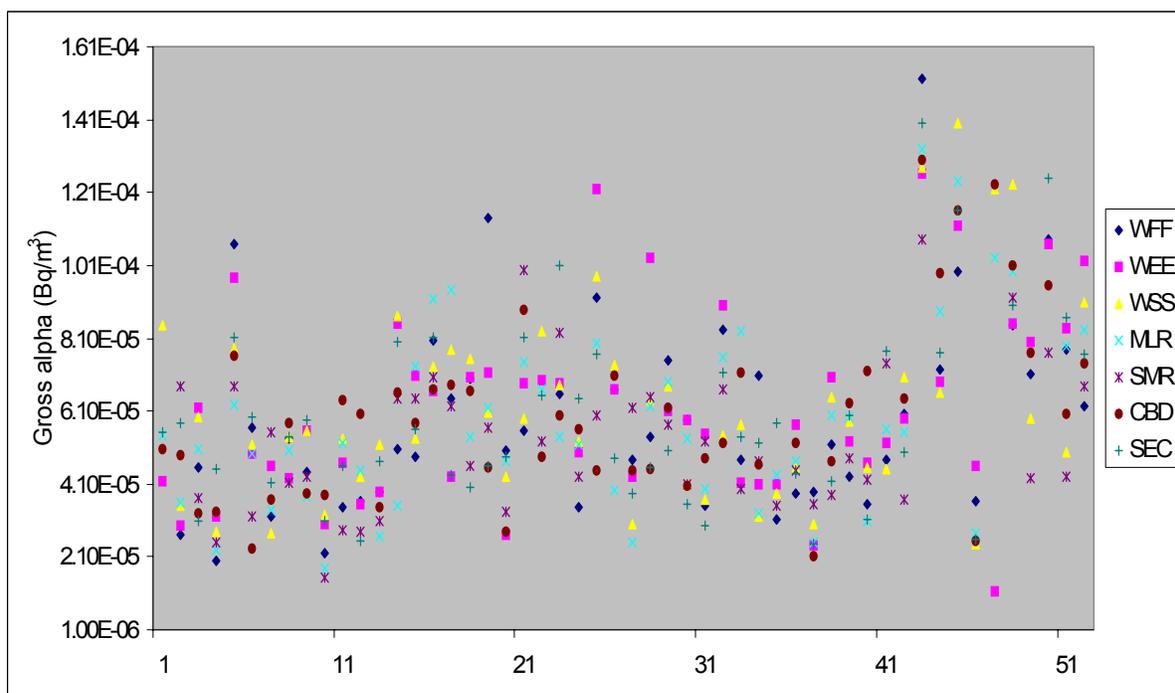


Figure 4.2 - Gross Alpha Activity Concentration Measured in Air Particulates Each Week in 2001. See text for sampling station locations.

Table 4.2 - Annual Mean Gross Alpha and Gross Beta Activity Concentrations (Bq/m³) Found in Weekly Air Particulate Samples (See Appendix B for sample locations.)

Location	Minimum	2 × TPU ^a	Maximum	2 × TPU	Mean	2 × SD ^b
Gross Alpha						
CBD	2.11×10 ⁻⁵	1.57×10 ⁻⁵	1.30×10 ⁻⁴	3.87×10 ⁻⁵	5.98×10 ⁻⁵	4.92×10 ⁻⁵
MLR	1.77×10 ⁻⁵	1.45×10 ⁻⁵	1.33×10 ⁻⁴	4.03×10 ⁻⁵	5.83×10 ⁻⁵	5.13×10 ⁻⁵
SEC	2.46×10 ⁻⁵	1.71×10 ⁻⁵	1.40×10 ⁻⁴	4.11×10 ⁻⁵	5.93×10 ⁻⁵	5.07×10 ⁻⁵
SMR	1.52×10 ⁻⁵	1.37×10 ⁻⁵	1.08×10 ⁻⁴	3.68×10 ⁻⁵	5.26×10 ⁻⁵	3.97×10 ⁻⁵
WEE	1.15×10 ⁻⁵	1.72×10 ⁻⁵	1.26×10 ⁻⁴	3.92×10 ⁻⁵	6.16×10 ⁻⁵	5.15×10 ⁻⁵
WFF	1.99×10 ⁻⁵	1.55×10 ⁻⁵	1.52×10 ⁻⁴	4.27×10 ⁻⁵	5.90×10 ⁻⁵	1.18×10 ⁻⁴
WSS	2.47×10 ⁻⁵	1.69×10 ⁻⁵	1.40×10 ⁻⁴	4.08×10 ⁻⁵	6.16×10 ⁻⁵	5.28×10 ⁻⁵
Gross Beta						
CBD	5.59×10 ⁻⁴	8.38×10 ⁻⁵	1.70×10 ⁻³	2.04×10 ⁻⁴	8.83×10 ⁻⁴	4.63×10 ⁻⁴
MLR	5.77×10 ⁻⁴	8.99×10 ⁻⁵	1.56×10 ⁻³	1.91×10 ⁻⁴	8.76×10 ⁻⁴	4.33×10 ⁻⁴
SEC	6.13×10 ⁻⁴	9.12×10 ⁻⁵	1.62×10 ⁻³	1.93×10 ⁻⁴	9.04×10 ⁻⁴	4.13×10 ⁻⁴
SMR	4.71×10 ⁻⁴	7.88×10 ⁻⁵	1.39×10 ⁻³	1.73×10 ⁻⁴	8.37×10 ⁻⁴	4.17×10 ⁻⁴
WEE	5.54×10 ⁻⁴	8.61×10 ⁻⁵	1.64×10 ⁻³	1.95×10 ⁻⁴	8.90×10 ⁻⁴	4.58×10 ⁻⁴
WFF	5.87×10 ⁻⁴	8.92×10 ⁻⁵	1.66×10 ⁻³	1.98×10 ⁻⁴	9.28×10 ⁻⁴	1.86×10 ⁻³
WSS	6.05×10 ⁻⁴	8.86×10 ⁻⁵	1.51×10 ⁻³	1.83×10 ⁻⁴	8.67×10 ⁻⁴	4.31×10 ⁻⁴

^a Total propagated uncertainty

^b Standard deviation of the mean

4.3 Airborne Particulates

The major pathways for the intake of radioactive materials into the human body are from the inhalation of dust particles and the ingestion of food and drinking water. Plutonium is the major constituent of the TRU wastes to be disposed at the WIPP site. Accordingly, plutonium and other radionuclides of interest were determined in air particulate samples around the WIPP site.

Isotopes of plutonium and americium were analyzed because they are the most significant alpha-emitting radionuclides among the constituents of TRU wastes received at the WIPP site. Uranium isotopes were analyzed because they are prominent alpha-emitting radionuclides in the natural environment.

WIPP analyzed samples for ^{90}Sr , ^{60}Co , and ^{137}Cs in order to demonstrate the ability to quantify these beta and gamma-emitting contaminants should they appear in the TRU waste stream. These radionuclides have been the subject of background studies at WIPP prior to 1999 and continue to be monitored. Potassium-40, a natural gamma-emitting radionuclide which is ubiquitous in the earth's crust, was also monitored because of its possible enhancement in southeastern New Mexico due to potash mining.

Gross alpha and gross beta measurements are used as a screening technique and to identify any seasonal trends. The results are compared to historical values. Any result above the 2σ warning limit is investigated for sampling error, instrument problems, and any other steps involved in the gross alpha and gross beta analysis. If the above-mentioned were ruled out as a contribution to the high result, a destructive analysis is performed to identify the specific nuclide contributing to the activity.

4.3.1 Sample Preparation

Weekly air particulate samples were collected as described in Section 4.2 and composited for each quarter. The composites were transferred into a Pyrex beaker, spiked with appropriate tracers, and heated in a Muffle furnace at 250°C (482°F) for two hours, followed by two hours at 375°C (707°F) and six hours at 525°C (977°F).

The ash was cooled, transferred quantitatively into a Teflon beaker by rinsing with concentrated nitric acid, and heated with concentrated hydrofluoric acid until completely dissolved. Hydrofluoric acid was removed by evaporating to dryness.

Approximately 25 ml (0.845 oz [ounce]) of concentrated nitric acid and one gram (0.0353 oz) of boric acid were added, heated, and finally evaporated to dryness. The residue was dissolved in 8 M (molar) nitric acid for gamma spectrometry and determinations of ^{90}Sr and alpha-emitting radionuclides.

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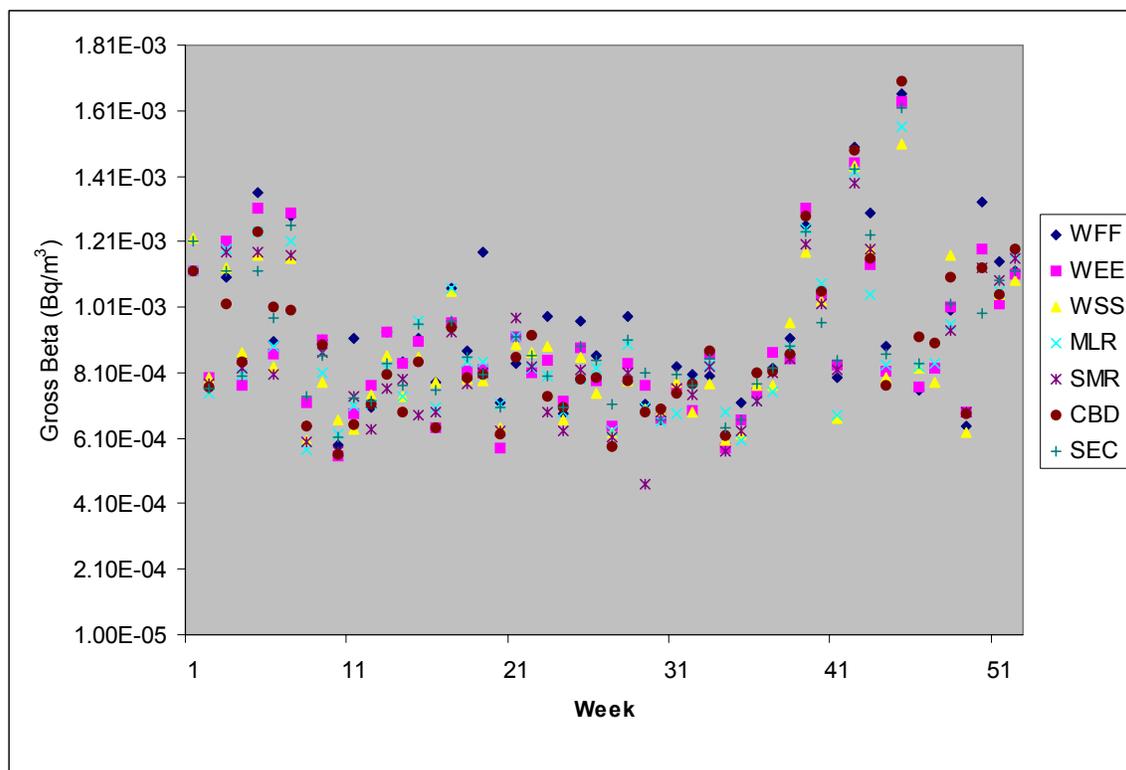


Figure 4.3 - Gross Beta Activity Concentration Measured in Air Particulates Each Week in 2001. See text for sampling station locations.

4.3.2 Determination of Individual Radionuclides

Gamma-emitting radionuclides were measured in the air filters by gamma spectrometry. Strontium-90 and alpha-emitting radionuclides were determined by sequential separation and counting. Determination of actinides involved co-precipitation, ion exchange separation, and alpha spectrometry.

4.3.3 Results and Discussions

The minima, maxima, and means for all stations combined are reported in Table 4.3. Detailed data for each station are reported in Appendix G (Table G.1). Natural uranium isotopes were detected in every composite sample. Concentrations of ^{234}U ranged from $2.01 \times 10^{-6} \pm 4.48 \times 10^{-7} \text{ Bq/m}^3$ ($5.43 \times 10^{-5} \pm 1.21 \times 10^{-5} \text{ pCi/m}^3$) at WSS in the first quarter to $4.59 \times 10^{-6} \pm 8.51 \times 10^{-7} \text{ Bq/m}^3$ ($1.24 \times 10^{-4} \pm 2.30 \times 10^{-5} \text{ pCi/m}^3$) at WFF in the second quarter (Appendix G, Table G.1). There was no significant difference between concentrations measured in 2000 and 2001 (ANOVA, $p = 0.345$).

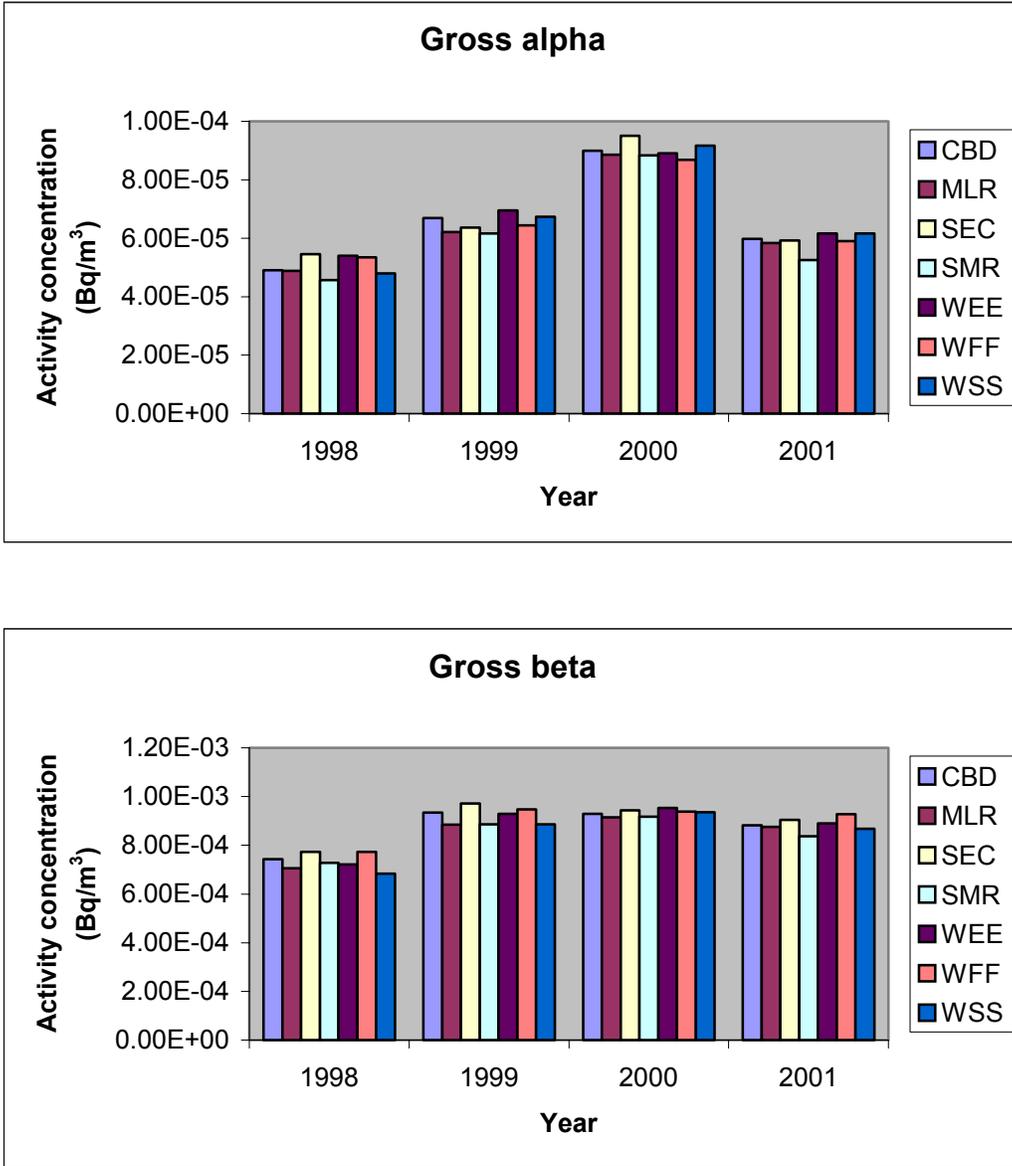


Figure 4.4 - Average Gross Alpha and Beta Activity Concentrations Measured in Air Particulates in Four Consecutive Years. The year 1999 was the first year in which radioactivity was stored in WIPP. See text for sampling station locations.

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Table 4.3 - Minimum, Maximum and Average Radionuclide Concentrations (Bq/m³) in Air Filter Composites from Stations Surrounding the WIPP Site. See Appendix B for locations. See Appendix G for supporting data.

Radionuclide		[RN] ^a	2×TPU ^b	MDC ^c
²⁴¹ Am	Minimum	-4.26×10 ⁻⁸	6.40×10 ⁻⁸	3.81×10 ⁻⁸
	Maximum	6.03×10 ⁻⁸	6.11×10 ⁻⁸	2.17×10 ⁻⁷
	Average	1.87×10 ⁻⁸	4.88×10 ⁻⁸	8.58×10 ⁻⁸
²³⁸ Pu	Minimum	-3.36×10 ⁻⁸	6.73×10 ⁻⁸	3.92×10 ⁻⁸
	Maximum	2.07×10 ⁻⁷	2.23×10 ⁻⁷	3.05×10 ⁻⁷
	Average	2.23×10 ⁻⁸	9.37×10 ⁻⁸	1.43×10 ⁻⁷
²³⁹⁺²⁴⁰ Pu	Minimum	-2.96×10 ⁻⁸	5.96×10 ⁻⁸	3.52×10 ⁻⁸
	Maximum	1.08×10 ⁻⁷	1.34×10 ⁻⁷	2.18×10 ⁻⁷
	Average	1.62×10 ⁻⁸	5.36×10 ⁻⁸	7.84×10 ⁻⁸
²³⁴ U	Minimum	2.01×10 ⁻⁶	4.48×10 ⁻⁷	3.52×10 ⁻⁸
	Maximum	4.59×10 ⁻⁶	8.51×10 ⁻⁷	1.29×10 ⁻⁷
	Average	2.96×10 ⁻⁶	1.66×10 ⁻⁶	5.80×10 ⁻⁸
²³⁵ U	Minimum	0.00×10 ⁰	0.00×10 ⁰	4.44×10 ⁻⁸
	Maximum	8.18×10 ⁻⁷	9.29×10 ⁻⁸	2.10×10 ⁻⁷
	Average	1.69×10 ⁻⁷	2.82×10 ⁻⁷	7.74×10 ⁻⁸
²³⁸ U	Minimum	1.75×10 ⁻⁶	4.18×10 ⁻⁷	3.51×10 ⁻⁸
	Maximum	4.81×10 ⁻⁶	9.55×10 ⁻⁷	1.82×10 ⁻⁷
	Average	2.90×10 ⁻⁶	1.63×10 ⁻⁶	6.42×10 ⁻⁸
⁴⁰ K	Minimum	-5.29×10 ⁻⁵	2.37×10 ⁻⁴	1.27×10 ⁻⁴
	Maximum	6.44×10 ⁻³	2.46×10 ⁻⁴	8.84×10 ⁻⁴
	Average	6.90×10 ⁻⁴	3.11×10 ⁻³	3.31×10 ⁻⁴
⁶⁰ Co	Minimum	-1.32×10 ⁻⁵	2.94×10 ⁻⁵	1.98×10 ⁻⁵
	Maximum	3.96×10 ⁻⁵	4.00×10 ⁻⁵	5.07×10 ⁻⁵
	Average	6.32×10 ⁻⁶	2.72×10 ⁻⁵	2.89×10 ⁻⁵
⁹⁰ Sr	Minimum	-7.47×10 ⁻⁶	5.66×10 ⁻⁶	6.99×10 ⁻⁶
	Maximum	6.33×10 ⁻⁶	4.40×10 ⁻⁶	1.44×10 ⁻⁵
	Average	2.01×10 ⁻⁷	7.08×10 ⁻⁶	8.77×10 ⁻⁶
¹³⁷ Cs	Minimum	-3.81×10 ⁻⁵	3.28×10 ⁻⁵	1.69×10 ⁻⁵
	Maximum	3.70×10 ⁻⁵	3.70×10 ⁻⁵	4.88×10 ⁻⁵
	Average	-7.71×10 ⁻⁷	3.35×10 ⁻⁵	2.62×10 ⁻⁵

^a [RN] = Radionuclide concentration

^b Total Propagated Uncertainty (Standard Deviation, in the case of the mean)

^c Minimum Detectable Concentration

The activity concentration of ²³⁵U in the natural environment is very low compared to the concentrations of ²³⁴U and ²³⁸U (1 µg of natural uranium contains 12.2 mBq [millibecquerel] [0.33 pCi] of ²³⁸U, 0.56 mBq [0.01 pCi] of ²³⁵U, and 12.8 mBq [0.35 pCi] of ²³⁴U); therefore, the amount of ²³⁵U in air particulate samples is expected to be lower. Uranium-235 was detected in approximately 75 percent of the quarterly composite samples. The lowest concentration (0.00×10⁰ ± 0.00×10⁰ Bq/m³ [0.00×10⁰ ± 0.00×10⁰ pCi/m³]) was measured at WFF in the fourth quarter and the highest concentration (8.18×10⁻⁷ ± 9.29×10⁻⁸ Bq/m³ [2.21×10⁻⁵ ± 2.51×10⁻⁶ pCi/m³]) was found at MLR in the first quarter (Table G.1).

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Uranium-238 was also, as expected, detected in 100 percent of the composite air filters. Concentrations ranged from $1.75 \times 10^{-6} \pm 4.18 \times 10^{-7}$ Bq/m³ ($4.73 \times 10^{-5} \pm 1.13 \times 10^{-5}$ pCi/m³) at WFF in the first quarter to $4.81 \times 10^{-6} \pm 9.55 \times 10^{-7}$ Bq/m³ ($1.30 \times 10^{-4} \pm 2.58 \times 10^{-5}$ pCi/m³) at CBD in the second quarter (Table G.1).

Neither ²³⁸Pu nor ²³⁹⁺²⁴⁰Pu were detected in any sample in 2001. Americium-241 was also not detected in any of the quarterly composites.

Concentrations of ⁴⁰K (Table G.1) were detected in approximately 50 percent of the samples. The minimum ($-5.29 \times 10^{-5} \pm 2.37 \times 10^{-4}$ Bq/m³ [$1.43 \times 10^{-3} \pm 6.41 \times 10^{-3}$ pCi/m³]) was found at WFF in the second quarter, while the maximum ($6.44 \times 10^{-3} \pm 2.46 \times 10^{-4}$ Bq/m³ [$1.74 \times 10^{-1} \pm 6.65 \times 10^{-3}$ pCi/m³]) was found at WEE in the second quarter.

Cesium-137 was not detected in any of the quarterly composite samples. Cobalt-60 was detected in one sample. Strontium-90 was never detected in a quarterly composite air filter in 2001.

Duplicate air particulate samples were collected by rotating the portable sampler from one location to another every quarter: WEE in the first quarter, WSS in the second quarter, MLR in the third quarter, and SMR in the fourth quarter. The samples were collected by both samplers in identical conditions at all four locations. The duplicate samples were analyzed to check the reproducibility of the data. The results are given in Table 4.4. The original and duplicate results for ²³⁴U, ²³⁸U, and ⁴⁰K were compared using the RER. The results for all other radionuclides were excluded because of insufficient detections for a meaningful test. Relative Error Ratios were less than one for all results except ²³⁴U and ²³⁸U at SMR fourth quarter due to the non-homogenous deposit of airborne particulates on the filter. Sample WSS in the second quarter failed to meet RER criteria for ⁴⁰K because the gamma software had a problem calculating the activity. The problem was isolated to this incidence. The sample could not be reanalyzed since the aliquot was used for actinide analysis.

The results obtained for the concentrations of ²³⁸Pu, ²³⁹⁺²⁴⁰Pu, and ²⁴¹Am in air particulates compared favorably with those measured by the EEG (Table 4.5). The annual mean concentrations of these radionuclides were very low, and most samples collected by either WIPP or EEG did not contain detectable concentrations.

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**Table 4.4 - Results of Duplicate Composite Air Filter Sampling. Units are Bq/m³.
See Appendix B for sampling stations.**

Location	Quarter	[RN] ^a	2×TPU ^b	MDC ^c	RER ^d
		⁴⁰ K			
WEE	1	2.46×10 ⁻⁴	2.43×10 ⁻⁴	3.06×10 ⁻⁴	0.155
WEE Dup.	1	2.93×10 ⁻⁴	1.85×10 ⁻⁴	2.40×10 ⁻⁴	
WSS	2	2.93×10 ⁻⁴	1.84×10 ⁻⁴	2.41×10 ⁻⁴	64.70
WSS Dup.	2	7.47×10 ⁻²	1.14×10 ⁻³	7.96×10 ⁻⁴	
MLR	3	2.26×10 ⁻⁴	1.04×10 ⁻⁴	1.36×10 ⁻⁴	0.035
MLR Dup.	3	2.21×10 ⁻⁴	9.55×10 ⁻⁵	1.22×10 ⁻⁴	
SMR	4	4.29×10 ⁻⁴	3.64×10 ⁻⁴	5.74×10 ⁻⁴	0.607
SMR Dup.	4	1.56×10 ⁻⁴	2.64×10 ⁻⁴	3.23×10 ⁻⁴	
²³⁴ U					
WEE	1	2.34×10 ⁻⁶	5.40×10 ⁻⁷	1.29×10 ⁻⁷	0.172
WEE Dup.	1	2.47×10 ⁻⁶	5.39×10 ⁻⁷	4.01×10 ⁻⁸	
WSS	2	4.29×10 ⁻⁶	8.62×10 ⁻⁷	4.18×10 ⁻⁸	0.025
WSS Dup.	2	4.26×10 ⁻⁶	8.29×10 ⁻⁷	3.99×10 ⁻⁸	
MLR	3	2.91×10 ⁻⁶	6.33×10 ⁻⁷	4.26×10 ⁻⁸	0.369
MLR Dup.	3	2.60×10 ⁻⁶	5.51×10 ⁻⁷	3.81×10 ⁻⁸	
SMR	4	2.58×10 ⁻⁶	5.99×10 ⁻⁷	5.33×10 ⁻⁸	2.760
SMR Dup.	4	3.33×10 ⁻⁷	5.51×10 ⁻⁷	1.09×10 ⁻⁷	
²³⁸ U					
WEE	1	2.35×10 ⁻⁶	5.40×10 ⁻⁷	4.29×10 ⁻⁸	0.288
WEE Dup.	1	2.14×10 ⁻⁶	4.85×10 ⁻⁷	9.59×10 ⁻⁷	
WSS	2	4.37×10 ⁻⁶	8.73×10 ⁻⁷	4.14×10 ⁻⁸	0.113
WSS Dup.	2	4.51×10 ⁻⁶	8.73×10 ⁻⁷	3.96×10 ⁻⁸	
MLR	3	2.53×10 ⁻⁶	5.70×10 ⁻⁷	1.15×10 ⁻⁷	0.000
MLR Dup.	3	2.53×10 ⁻⁶	5.40×10 ⁻⁷	1.03×10 ⁻⁸	
SMR	4	2.56×10 ⁻⁶	6.03×10 ⁻⁷	1.82×10 ⁻⁷	2.797
SMR Dup.	4	2.60×10 ⁻⁷	5.59×10 ⁻⁷	1.08×10 ⁻⁷	

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

^d Relative Error Ratio

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Table 4.5 - Preliminary Quarterly Average Radionuclide Concentrations (Bq/m³) Measured in Air Particulate Samples by the Environmental Evaluation Group in 2001

	Quarter			
	1	2	3	4
²⁴¹Am				
Concentration	2.99×10^{-8}	2.52×10^{-8}	9.59×10^{-9}	NR ^b
2×SD ^a	3.53×10^{-8}	3.49×10^{-8}	3.50×10^{-8}	NR
²³⁸Pu				
Concentration	-1.51×10^{-9}	1.28×10^{-8}	-8.32×10^{-9}	NR
2×SD	4.20×10^{-8}	4.46×10^{-8}	-4.29×10^{-8}	NR
²³⁹⁺²⁴⁰Pu				
Concentration	6.21×10^{-9}	2.46×10^{-8}	8.42×10^{-9}	NR
2×SD	2.05×10^{-8}	2.29×10^{-8}	1.97×10^{-8}	NR

^a Standard Deviation.

^b Not reported

4.4 Groundwater

4.4.1 Sample Collection

Groundwater samples were collected from seven different wells around the WIPP site as shown in Figure 6.1. Approximately three bore volumes (approximately 3,800 l [1,000 gal]) of water were pumped out of these wells before collecting approximately 38 l (10 gal) of water samples. The water samples were collected from depths ranging from 180-270 m (600-900 ft) from six wells (WQSP-1 to WQSP-6), and from a depth of 69 m (225 ft) from WQSP-6A. Samples were collected twice in 2001. Approximately 8 l (2 gal) of water were sent to the laboratory for the determination of radionuclides of interest. The rest of the samples were used to analyze for nonradiological parameters or were put into storage. The samples were acidified to pH ≤ 2 by adding concentrated nitric acid drop by drop.

4.4.2 Determination of Individual Radionuclides

The acidified water samples were used for the determination of gamma-emitting radionuclides, such as ⁴⁰K, ⁶⁰Co, and ¹³⁷Cs, by gamma-spectrometry. An aliquot of approximately 0.5 l (16.9 oz) was used for the determination of ⁹⁰Sr. Another aliquot was used for the sequential determinations of the uranium isotopes, the plutonium isotopes, and ²⁴¹Am by alpha spectrometry, which involved the co-precipitation of actinides with iron carrier, ion exchange chromatographic separation of individual radionuclides, source preparation by micro-precipitating, and alpha spectrometry.

4.4.3 Results and Discussions

Isotopes of naturally-occurring uranium were detected in every well in 2001 (Table 4.6). The mean concentrations of ²³⁴U ranged from $2.53 \times 10^{-1} \pm 7.69 \times 10^{-3}$ Bq/l (becquerels per liter) ($6.84 \times 10^0 \pm 2.08 \times 10^{-1}$ pCi/l) (picoCuries per liter) in WQSP-6A to $1.29 \times 10^0 \pm 1.90 \times 10^{-1}$ Bq/l ($3.49 \times 10^1 \pm 5.14 \times 10^0$ pCi/l) in WQSP-1. Uranium-235 ranged from

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5.88×10⁻³ ± 1.13×10⁻³ Bq/l (1.59×10⁻¹ ± 3.05×10⁻² pCi/l) in WQSP-3 to 3.34×10⁻² ± 2.95×10⁻² Bq/l (9.02×10⁻¹ ± 7.97×10⁻¹ pCi/l) in WQSP-1. The mean concentration of ²³⁸U ranged from 4.14×10⁻² ± 1.13×10⁻³ Bq/l (1.12×10⁰ ± 3.05×10⁻¹ pCi/l) in WQSP-3 to 2.11×10⁻¹ ± 2.15×10⁻² Bq/l (5.70×10⁰ ± 5.81×10⁻¹ pCi/l) in WQSP-1.

Table 4.6 - Average Annual Radionuclide Concentrations (Bq/l) in Groundwater from Wells at the WIPP Site. See Chapter 6 for the sampling locations.

Location	²⁴¹ Am			²³⁸ Pu			²³⁹⁺²⁴⁰ Pu		
	Mean	2 × SD ^a	MDC ^b	Mean	2 × SD	MDC	Mean	2 × SD	MDC
WQSP-1	3.99×10 ⁻⁴	7.00×10 ⁻⁴	7.59×10 ⁻⁴	2.93×10 ⁻⁴	1.53×10 ⁻⁴	9.45×10 ⁻⁴	5.79×10 ⁻⁵	1.61×10 ⁻⁴	4.79×10 ⁻⁴
WQSP-2	0.00×10 ⁰	0.00×10 ⁰	1.41×10 ⁻³	2.19×10 ⁻⁴	1.36×10 ⁻⁴	8.82×10 ⁻⁴	-2.19×10 ⁻⁴	1.35×10 ⁻⁴	1.44×10 ⁻³
WQSP-3	5.20×10 ⁻⁴	5.39×10 ⁻⁴	1.91×10 ⁻³	-9.56×10 ⁻⁵	2.65×10 ⁻⁴	2.28×10 ⁻³	0.00×10 ⁰	0.00×10 ⁰	6.64×10 ⁻⁴
WQSP-4	3.00×10 ⁻⁴	3.29×10 ⁻⁴	8.55×10 ⁻⁴	2.15×10 ⁻⁴	2.52×10 ⁻⁴	3.75×10 ⁻⁴	1.44×10 ⁻⁵	3.84×10 ⁻⁴	6.64×10 ⁻⁴
WQSP-5	-9.62×10 ⁻⁵	2.67×10 ⁻⁴	1.39×10 ⁻³	1.08×10 ⁻⁴	2.99×10 ⁻⁴	7.01×10 ⁻⁴	5.40×10 ⁻⁵	1.50×10 ⁻⁴	6.01×10 ⁻⁴
WQSP-6	-1.46×10 ⁻⁴	8.56×10 ⁻⁵	1.07×10 ⁻³	5.22×10 ⁻⁴	2.39×10 ⁻³	1.82×10 ⁻³	-9.29×10 ⁻⁵	6.83×10 ⁻⁴	1.46×10 ⁻³
WQSP-6A	2.11×10 ⁻⁴	7.08×10 ⁻⁵	1.12×10 ⁻³	3.40×10 ⁻⁴	5.33×10 ⁻⁵	1.03×10 ⁻³	-5.98×10 ⁻⁵	1.66×10 ⁻⁴	6.57×10 ⁻⁴
	²³⁴ U			²³⁵ U			²³⁸ U		
WQSP-1	1.29×10 ⁻¹	1.90×10 ⁻¹	6.44×10 ⁻⁴	3.34×10 ⁻²	2.95×10 ⁻²	1.32×10 ⁻³	2.11×10 ⁻¹	2.15×10 ⁻²	6.40×10 ⁻⁴
WQSP-2	1.15×10 ⁰	1.54×10 ⁻¹	3.86×10 ⁻⁴	1.76×10 ⁻²	1.26×10 ⁻²	4.75×10 ⁻⁴	1.88×10 ⁻¹	1.79×10 ⁻²	6.62×10 ⁻⁴
WQSP-3	2.71×10 ⁻¹	4.05×10 ⁻²	9.18×10 ⁻⁴	5.88×10 ⁻³	1.13×10 ⁻³	6.42×10 ⁻⁴	4.14×10 ⁻²	1.13×10 ⁻²	5.18×10 ⁻⁴
WQSP-4	5.31×10 ⁻¹	1.54×10 ⁻²	2.26×10 ⁻³	8.20×10 ⁻³	5.13×10 ⁻⁵	6.48×10 ⁻⁴	8.90×10 ⁻²	1.18×10 ⁻²	5.22×10 ⁻⁴
WQSP-5	5.75×10 ⁻¹	1.28×10 ⁻¹	1.17×10 ⁻³	8.10×10 ⁻³	1.33×10 ⁻³	1.55×10 ⁻³	8.33×10 ⁻²	1.33×10 ⁻²	5.28×10 ⁻⁴
WQSP-6	5.48×10 ⁻¹	7.18×10 ⁻³	1.44×10 ⁻³	1.22×10 ⁻²	1.44×10 ⁻²	9.03×10 ⁻⁴	7.47×10 ⁻²	1.64×10 ⁻²	7.29×10 ⁻³
WQSP-6A	2.53×10 ⁻¹	7.69×10 ⁻³	3.71×10 ⁻⁴	9.10×10 ⁻³	2.05×10 ⁻³	8.81×10 ⁻⁴	1.33×10 ⁻¹	3.59×10 ⁻³	3.69×10 ⁻⁴
	¹³⁷ Cs			⁶⁰ Co			⁴⁰ K		
WQSP-1	-1.13×10 ⁻²	9.29×10 ⁻²	4.40×10 ⁻¹	7.57×10 ⁻²	7.68×10 ⁻¹	4.62×10 ⁻¹	2.15×10 ¹	2.97×10 ⁰	5.55×10 ⁰
WQSP-2	-2.52×10 ⁻¹	5.03×10 ⁻¹	5.68×10 ⁻¹	5.22×10 ⁻¹	2.56×10 ⁻¹	5.81×10 ⁻¹	1.57×10 ¹	5.64×10 ¹	8.97×10 ⁰
WQSP-3	-4.81×10 ⁻³	4.89×10 ⁻¹	4.55×10 ⁻¹	1.09×10 ⁻¹	2.72×10 ⁻²	4.96×10 ⁻¹	5.20×10 ¹	1.59×10 ¹	6.08×10 ⁰
WQSP-4	-1.27×10 ⁻¹	4.56×10 ⁻¹	3.62×10 ⁻¹	6.44×10 ⁻²	3.59×10 ⁻¹	4.16×10 ⁻¹	2.57×10 ¹	8.20×10 ¹	3.52×10 ⁰
WQSP-5	-8.57×10 ⁻²	7.14×10 ⁻¹	4.09×10 ⁻¹	3.68×10 ⁻²	4.32×10 ⁻¹	4.44×10 ⁻¹	1.02×10 ¹	4.00×10 ⁰	4.31×10 ⁰
WQSP-6	-3.86×10 ⁻¹	4.78×10 ⁻¹	3.82×10 ⁻¹	1.73×10 ⁻¹	4.91×10 ⁻¹	4.28×10 ⁻¹	6.14×10 ⁰	5.13×10 ¹	4.01×10 ⁰
WQSP-6A	8.29×10 ⁻²	5.23×10 ⁻²	3.90×10 ⁻¹	1.44×10 ⁻¹	7.28×10 ⁻²	4.18×10 ⁻¹	6.08×10 ⁰	7.34×10 ⁰	4.52×10 ⁰
	⁹⁰ Sr			²²⁶ Ra			²²⁸ Ra		
WQSP-1	-1.13×10 ⁻²	2.93×10 ⁻²	4.37×10 ⁻²	5.52×10 ⁰	5.49×10 ⁻¹	3.59×10 ⁻²	1.04×10 ⁰	1.36×10 ⁻¹	1.38×10 ⁻¹
WQSP-2	-5.16×10 ⁻³	1.45×10 ⁻²	2.93×10 ⁻²	3.88×10 ⁰	8.61×10 ⁻²	2.57×10 ⁻²	5.14×10 ⁻¹	1.26×10 ⁻¹	1.25×10 ⁻¹
WQSP-3	-9.23×10 ⁻³	6.28×10 ⁻²	4.43×10 ⁻²	6.75×10 ⁰	6.54×10 ⁻¹	3.16×10 ⁻²	1.10×10 ⁰	1.84×10 ⁻¹	1.25×10 ⁻¹
WQSP-4	1.60×10 ⁻²	1.16×10 ⁻¹	3.25×10 ⁻²	8.86×10 ⁰	1.04×10 ⁰	3.53×10 ⁻²	1.36×10 ⁰	2.60×10 ⁻¹	1.49×10 ⁻¹
WQSP-5	9.84×10 ⁻³	8.14×10 ⁻²	6.11×10 ⁻²	2.71×10 ⁰	1.22×10 ⁻¹	2.35×10 ⁻²	3.83×10 ⁻¹	3.08×10 ⁻³	1.18×10 ⁻¹
WQSP-6	1.65×10 ⁻³	8.10×10 ⁻²	5.57×10 ⁻²	1.26×10 ⁰	7.69×10 ²	1.81×10 ²	1.70×10 ⁻¹	1.27×10 ⁻¹	1.11×10 ⁻¹
WQSP-6A	1.21×10 ⁻²	6.72×10 ⁻²	5.70×10 ⁻²	4.07×10 ³	3.08×10 ³	1.37×10 ²	-6.48×10 ⁻³	9.38×10 ⁻²	1.06×10 ⁻¹

^a Standard deviation of the mean

^b Minimum detectable concentration

The concentrations of uranium isotopes in water samples collected from these wells were compared between the years 2000 and 2001. There was a significant difference in the concentration of uranium isotopes (ANOVA, ²³⁴U p = 0.008, ²³⁸U p=0.009). The average concentration for both nuclides was approximately two times higher in 2001. Two different laboratories performed the analysis in years 2000 and 2001, and

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employed two different methods. The groundwater had a high content of total dissolved solids, which caused the average chemical recovery of the samples to be less in 2001. The lower chemical recovery causes the activity to be higher. The 2001 values are within the 2σ limit.

Plutonium-238, $^{239+240}\text{Pu}$, and ^{241}Am were also analyzed in these groundwater samples (Table 4.6). Neither $^{239+240}\text{Pu}$ nor ^{241}Am were detected in any sample. The concentration of ^{238}Pu was greater than the MDC in one sample from well WQSP-6 during the spring sampling ($1.38 \times 10^{-3} \pm 1.05 \times 10^{-3}$ Bq/l; MDC = 1.13×10^{-3} Bq/l [$3.73 \times 10^{-2} \pm 2.84 \times 10^{-2}$ pCi/l; MDC = 3.05×10^{-2} pCi/l]). However, this result was very close to the MDC. All wells' sample results and means were below the detection limit for $^{239+240}\text{Pu}$. Analysis of variance did not show differences in ^{238}Pu , $^{239+240}\text{Pu}$, or ^{241}Am (ANOVA ^{238}Pu $p = 0.619$, $^{239+240}\text{Pu}$ $p = 0.520$, ^{241}Am $p = 0.423$) between years 2000 and 2001.

As discussed in last year's annual Site Environmental Report (DOE/WIPP 01-2225), groundwater results from wells WQSP-1, WQSP-3, and WQSP-4 have exhibited a pattern of activity above the MDC for ^{238}Pu and ^{241}Am . In order to help explain these apparently above background concentrations, WIPP began analyzing groundwater for ^{226}Ra and ^{228}Ra during the fall sampling of 2000. Radium-226 and ^{228}Ra were detected in 100 percent of the samples. The mean concentrations were all above the mean detection limits (Table 4.6). However, the concentrations of ^{226}Ra in water from wells WQSP-1, WQSP-3, and WQSP-4 were all lower than those reported in the 1995 Annual Site Environmental Report (6.0 ± 0.06 Bq/l, 7.8 ± 0.06 Bq/l, and 9.1 ± 0.07 Bq/l, respectively).

These results are important because one decay product of ^{226}Ra , ^{222}Rn , emits alpha particles with an energy of 5.489 MeV, very close to the most abundant alpha energy of ^{241}Am (5.486 MeV) and ^{238}Pu (5.499 MeV). Because these energies are close, the region of interest in the alpha spectrum from the groundwater samples likely contained counts originating from ^{222}Rn that were identified as ^{238}Pu or ^{241}Am . Additional ^{226}Ra progeny were also likely present. The solubility of the components can vary causing the ^{222}Rn activity and associated ^{226}Ra progeny to appear in some analyses, but not all. This phenomenon may explain the trend of seemingly high concentrations of ^{238}Pu and ^{241}Am observed in some groundwater samples over time. These patterns will become more apparent as more samples are analyzed for ^{226}Ra .

Cesium-137 and ^{60}Co were not detected in any of the samples. Potassium-40 was detected in all the wells except for the spring sampling round WQSP-6A. Strontium-90 was not detectable in any of the wells.

4.5 Surface Water

4.5.1 Sample Collection

Fourteen different locations around the WIPP site, as shown in Figure 4.5, were identified for collecting the surface water samples (see Appendix B for location codes). Samples were collected once in 2001 from ten sampling locations. If the surface water

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collection location was dry, sediment was collected. Sediment results are described in Section 4.7.

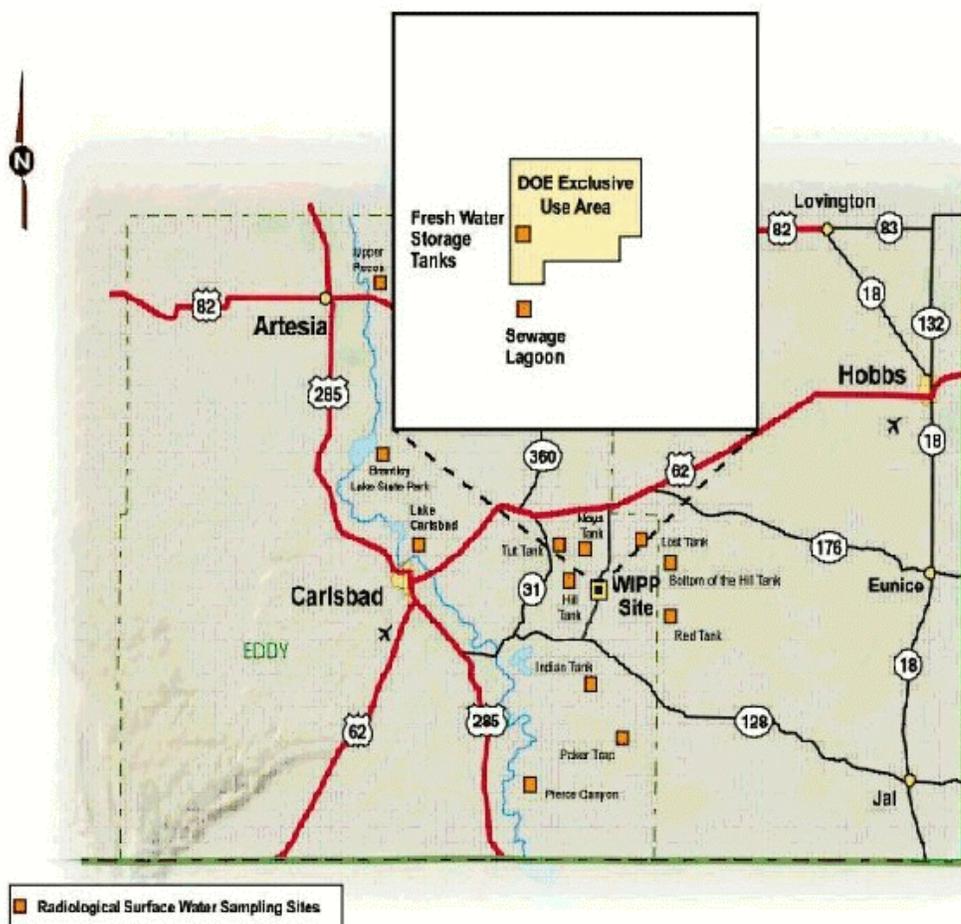


Figure 4.5 - Surface Water Sampling Locations in 2001

Water from the sampling location was used to rinse 3.78-l (1-gal) polyethylene containers several times. Approximately 3.78 l (1 gal) of water was collected from each location. The samples were acidified immediately after collection with concentrated nitric acid to $\text{pH} \leq 2$. Later, the samples were shipped to the laboratory for analysis. Chain of custody was maintained throughout the process.

4.5.2 Determination of Individual Radionuclides

Gamma-spectrometry was used for the determination of ^{40}K , ^{60}Co , and ^{137}Cs . Strontium-90, a beta-emitting radionuclide, was determined by chemical separation and counting it on the gas proportional counter. Uranium, plutonium, and americium were determined by alpha spectrometry. These alpha-emitting radionuclides were separated from the bulk of water samples by co-precipitation with an iron carrier. Ion-exchange

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chromatography was used for the separation of individual radionuclides. Finally, the samples were counted by alpha spectrometry.

4.5.3 Results and Discussions

Isotopes of natural uranium were detected in surface water at every sampling location (Table 4.7). Uranium-234 was lowest at Coyote Well (COW) ($4.14 \times 10^{-4} \pm 5.11 \times 10^{-4}$ Bq/l [$1.12 \times 10^{-2} \pm 1.38 \times 10^{-2}$ pCi/l]) and highest at Pierce Canyon (PCN) ($2.18 \times 10^{-1} \pm 3.42 \times 10^{-2}$ Bq/l [$5.89 \times 10^0 \pm 9.24 \times 10^{-1}$ pCi/l]). Uranium-235 was detected in 54 percent of the samples. Concentrations ranged from $1.28 \times 10^{-4} \pm 2.56 \times 10^{-4}$ Bq/l ($3.46 \times 10^{-3} \pm 6.92 \times 10^{-2}$ pCi/l) at COW to $6.51 \times 10^{-3} \pm 2.06 \times 10^{-3}$ Bq/l ($1.76 \times 10^{-1} \pm 5.57 \times 10^{-2}$ pCi/l) at PCN. Concentrations of ^{238}U , detected in all samples, ranged from $0.00 \times 10^0 \pm 0.00 \times 10^0$ Bq/l ($0.00 \times 10^0 \pm 0.00 \times 10^0$ pCi/l) at PCN to $1.08 \times 10^{-1} \pm 1.75 \times 10^{-2}$ Bq/l ($2.92 \times 10^0 \pm 4.73 \times 10^{-1}$ pCi/l) at PCN.

Results for uranium concentrations in 2001 samples were compared with the uranium concentrations in 2000 samples. There was no significant difference in the concentration of any uranium isotope between years (ANOVA, ^{234}U $p = 0.227$, ^{235}U $p = 0.869$, ^{238}U $p = 0.817$).

**Table 4.7 - Uranium Concentrations (Bq/l) in Surface Water Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	^{234}U			^{235}U			^{238}U		
	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
BRA	1.07×10^{-1}	1.79×10^{-2}	2.92×10^{-4}	3.19×10^{-3}	1.44×10^{-3}	9.81×10^{-4}	5.44×10^{-2}	9.69×10^{-3}	7.92×10^{-4}
CBD	1.32×10^{-1}	2.25×10^{-2}	2.96×10^{-4}	3.64×10^{-3}	1.52×10^{-3}	3.66×10^{-4}	6.14×10^{-2}	1.11×10^{-2}	2.95×10^{-4}
FWT	5.29×10^{-2}	9.36×10^{-3}	2.77×10^{-4}	1.39×10^{-3}	9.36×10^{-4}	9.29×10^{-4}	2.28×10^{-2}	4.66×10^{-3}	2.76×10^{-4}
HIL	2.19×10^{-2}	4.96×10^{-3}	3.59×10^{-4}	9.81×10^{-4}	8.18×10^{-4}	4.44×10^{-4}	1.85×10^{-2}	4.37×10^{-3}	3.58×10^{-4}
IDN	1.21×10^{-2}	3.00×10^{-3}	7.99×10^{-4}	9.36×10^{-4}	8.14×10^{-4}	9.84×10^{-4}	1.22×10^{-2}	3.00×10^{-3}	2.92×10^{-4}
NOY	1.10×10^{-2}	3.22×10^{-3}	4.14×10^{-4}	5.66×10^{-4}	6.59×10^{-4}	5.11×10^{-4}	8.21×10^{-3}	2.65×10^{-3}	4.11×10^{-4}
PCN	2.18×10^{-1}	3.42×10^{-2}	7.62×10^{-4}	6.51×10^{-3}	2.06×10^{-3}	3.45×10^{-4}	1.08×10^{-1}	1.75×10^{-2}	2.79×10^{-4}
SWL	4.48×10^{-2}	9.51×10^{-3}	4.22×10^{-4}	1.92×10^{-4}	6.66×10^{-4}	1.42×10^{-3}	1.63×10^{-2}	4.29×10^{-3}	4.22×10^{-4}
TUT	9.66×10^{-3}	2.49×10^{-3}	2.76×10^{-4}	5.03×10^{-4}	5.07×10^{-4}	3.40×10^{-4}	7.81×10^{-3}	2.15×10^{-3}	2.75×10^{-4}
UPR	8.14×10^{-2}	1.42×10^{-2}	3.03×10^{-4}	3.59×10^{-3}	1.52×10^{-3}	3.74×10^{-4}	4.51×10^{-2}	8.36×10^{-3}	3.02×10^{-4}

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

Analysis of variance was also used to test for differences in uranium concentration between sampling locations. Differences were detected for each uranium isotope ($p < 0.001$). Pierce Canyon had the highest concentrations, with other locations along the Pecos River (Brantley Lake [BRA], Carlsbad [CBD], and Upper Pecos River [UPR]) in another homogeneous subset of the data. All of the surface tanks were in another homogeneous subset having the lowest concentrations. Large spatial variations in uranium concentration in surface water are expected because of the different characteristics of the water bodies and the underlying sediments. For example, the PCN site drains a large surface area and leaches uranium from the sediments. The Tut Tank (TUT) is mostly rainwater and has relatively little contact with sediments.

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These water samples were also analyzed for ^{238}Pu , $^{239+240}\text{Pu}$, and ^{241}Am (Table 4.8). Concentrations of ^{241}Am , ^{238}Pu and $^{239+240}\text{Pu}$ were below the MDC in every sample.

Potassium-40, ^{60}Co , ^{90}Sr , and ^{137}Cs are ubiquitous in soils and might reasonably be expected in surface water samples due to leaching from sediments. As expected, ^{40}K was detected in 70 percent of the surface water samples (Table 4.9). Its concentration ranged from $-2.87 \times 10^0 \pm 3.85 \times 10^0$ Bq/l ($-7.76 \times 10^1 \pm 1.04 \times 10^2$ pCi/l) at Noya Tank (NOY) to $1.02 \times 10^2 \pm 1.57 \times 10^1$ Bq/l ($2.76 \times 10^3 \pm 4.54 \times 10^2$ pCi/l) at PCN. Cobalt-60, ^{137}Cs , and ^{90}Sr were not detected in the samples.

**Table 4.8 - Americium and Plutonium Concentrations (Bq/l) in Surface Water Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	^{241}Am			^{238}Pu			$^{239+240}\text{Pu}$		
	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
BRA	2.41×10^{-4}	5.92×10^{-4}	1.12×10^{-3}	1.05×10^{-4}	2.11×10^{-4}	2.84×10^{-4}	1.05×10^{-4}	2.10×10^{-4}	2.84×10^{-4}
CBD	1.13×10^{-4}	2.26×10^{-4}	3.05×10^{-4}	0.00×10^0	0.00×10^0	8.25×10^{-4}	0.00×10^0	0.00×10^0	3.03×10^{-4}
FWT	2.21×10^{-4}	7.66×10^{-4}	1.62×10^{-3}	0.00×10^0	0.00×10^0	9.25×10^{-4}	1.26×10^{-4}	2.52×10^{-4}	3.41×10^{-4}
HIL	-1.18×10^{-4}	2.38×10^{-4}	8.73×10^{-4}	2.11×10^{-4}	3.00×10^{-4}	2.86×10^{-4}	3.16×10^{-4}	5.59×10^{-4}	9.81×10^{-4}
IDN	3.05×10^{-4}	7.47×10^{-4}	1.42×10^{-4}	0.00×10^0	0.00×10^0	7.59×10^{-4}	4.11×10^{-4}	4.18×10^{-4}	2.79×10^{-4}
NOY	4.81×10^{-4}	5.92×10^{-4}	8.84×10^{-4}	1.37×10^{-4}	2.74×10^{-4}	3.70×10^{-4}	4.11×10^{-5}	6.14×10^{-4}	1.01×10^{-3}
PCN	3.81×10^{-4}	4.44×10^{-4}	3.44×10^{-4}	-1.05×10^{-4}	2.12×10^{-4}	7.77×10^{-4}	0.00×10^0	0.00×10^0	2.86×10^{-4}
SWL	6.51×10^{-4}	6.62×10^{-4}	4.40×10^{-4}	2.56×10^{-4}	3.64×10^{-4}	3.46×10^{-4}	0.00×10^0	0.00×10^0	3.46×10^{-4}
TUT	1.22×10^{-4}	5.48×10^{-4}	1.14×10^{-3}	2.13×10^{-4}	3.03×10^{-4}	2.88×10^{-4}	1.06×10^{-4}	2.13×10^{-4}	2.88×10^{-4}
UPR	0.00×10^0	0.00×10^0	1.25×10^{-3}	3.64×10^{-4}	4.26×10^{-4}	3.28×10^{-4}	1.21×10^{-4}	4.22×10^{-4}	8.92×10^{-4}

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

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**Table 4.9 - Selected Radionuclide Concentrations (Bq/l) in Surface Water near the WIPP Site.
See Appendix B for the sampling locations.**

Location	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC
	¹³⁷ Cs			⁶⁰ Co		
BRA	1.21×10 ⁻¹	4.51×10 ⁻¹	5.07×10 ⁻¹	4.66×10 ⁻¹	4.51×10 ⁻¹	5.37×10 ⁻¹
CBD	3.23×10 ⁻¹	3.15×10 ⁻¹	3.74×10 ⁻¹	-9.88×10 ⁻³	3.17×10 ⁻¹	3.74×10 ⁻¹
FWT	-8.33×10 ⁻¹	5.11×10 ⁻¹	4.92×10 ⁻¹	3.05×10 ⁻²	4.44×10 ⁻¹	5.07×10 ⁻¹
HIL	2.05×10 ⁻¹	2.13×10 ⁻¹	2.65×10 ⁻¹	7.18×10 ⁻²	2.79×10 ⁻¹	3.26×10 ⁻¹
IDN	2.03×10 ⁻¹	3.25×10 ⁻¹	3.77×10 ⁻¹	7.55×10 ⁻³	3.44×10 ⁻¹	4.07×10 ⁻¹
NOY	1.99×10 ⁻²	3.23×10 ⁻¹	3.66×10 ⁻¹	2.16×10 ⁻²	3.37×10 ⁻¹	4.00×10 ⁻¹
PCN	2.54×10 ⁻¹	5.29×10 ⁻¹	6.18×10 ⁻¹	-2.43×10 ⁻¹	5.66×10 ⁻¹	5.92×10 ⁻¹
SWL	-4.29×10 ⁻²	2.23×10 ⁻¹	2.58×10 ⁻¹	-1.47×10 ⁻¹	3.00×10 ⁻¹	3.19×10 ⁻¹
TUT	-4.59×10 ⁻¹	4.88×10 ⁻¹	5.00×10 ⁻¹	-3.06×10 ⁻¹	4.77×10 ⁻¹	5.11×10 ⁻¹
UPR	7.40×10 ⁻²	2.13×10 ⁻¹	2.56×10 ⁻¹	1.74×10 ⁻¹	2.92×10 ⁻¹	3.50×10 ⁻¹
⁹⁰ Sr			⁴⁰ K			
BRA	-1.90×10 ⁻²	3.74×10 ⁻²	6.29×10 ⁻²	7.36×10 ⁰	4.37×10 ⁰	5.22×10 ⁰
CBD	2.95×10 ⁻³	4.00×10 ⁻²	6.55×10 ⁻²	4.29×10 ⁰	3.20×10 ⁰	4.22×10 ⁰
FWT	1.19×10 ⁻²	3.62×10 ⁻²	6.03×10 ⁻²	4.81×10 ⁰	2.22×10 ⁰	3.13×10 ⁰
HIL	2.32×10 ⁻²	3.42×10 ⁻²	5.62×10 ⁻²	3.92×10 ⁰	2.75×10 ⁰	3.52×10 ⁰
IDN	-1.84×10 ⁻²	4.14×10 ⁻²	6.96×10 ⁻²	-1.24×10 ⁰	3.74×10 ⁰	4.07×10 ⁰
NOY	3.54×10 ⁻²	4.14×10 ⁻²	6.55×10 ⁻²	-2.87×10 ⁰	3.85×10 ⁰	3.92×10 ⁰
PCN	1.40×10 ⁻²	4.51×10 ⁻²	7.36×10 ⁻²	1.02×10 ²	1.57×10 ¹	1.10×10 ¹
SWL	-2.67×10 ⁻²	4.40×10 ⁻²	7.51×10 ⁻²	2.19×10 ¹	4.81×10 ⁰	4.81×10 ⁰
TUT	4.81×10 ⁻³	4.14×10 ⁻²	6.77×10 ⁻²	5.66×10 ⁰	2.45×10 ⁰	3.41×10 ⁰
UPR	-1.63×10 ⁻²	3.33×10 ⁻²	5.77×10 ⁻²	3.20×10 ⁰	2.68×10 ⁰	3.40×10 ⁰

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

Duplicate samples were collected from two locations (Indian Tank [IDN] and TUT) to check the reproducibility of the sampling and the measurement techniques (Table 4.10). The RER values for ²⁴¹Am, plutonium, and the uranium isotopes in these samples were all less than one, indicating no difference between duplicate samples.

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**Table 4.10 - Results of Duplicate Surface Water Sample Analysis. Units are Bq/l.
See Appendix B for the sampling locations.**

Location	[RN] ^a	2×TPU ^b	MDC ^c	RER ^d	[RN]	2×TPU	MDC	RER
	²⁴¹ Am				²³⁸ Pu			
IDN	3.05×10 ⁻⁴	7.47×10 ⁻⁴	1.42×10 ⁻⁴	0.050	0.00×10 ⁰	0.00×10 ⁰	7.59×10 ⁻⁴	0.500
IDN Dup.	2.63×10 ⁻⁴	3.74×10 ⁻⁴	3.57×10 ⁻⁴		1.96×10 ⁻⁴	3.92×10 ⁻⁴	5.29×10 ⁻⁴	
TUT	1.22×10 ⁻⁴	5.48×10 ⁻⁴	1.14×10 ⁻³	0.495	2.13×10 ⁻⁴	3.03×10 ⁻⁴	2.88×10 ⁻⁴	0.407
TUT Dup.	4.85×10 ⁻⁴	4.88×10 ⁻⁴	3.28×10 ⁻⁴		5.62×10 ⁻⁴	8.03×10 ⁻⁴	7.62×10 ⁻⁴	
²³⁹⁺²⁴⁰ Pu				²³⁴ U				
IDN	4.11×10 ⁻⁴	4.18×10 ⁻⁴	2.79×10 ⁻⁴	0.983	1.21×10 ⁻²	3.00×10 ⁻³	7.99×10 ⁻⁴	0.355
IDN Dup.	0.00×10 ⁰	0.00×10 ⁰	5.29×10 ⁻⁴		1.37×10 ⁻²	3.36×10 ⁻³	3.16×10 ⁻⁴	
TUT	1.06×10 ⁻⁴	2.13×10 ⁻⁴	2.88×10 ⁻⁴	0.288	9.66×10 ⁻³	2.49×10 ⁻³	2.76×10 ⁻⁴	0.818
TUT Dup.	2.80×10 ⁻⁴	5.66×10 ⁻⁴	7.62×10 ⁻⁴		1.45×10 ⁻²	5.37×10 ⁻³	8.55×10 ⁻⁴	
²³⁵ U				²³⁸ U				
IDN	9.36×10 ⁻⁴	8.14×10 ⁻⁴	9.84×10 ⁻⁴	0.066	1.22×10 ⁻²	3.00×10 ⁻³	2.92×10 ⁻⁴	0.693
IDN Dup.	1.01×10 ⁻³	7.81×10 ⁻⁴	3.89×10 ⁻⁴		9.40×10 ⁻³	2.61×10 ⁻³	8.55×10 ⁻⁴	
TUT	5.03×10 ⁻⁴	5.07×10 ⁻⁴	3.40×10 ⁻⁴	0.122	7.81×10 ⁻³	2.15×10 ⁻³	2.75×10 ⁻⁴	0.704
TUT Dup.	3.89×10 ⁻⁴	7.84×10 ⁻⁴	1.05×10 ⁻³		5.33×10 ⁻³	2.86×10 ⁻³	8.51×10 ⁻⁴	

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

^d Relative Error Ratio

4.6 Soil Samples

4.6.1 Sampling

Soil samples were collected from near the low-volume air samplers at six different locations around the WIPP site: MLR, SEC, SMR, WEE, WFF, and WSS (Figure 4.6). Samples were collected from each location in three incremental profiles: surface soil (SS, 0-2 cm [0-0.8 in.]), intermediate soil (SI, 2-5 cm [0.8-2 in.]), and deep soil (SD, 5-10 cm [2-4 in.]). Measurements of radionuclides in depth profiles provide information about their vertical movements in the soil systems.

4.6.2 Sample Preparation

Soil samples were dried at 110°C (230°F) for several hours and homogenized by grinding to small particle sizes. One gram (0.04 oz) of soil was dissolved by heating it with a mixture of nitric, hydrochloric, and hydrofluoric acids. Finally, it was heated with nitric and boric acids, and the residue was dissolved in hydrochloric acid for the determination of individual radionuclides.

4.6.3 Determination of Individual Radionuclides

Gamma-emitting radionuclides (⁴⁰K, ⁶⁰Co, and ¹³⁷Cs) were determined by counting an aliquot of well-homogenized ground soil samples by gamma-spectrometry. Strontium-90 was analyzed from an aliquot of the sample solution by separating it from other stable and radioactive elements using radiochemical techniques and beta

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counting. Another aliquot of the sample solution was used for the sequential determinations of alpha-emitting radionuclides, such as ^{234}U , ^{235}U , and ^{238}U ; ^{238}Pu and $^{239+240}\text{Pu}$; and ^{241}Am . These radionuclides were separated from the bulk of the inorganic materials present in the soil samples and from one another by radiochemical separations including co-precipitation and ion-exchange chromatography. Finally, the samples were micro-precipitated, filtered onto micro-filters, and counted on the alpha spectrometer.



Figure 4.6 - Soil and Vegetation Sampling Areas in 2001

4.6.4 Results and Discussions

Uranium-234 and ^{238}U were detected in every soil sample in 2001 and ^{235}U was detected in all but one. Concentrations of ^{234}U in surface soils (0-2 cm) ranged from a minimum of $5.66 \times 10^{-3} \pm 1.35 \times 10^{-3}$ Bq/g ($1.53 \times 10^{-1} \pm 3.65 \times 10^{-2}$ pCi/g) at WEE to a maximum of $1.25 \times 10^{-2} \pm 2.48 \times 10^{-3}$ Bq/g ($3.38 \times 10^{-1} \pm 6.70 \times 10^{-2}$ pCi/g) at SEC (Table 4.11). Concentrations of ^{235}U in the same samples ranged from $2.83 \times 10^{-4} \pm 2.72 \times 10^{-4}$ Bq/g ($7.65 \times 10^{-3} \pm 7.35 \times 10^{-3}$ pCi/g) at WFF to $2.32 \times 10^{-3} \pm 2.48 \times 10^{-4}$ Bq/g ($6.27 \times 10^{-2} \pm 6.70 \times 10^{-3}$ pCi/g) at WEE. The concentration of ^{238}U in surface soils ranged from $6.85 \times 10^{-3} \pm 1.57 \times 10^{-3}$ Bq/g ($1.85 \times 10^{-1} \pm 4.24 \times 10^{-2}$ pCi/g) at WEE to $1.28 \times 10^{-2} \pm 2.63 \times 10^{-3}$ Bq/g ($3.46 \times 10^{-1} \pm 7.11 \times 10^{-1}$ pCi/g) at WFF.

The results for uranium in intermediate depth (2-5 cm) soil samples are also given in Table 4.11. The concentration of ^{234}U ranged from $6.73 \times 10^{-3} \pm 1.38 \times 10^{-3}$ Bq/g ($1.82 \times 10^{-1} \pm 3.73 \times 10^{-2}$ pCi/g) at WEE to $2.03 \times 10^{-2} \pm 3.92 \times 10^{-3}$ Bq/g ($5.49 \times 10^{-1} \pm$

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1.06×10⁻¹ pCi/g) at SEC. Uranium-235 in these soils was lowest at WEE (3.92×10⁻⁴ ± 2.43×10⁻⁴ Bq/g [1.06×10⁻² ± 6.57×10⁻³ pCi/g]) and highest at SEC (1.11×10⁻³ ± 4.92×10⁻⁴ Bq/g [3.00×10⁻² ± 1.16×10⁻² pCi/g]). The concentration of ²³⁸U ranged from 7.33×10⁻³ ± 1.48×10⁻³ Bq/g (1.98×10⁻¹ ± 4.00×10⁻² pCi/g) at WEE to 2.27×10⁻² ± 4.33×10⁻³ Bq/g (6.14×10⁻¹ ± 1.17×10⁻¹ pCi/g) at SEC.

**Table 4.11 - Uranium Concentrations (Bq/g) in Soil Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	Depth (cm)	²³⁴ U			²³⁵ U			²³⁸ U		
		[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
MLR	0-2	1.20×10 ⁻²	2.22×10 ⁻³	2.19×10 ⁻⁴	4.77×10 ⁻⁴	2.75×10 ⁻⁴	9.95×10 ⁻⁵	1.13×10 ⁻²	2.10×10 ⁻³	8.03×10 ⁻⁵
MLR	2-5	1.41×10 ⁻²	2.45×10 ⁻³	7.22×10 ⁻⁵	4.92×10 ⁻⁴	2.66×10 ⁻⁴	8.92×10 ⁻²	1.32×10 ⁻²	2.32×10 ⁻³	2.47×10 ⁻⁴
MLR	5-10	1.18×10 ⁻²	2.13×10 ⁻³	6.99×10 ⁻⁵	6.36×10 ⁻⁴	3.00×10 ⁻⁴	8.62×10 ⁻⁵	1.17×10 ⁻²	2.11×10 ⁻³	6.96×10 ⁻⁵
SEC	0-2	1.25×10 ⁻²	2.48×10 ⁻³	2.47×10 ⁻⁴	1.03×10 ⁻³	4.48×10 ⁻⁴	1.12×10 ⁻⁴	1.28×10 ⁻²	2.52×10 ⁻³	9.03×10 ⁻⁵
SEC	2-5	2.03×10 ⁻²	3.92×10 ⁻³	2.77×10 ⁻⁴	1.11×10 ⁻³	4.92×10 ⁻⁴	1.25×10 ⁻⁴	2.27×10 ⁻²	4.33×10 ⁻³	1.01×10 ⁻⁴
SEC	5-10	1.90×10 ⁻²	3.50×10 ⁻³	8.77×10 ⁻⁵	8.40×10 ⁻⁴	4.07×10 ⁻⁴	2.95×10 ⁻⁴	1.61×10 ⁻²	3.02×10 ⁻³	2.38×10 ⁻⁴
SMR	0-2	1.04×10 ⁻²	1.92×10 ⁻³	7.18×10 ⁻⁵	4.59×10 ⁻⁴	2.55×10 ⁻⁴	8.84×10 ⁻⁵	1.09×10 ⁻²	2.00×10 ⁻³	7.14×10 ⁻⁵
SMR	2-5	1.11×10 ⁻²	2.02×10 ⁻³	7.22×10 ⁻⁵	7.22×10 ⁻⁴	3.27×10 ⁻³	8.88×10 ⁻⁵	1.14×10 ⁻²	2.06×10 ⁻³	7.18×10 ⁻⁵
SMR	5-10	2.09×10 ⁻²	3.74×10 ⁻³	8.51×10 ⁻⁵	8.92×10 ⁻⁴	4.00×10 ⁻⁴	1.05×10 ⁻⁴	2.09×10 ⁻²	3.74×10 ⁻³	8.47×10 ⁻⁵
WEE	0-2	5.66×10 ⁻³	1.35×10 ⁻³	1.02×10 ⁻⁴	2.32×10 ⁻⁵	2.48×10 ⁻⁴	3.41×10 ⁻⁴	6.85×10 ⁻³	1.57×10 ⁻³	1.01×10 ⁻⁴
WEE	2-5	6.73×10 ⁻³	1.38×10 ⁻³	7.81×10 ⁻⁵	3.92×10 ⁻⁴	2.43×10 ⁻⁴	9.62×10 ⁻⁵	7.33×10 ⁻³	1.48×10 ⁻³	7.77×10 ⁻⁵
WEE	5-10	1.84×10 ⁻²	3.68×10 ⁻³	2.83×10 ⁻⁴	4.74×10 ⁻⁴	3.11×10 ⁻⁴	1.28×10 ⁻⁴	2.00×10 ⁻²	3.96×10 ⁻³	1.04×10 ⁻⁴
WFF	0-2	1.17×10 ⁻²	2.45×10 ⁻³	1.04×10 ⁻⁴	2.83×10 ⁻⁴	2.72×10 ⁻⁴	3.48×10 ⁻⁴	1.28×10 ⁻²	2.63×10 ⁻³	2.80×10 ⁻⁴
WFF	2-5	1.22×10 ⁻²	2.62×10 ⁻³	3.56×10 ⁻⁴	6.62×10 ⁻⁴	3.74×10 ⁻⁴	1.28×10 ⁻⁴	1.23×10 ⁻²	2.62×10 ⁻³	2.81×10 ⁻⁴
WFF	5-10	1.00×10 ⁻²	2.18×10 ⁻³	1.08×10 ⁻⁴	2.96×10 ⁻⁴	2.47×10 ⁻⁴	1.34×10 ⁻⁴	9.36×10 ⁻³	2.05×10 ⁻³	1.08×10 ⁻⁴
WSS	0-2	1.24×10 ⁻²	2.37×10 ⁻³	2.92×10 ⁻⁴	4.26×10 ⁻⁴	2.66×10 ⁻⁴	1.05×10 ⁻⁴	1.25×10 ⁻²	2.39×10 ⁻³	2.30×10 ⁻⁴
WSS	2-5	9.58×10 ⁻³	1.97×10 ⁻³	9.25×10 ⁻⁵	7.99×10 ⁻⁴	3.92×10 ⁻⁴	1.14×10 ⁻⁴	9.18×10 ⁻³	1.53×10 ⁻³	9.18×10 ⁻⁵
WSS	5-10	8.73×10 ⁻³	1.86×10 ⁻³	9.77×10 ⁻⁵	1.78×10 ⁻⁴	1.81×10 ⁻⁴	1.21×10 ⁻⁴	8.51×10 ⁻³	1.82×10 ⁻³	9.73×10 ⁻⁵

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

Concentrations of ²³⁴U, ²³⁵U, and ²³⁸U were also measured in deep soils (5-10 cm) (Table 4.11). Concentrations of ²³⁴U varied from 8.73×10⁻³ ± 1.86×10⁻³ Bq/g (2.36×10⁻¹ ± 5.03×10⁻² pCi/g) at WSS to 2.09×10⁻² ± 3.74×10⁻³ Bq/g (5.65×10⁻¹ ± 1.01×10⁻¹ pCi/g) at SMR. The lowest concentration of ²³⁵U in deep soils was found at WSS (1.78×10⁻⁴ ± 1.81×10⁻⁴ Bq/g [4.81×10⁻³ ± 4.89×10⁻³ pCi/g]) and the highest concentration was found at SMR (8.92×10⁻⁴ ± 4.00×10⁻⁴ Bq/g [2.41×10⁻² ± 1.08×10⁻² pCi/g]). Uranium-238 lowest concentration was 8.51×10⁻³ ± 1.82×10⁻³ Bq/g (2.30×10⁻¹ ± 4.92×10⁻² pCi/g) at WSS and the highest was found 2.09×10⁻² ± 3.74×10⁻³ Bq/g (5.65×10⁻¹ ± 1.01×10⁻¹ pCi/g) at SMR.

No uranium isotope varied significantly with year 2001 (ANOVA, ²³⁴U p = 0.105, ²³⁸U p = 0.722). All maximum measured concentrations fell within the range of natural concentrations of uranium found in soils throughout the world (Pais and Jones 1997). All these results suggest a pattern of natural variability consistent with the existence of natural uranium, without amendment from artificial sources.

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Plutonium-238, ²³⁹⁺²⁴⁰Pu, and ²⁴¹Am were also analyzed in these soil samples (Table 4.12). Plutonium-238 was not detected in any samples. The measured concentration of ²³⁹⁺²⁴⁰Pu was greater than the MDC at location MLR at all three depths. The ²⁴¹Am concentration was greater than the MDC at MLR, 0-2 cm and 2-5 cm, SEC, 5-10cm, and WEE, 5-10cm. Historically, soil samples collected in the same locations have shown positive results on numerous occasions. Since 1997, soil samples collected by the Environmental Monitoring group at WEE, SEC, and MLR have shown levels of ²⁴¹Am and ^{239/240}Pu slightly above background. During this time period, three different analytical laboratories were used; all had similar results. The source of activity in WIPP samples could be due to natural transport of contaminated soil from the Gnome Site via wind. The Gnome Site lies about 9km southwest of the WIPP boundary and was contaminated with fission products in 1961 when an underground test of a 3-kiloton ²³⁹Pu device vented to the surface. Because there are elevated levels of radionuclides in the soil near the Gnome Site, there is potential for contamination of WIPP environmental samples. The measurable levels of radionuclides remains relatively high around the Gnome Site despite remediation efforts.

Table 4.12 - Americium and Plutonium Concentrations (Bq/g) in Soil Near the WIPP Site.
See Appendix B for the sampling locations.

Location	Depth (cm)	²⁴¹ Am			²³⁸ Pu			²³⁹⁺²⁴⁰ Pu		
		[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
MLR	0-2	1.79×10 ⁻⁴	1.49×10 ⁻⁴	8.07×10 ⁻⁵	-3.43×10 ⁻⁵	6.88×10 ⁻⁵	2.52×10 ⁻⁴	3.42×10 ⁻⁴	2.23×10 ⁻⁴	9.29×10 ⁻⁵
MLR	2-5	4.18×10 ⁻⁴	2.29×10 ⁻⁴	8.10×10 ⁻⁵	0.00×10 ⁰	0.00×10 ⁰	1.28×10 ⁻⁴	6.59×10 ⁻⁴	3.70×10 ⁻⁴	1.28×10 ⁻⁴
MLR	5-10	2.41×10 ⁻⁴	2.31×10 ⁻⁴	3.19×10 ⁻⁴	-4.88×10 ⁻⁵	9.84×10 ⁻⁵	3.60×10 ⁻⁴	5.85×10 ⁻⁴	3.55×10 ⁻⁴	1.32×10 ⁻⁴
SEC	0-2	3.23×10 ⁻⁵	1.45×10 ⁻⁴	3.00×10 ⁻⁴	4.44×10 ⁻⁵	8.92×10 ⁻⁵	1.20×10 ⁻⁴	1.77×10 ⁻⁴	1.80×10 ⁻⁴	1.20×10 ⁻⁴
SEC	2-5	8.95×10 ⁻⁵	1.34×10 ⁻⁴	2.20×10 ⁻⁴	1.70×10 ⁻⁴	2.10×10 ⁻⁴	3.13×10 ⁻⁴	1.70×10 ⁻⁴	1.72×10 ⁻⁴	1.15×10 ⁻⁴
SEC	5-10	1.37×10 ⁻⁴	1.16×10 ⁻⁴	8.99×10 ⁻⁴	6.29×10 ⁻⁵	1.26×10 ⁻⁴	2.31×10 ⁻⁴	6.25×10 ⁻⁵	1.26×10 ⁻⁴	2.31×10 ⁻⁴
SMR	0-2	0.00×10 ⁰	0.00×10 ⁰	2.21×10 ⁻⁴	-4.07×10 ⁻⁵	8.14×10 ⁻⁵	2.99×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	2.99×10 ⁻⁴
SMR	2-5	8.03×10 ⁻⁵	1.15×10 ⁻⁴	1.09×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	1.30×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	3.52×10 ⁻⁴
SMR	5-10	2.98×10 ⁻⁵	1.34×10 ⁻⁴	2.78×10 ⁻⁴	-6.62×10 ⁻⁵	9.44×10 ⁻⁵	3.07×10 ⁻⁴	3.30×10 ⁻⁵	1.15×10 ⁻⁴	2.43×10 ⁻⁴
WEE	0-2	6.33×10 ⁻⁵	9.03×10 ⁻⁵	8.58×10 ⁻⁵	0.00×10 ⁰	0.00×10 ⁰	9.81×10 ⁻⁵	3.61×10 ⁻⁵	7.25×10 ⁻⁵	9.81×10 ⁻⁵
WEE	2-5	0.00×10 ⁰	0.00×10 ⁰	3.47×10 ⁻⁴	3.96×10 ⁻⁵	7.92×10 ⁻⁵	1.07×10 ⁻⁴	1.58×10 ⁻⁴	1.60×10 ⁻⁴	1.07×10 ⁻⁴
WEE	5-10	1.32×10 ⁻⁴	1.54×10 ⁻⁴	1.19×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	2.25×10 ⁻⁴	9.18×10 ⁻⁵	1.07×10 ⁻⁴	8.29×10 ⁻⁵
WFF	0-2	1.68×10 ⁻⁴	1.71×10 ⁻⁴	1.14×10 ⁻⁴	4.14×10 ⁻⁵	8.29×10 ⁻⁵	1.12×10 ⁻⁴	1.65×10 ⁻⁴	1.67×10 ⁻⁴	1.12×10 ⁻⁴
WFF	2-5	1.96×10 ⁻⁴	2.09×10 ⁻⁴	3.03×10 ⁻⁴	8.51×10 ⁻⁵	2.95×10 ⁻⁴	6.25×10 ⁻⁴	8.51×10 ⁻⁵	1.71×10 ⁻⁴	2.30×10 ⁻⁴
WFF	5-10	5.62×10 ⁻⁵	1.95×10 ⁻⁴	4.14×10 ⁻⁴	1.18×10 ⁻⁴	1.77×10 ⁻⁴	2.89×10 ⁻⁴	7.84×10 ⁻⁵	1.12×10 ⁻⁴	1.06×10 ⁻⁴
WSS	0-2	-3.25×10 ⁻⁵	1.45×10 ⁻⁴	3.50×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	9.21×10 ⁻⁵	1.36×10 ⁻⁴	1.38×10 ⁻⁴	9.21×10 ⁻⁵
WSS	2-5	7.29×10 ⁻⁵	1.04×10 ⁻⁴	9.48×10 ⁻⁵	-3.53×10 ⁻⁵	1.22×10 ⁻⁴	3.27×10 ⁻⁴	7.03×10 ⁻⁵	1.00×10 ⁻⁴	9.55×10 ⁻⁵
WSS	5-10	1.21×10 ⁻⁴	1.73×10 ⁻⁴	2.82×10 ⁻⁴	9.62×10 ⁻⁵	1.37×10 ⁻⁴	1.30×10 ⁻⁴	4.81×10 ⁻⁵	1.67×10 ⁻⁴	3.54×10 ⁻⁴

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

Potassium-40, as expected, was detected in every sample (Table 4.13). This naturally-occurring gamma-emitting radionuclide is ubiquitous in soils. Concentrations in surface soils ranged from 2.24×10⁻¹ ± 3.05×10⁻² Bq/g (6.05×10⁰ ± 8.24×10⁻¹ pCi/g) at SEC to 4.74×10⁻¹ ± 6.18×10⁻² Bq/g (1.28×10¹ ± 1.67×10⁰ pCi/g) at SMR. In intermediate

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depth soils, concentrations of ^{40}K varied from $2.32 \times 10^{-1} \pm 3.15 \times 10^{-2}$ Bq/g ($6.27 \times 10^0 \pm 8.51 \times 10^{-1}$ pCi/g) at SEC to $5.11 \times 10^{-1} \pm 6.73 \times 10^{-2}$ Bq/g ($1.38 \times 10^1 \pm 1.82 \times 10^0$ pCi/g) at SMR. Potassium-40 concentrations in deep soils were lowest at WFF ($2.09 \times 10^{-1} \pm 2.76 \times 10^{-2}$ Bq/g ($5.65 \times 10^0 \pm 7.46 \times 10^{-1}$ pCi/g)) and highest at SMR ($5.62 \times 10^{-1} \pm 7.29 \times 10^{-2}$ Bq/g ($1.52 \times 10^1 \pm 1.97 \times 10^0$ pCi/g)).

The concentration of ^{40}K was not significantly different between depths or between years. The range of concentrations observed is consistent with the average natural ^{40}K concentration in soils around the world (4.00×10^{-1} Bq/g [1.08×10^1 pCi/g]; NCRP, 1994).

Cesium-137 was detected in 17 of the 18 soil samples (Table 4.13). In surface soils, concentrations ranged from $9.29 \times 10^{-4} \pm 5.14 \times 10^{-4}$ Bq/g ($2.51 \times 10^{-2} \pm 1.39 \times 10^{-2}$ pCi/g) at SMR to $8.88 \times 10^{-3} \pm 1.22 \times 10^{-3}$ Bq/g ($2.40 \times 10^{-1} \pm 3.30 \times 10^{-2}$ pCi/g) at MLR. The concentration in intermediate depth soils ranged from $1.16 \times 10^{-3} \pm 4.33 \times 10^{-4}$ Bq/g ($3.14 \times 10^{-2} \pm 1.17 \times 10^{-2}$ pCi/g) at SMR to $1.65 \times 10^{-2} \pm 2.16 \times 10^{-3}$ Bq/g ($4.46 \times 10^{-1} \pm 5.84 \times 10^{-2}$ pCi/g) at MLR. In deep soils, the lowest concentrations of ^{137}Cs were found at SMR ($7.55 \times 10^{-4} \pm 5.00 \times 10^{-4}$ Bq/g [$2.04 \times 10^{-2} \pm 1.35 \times 10^{-2}$ pCi/g]) and the highest concentrations were found at MLR ($1.48 \times 10^{-2} \pm 2.01 \times 10^{-3}$ Bq/g [$4.00 \times 10^{-1} \pm 5.43 \times 10^{-2}$ pCi/g]).

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**Table 4.13 - Selected Radionuclide Concentrations (Bq/g) in Soil Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	Depth (cm)	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC
		¹³⁷ Cs			⁶⁰ Co		
MLR	0-2	8.88×10 ⁻³	1.22×10 ⁻³	4.29×10 ⁻⁴	2.97×10 ⁻⁴	3.03×10 ⁻⁴	4.81×10 ⁻⁴
MLR	2-5	1.65×10 ⁻²	2.16×10 ⁻³	5.81×10 ⁻⁴	-1.72×10 ⁻⁴	4.88×10 ⁻⁴	8.25×10 ⁻⁴
MLR	5-10	1.48×10 ⁻²	2.01×10 ⁻³	8.07×10 ⁻⁴	2.20×10 ⁻⁶	4.33×10 ⁻⁴	7.33×10 ⁻⁴
SEC	0-2	2.82×10 ⁻³	5.48×10 ⁻⁴	5.14×10 ⁻⁴	2.28×10 ⁻⁴	2.34×10 ⁻⁴	3.68×10 ⁻⁴
SEC	2-5	2.15×10 ⁻³	4.51×10 ⁻⁴	4.51×10 ⁻⁴	7.22×10 ⁻⁵	2.48×10 ⁻⁴	4.22×10 ⁻⁴
SEC	5-10	9.44×10 ⁻⁴	3.77×10 ⁻⁴	5.29×10 ⁻⁴	8.55×10 ⁻⁵	2.80×10 ⁻⁴	4.74×10 ⁻⁴
SMR	0-2	9.29×10 ⁻⁴	5.14×10 ⁻⁴	7.81×10 ⁻⁴	3.66×10 ⁻⁴	4.29×10 ⁻⁴	6.92×10 ⁻⁴
SMR	2-5	1.16×10 ⁻³	4.33×10 ⁻⁴	6.03×10 ⁻⁴	1.82×10 ⁻⁴	3.20×10 ⁻⁴	5.25×10 ⁻⁴
SMR	5-10	7.55×10 ⁻⁴	5.00×10 ⁻⁴	7.73×10 ⁻⁴	2.11×10 ⁻⁴	4.63×10 ⁻⁴	7.59×10 ⁻⁴
WEE	0-2	2.21×10 ⁻³	5.48×10 ⁻⁴	6.55×10 ⁻⁴	8.29×10 ⁻⁵	2.48×10 ⁻⁴	4.22×10 ⁻⁴
WEE	2-5	3.13×10 ⁻³	5.33×10 ⁻⁴	5.62×10 ⁻⁴	-3.74×10 ⁻⁴	4.14×10 ⁻⁴	7.10×10 ⁻⁴
WEE	5-10	2.49×10 ⁻³	6.22×10 ⁻⁴	7.62×10 ⁻⁴	-5.03×10 ⁻⁴	4.63×10 ⁻⁴	7.88×10 ⁻⁴
WFF	0-2	3.57×10 ⁻³	5.40×10 ⁻⁴	3.59×10 ⁻⁴	-6.99×10 ⁻⁵	1.75×10 ⁻⁴	3.40×10 ⁻⁴
WFF	2-5	4.48×10 ⁻³	6.22×10 ⁻⁴	3.89×10 ⁻⁴	-1.96×10 ⁻⁵	2.76×10 ⁻⁴	4.66×10 ⁻⁴
WFF	5-10	3.30×10 ⁻³	4.88×10 ⁻⁴	2.63×10 ⁻⁴	2.13×10 ⁻⁴	1.61×10 ⁻⁴	2.46×10 ⁻⁴
WSS	0-2	1.95×10 ⁻³	4.11×10 ⁻⁴	3.96×10 ⁻⁴	5.85×10 ⁻⁵	2.42×10 ⁻⁴	4.14×10 ⁻⁴
WSS	2-5	1.78×10 ⁻³	5.07×10 ⁻⁴	6.51×10 ⁻⁴	-3.08×10 ⁻⁴	4.22×10 ⁻⁴	7.18×10 ⁻⁴
WSS	5-10	1.10×10 ⁻³	3.29×10 ⁻⁴	4.07×10 ⁻⁴	2.24×10 ⁻⁴	2.49×10 ⁻⁴	3.96×10 ⁻⁴
		⁹⁰ Sr			⁴⁰ K		
MLR	0-2	-2.81×10 ⁻³	1.14×10 ⁻²	1.89×10 ⁻²	4.51×10 ⁻¹	5.96×10 ⁻²	9.14×10 ⁻³
MLR	2-5	9.62×10 ⁻³	1.27×10 ⁻²	2.00×10 ⁻²	4.77×10 ⁻¹	6.25×10 ⁻²	1.38×10 ⁻²
MLR	5-10	-3.96×10 ⁻⁴	1.04×10 ⁻²	1.72×10 ⁻²	4.29×10 ⁻¹	5.66×10 ⁻²	1.37×10 ⁻²
SEC	0-2	4.37×10 ⁻³	1.21×10 ⁻²	2.05×10 ⁻²	2.24×10 ⁻¹	3.05×10 ⁻²	5.62×10 ⁻³
SEC	2-5	1.29×10 ⁻²	1.21×10 ⁻²	1.97×10 ⁻²	2.32×10 ⁻¹	3.15×10 ⁻²	5.85×10 ⁻³
SEC	5-10	1.17×10 ⁻²	1.33×10 ⁻²	2.18×10 ⁻²	2.51×10 ⁻¹	3.39×10 ⁻²	5.48×10 ⁻³
SMR	0-2	-1.34×10 ⁻³	1.26×10 ⁻²	2.07×10 ⁻²	4.74×10 ⁻¹	6.18×10 ⁻²	1.34×10 ⁻²
SMR	2-5	-2.93×10 ⁻³	1.17×10 ⁻²	1.94×10 ⁻²	5.11×10 ⁻¹	6.73×10 ⁻²	9.47×10 ⁻³
SMR	5-10	3.37×10 ⁻³	1.25×10 ⁻²	2.13×10 ⁻²	5.62×10 ⁻¹	7.29×10 ⁻²	1.37×10 ⁻²
WEE	0-2	1.79×10 ⁻²	9.55×10 ⁻³	1.60×10 ⁻²	2.25×10 ⁻¹	3.07×10 ⁻²	7.36×10 ⁻³
WEE	2-5	-8.70×10 ⁻³	9.07×10 ⁻³	1.60×10 ⁻²	2.50×10 ⁻¹	3.41×10 ⁻²	1.33×10 ⁻²
WEE	5-10	-3.15×10 ⁻³	9.47×10 ⁻³	1.63×10 ⁻²	2.62×10 ⁻¹	3.55×10 ⁻²	1.32×10 ⁻²
WFF	0-2	-3.40×10 ⁻³	9.32×10 ⁻³	1.61×10 ⁻²	2.53×10 ⁻¹	3.31×10 ⁻²	4.33×10 ⁻³
WFF	2-5	-4.22×10 ⁻³	9.14×10 ⁻³	1.58×10 ⁻²	2.58×10 ⁻¹	3.40×10 ⁻²	1.06×10 ⁻²
WFF	5-10	-4.22×10 ⁻³	9.51×10 ⁻³	1.65×10 ⁻²	2.09×10 ⁻¹	2.76×10 ⁻²	4.63×10 ⁻³
WSS	0-2	9.62×10 ⁻³	1.25×10 ⁻²	2.07×10 ⁻²	2.29×10 ⁻¹	3.12×10 ⁻²	6.96×10 ⁻³
WSS	2-5	7.92×10 ⁻³	1.24×10 ⁻²	2.06×10 ⁻²	2.44×10 ⁻¹	3.34×10 ⁻²	1.33×10 ⁻²
WSS	5-10	4.07×10 ⁻³	1.20×10 ⁻²	2.03×10 ⁻²	2.35×10 ⁻¹	3.20×10 ⁻²	5.74×10 ⁻³

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

Although ¹³⁷Cs is a fission product, it is ubiquitous in soils because of global fallout from atmospheric nuclear weapons testing. In 1998, prior to WIPP accepting any waste, the average concentration of ¹³⁷Cs in soils around WIPP was 4.3×10⁻³ Bq/g (1.16×10⁻¹ pCi/g). There was no statistically significant difference between concentrations measured in 2000 and 2001 (ANOVA, p = 0.519).

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Strontium-90 was only detected at WEE, depth 0-2cm, slightly above the MDC (Table 4.13). However, ⁶⁰Co was not detected in any of the soil samples. There was nonsignificant difference in ⁶⁰Co concentrations between years ($p = 0.421$).

Soil samples collected from one location (WEE) were divided into two parts and analyzed separately (Table 4.14). Uranium-234, ²³⁸U, ⁴⁰K, and ¹³⁷Cs were compared between the duplicates. Other radionuclides of interest had insufficient detections to allow a reasonable comparison. The RER was greater than one for ²³⁴U and ²³⁸U in all samples. However, it was less than one in one for ⁴⁰K analyses and ¹³⁷Cs analyses. A paired t-test indicated no significant difference between ²³⁴U duplicates ($p = 0.624$) and between ²³⁸U duplicates ($p = 0.666$). This circumstance indicates a lack of precision in these analyses, primarily due to the non-homogeneous distribution of radionuclides in soils. Because of small-scale differences in topography, soil type and structure, soil moisture, and other microenvironmental conditions, radionuclides are rarely homogeneously distributed in soils, and good agreement between duplicate samples is difficult to achieve. However, all the measurements were low, within the range of natural concentrations, and did not differ in time or space in such a way as to suggest WIPP-related contamination of the environment.

**Table 4.14 - Results of Duplicate Soil Sample Analysis. Units are Bq/g.
See Appendix B for the sampling locations.**

Location	Depth (cm)	²³⁴ U				²³⁸ U			
		[RN] ^a	2×TPU ^b	MDC ^c	RER ^d	[RN]	2×TPU ^a	MDC ^b	RER ^c
WEE	0-2	5.66×10 ⁻³	1.35×10 ⁻³	1.02×10 ⁻⁴	2.94	6.85×10 ⁻³	1.57×10 ⁻³	1.01×10 ⁻⁴	2.26
WEE D ^e	0-2	1.50×10 ⁻²	2.88×10 ⁻³	8.92×10 ⁻⁴		1.39×10 ⁻²	2.70×10 ⁻³	8.88×10 ⁻⁵	
WEE	2-5	6.73×10 ⁻³	1.38×10 ⁻³	7.81×10 ⁻⁵	2.63	7.33×10 ⁻³	1.48×10 ⁻³	7.77×10 ⁻⁵	2.81
WEE D ^e	2-5	1.57×10 ⁻²	3.12×10 ⁻³	9.99×10 ⁻⁵		1.81×10 ⁻²	3.53×10 ⁻³	9.92×10 ⁻⁵	
WEE	5-10	1.84×10 ⁻²	3.68×10 ⁻³	2.83×10 ⁻⁴	1.94	2.00×10 ⁻²	3.96×10 ⁻³	1.04×10 ⁻⁴	1.90
WEE D ^e	5-10	1.01×10 ⁻²	2.20×10 ⁻³	3.00×10 ⁻⁴		1.12×10 ⁻²	2.39×10 ⁻³	3.77×10 ⁻⁴	
		⁴⁰ K				¹³⁷ Cs			
WEE	0-2	2.25×10 ⁻¹	3.07×10 ⁻²	7.36×10 ⁻³	0.40	2.21×10 ⁻³	5.48×10 ⁻⁴	6.55×10 ⁻⁴	0.25
WEE D ^e	0-2	2.43×10 ⁻¹	3.30×10 ⁻²	6.29×10 ⁻³		2.40×10 ⁻³	5.22×10 ⁻⁴	5.55×10 ⁻⁴	
WEE	2-5	2.62×10 ⁻¹	3.55×10 ⁻²	1.32×10 ⁻²	0.41	2.49×10 ⁻³	6.22×10 ⁻⁴	7.62×10 ⁻⁴	0.18
WEE D ^e	2-5	2.42×10 ⁻¹	3.28×10 ⁻²	6.36×10 ⁻³		2.35×10 ⁻³	4.74×10 ⁻⁴	4.55×10 ⁻⁴	
WEE	5-10	2.62×10 ⁻¹	3.55×10 ⁻²	1.32×10 ⁻²	0.22	2.49×10 ⁻³	6.22×10 ⁻⁴	7.62×10 ⁻⁴	0.50
WEE D ^e	5-10	2.51×10 ⁻¹	3.42×10 ⁻²	1.34×10 ⁻²		2.12×10 ⁻³	4.07×10 ⁻⁴	5.14×10 ⁻⁴	

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

^d Relative Error Ratio

^e Duplicate

4.7 Sediments

4.7.1 Sample Collection

Sediment samples were collected from 12 locations around the WIPP site, mostly from the same water bodies from which the surface water samples were collected (Figure 4.7, see Appendix B for location codes). The samples were collected in 1 l

plastic containers from the top 15 cm (6 in) of the sediments of the water bodies and shipped to the laboratory for the determination of individual radionuclides.

4.7.2 Sample Preparation

Sediment samples were dried at 110°C (230°F) for several hours and homogenized by grinding to smaller particle sizes. A 0.75-g (0.04-oz) aliquot was dissolved by heating it with a mixture of nitric, hydrochloric, and hydrofluoric acids. The residue was heated with nitric and boric acids to remove hydrofluoric acid quantitatively. Finally, the residue was dissolved in hydrochloric acid for the determination of individual radionuclides.

4.7.3 Determination of Individual Radionuclides

About 100 g (4 oz) of dried and homogenized sediment samples were counted by gamma-spectrometry for the determinations of ⁴⁰K, ⁶⁰Co, and ¹³⁷Cs. Strontium-90 was determined from an aliquot of dissolved sediment samples by chemical separation and beta counting. Uranium, plutonium, and americium were determined by alpha spectrometry after chemical separations, micro-precipitating, and filtering onto micro filter papers.

4.7.4 Results and Discussions

Uranium-234, ²³⁵U, and ²³⁸U were detected in every sediment sample in (Table 4.15). The concentration of ²³⁴U ranged from $1.73 \times 10^{-2} \pm 3.10 \times 10^{-3}$ Bq/g ($4.68 \times 10^{-1} \pm 8.38 \times 10^{-2}$ pCi/g) at LST to $4.96 \times 10^{-2} \pm 8.33 \times 10^{-3}$ Bq/g ($1.34 \times 10^0 \pm 2.25 \times 10^{-1}$ pCi/g) at CBD. The concentration of ²³⁵U ranged from $9.32 \times 10^{-4} \pm 3.60 \times 10^{-4}$ Bq/g ($2.52 \times 10^{-2} \pm 9.73 \times 10^{-3}$ pCi/g) at RED to $2.12 \times 10^{-3} \pm 6.25 \times 10^{-4}$ Bq/g ($5.73 \times 10^{-2} \pm 1.69 \times 10^{-2}$ pCi/g) at CBD. The concentration of ²³⁸U was lowest at LST ($1.84 \times 10^{-2} \pm 3.27 \times 10^{-3}$ Bq/g [$4.97 \times 10^{-1} \pm 8.84 \times 10^{-2}$ pCi/g]) and highest at CBD ($3.35 \times 10^{-2} \pm 5.74 \times 10^{-4}$ Bq/g [$9.05 \times 10^{-1} \pm 1.55 \times 10^{-2}$ pCi/g]). As expected, the ²³⁵U concentration was much lower than the concentrations of ²³⁴U and ²³⁸U. There was not a significant difference between sampling years (ANOVA ²³⁴Up = 0.526, ²³⁵Up = 0.399, ²³⁸U p = 0.315).

Plutonium-238 was not detected in any sediment sample in 2001 (Table 4.16). Americium-241 was measured above the MDC at BRA. Plutonium-239+240 concentration was greater than the MDC at BRA, IDN, and Poker Trap [PKT]. These samples were processed several times in the laboratory due to interference in the spectra. The samples showed concentration barely above the MDC for two out of three analysis. The apparent lack of homogeneity of the samples caused the different results. Sample location BRA indicated ²⁴¹Am concentration above the MDC. This sample was also reprocessed for spectral interference. The radionuclide concentrations in Table 4.16 are the reprocessed results.

Cesium-137 was detected in all the sediment samples, ranging from $4.14 \times 10^{-4} \pm 1.60 \times 10^{-4}$ Bq/g ($1.12 \times 10^{-2} \pm 4.32 \times 10^{-3}$ pCi/g) at UPR to $4.59 \times 10^{-2} \pm 5.77 \times 10^{-3}$ Bq/g ($1.24 \times 10^0 \pm 1.56 \times 10^{-1}$ pCi/g) at BRA (Table 4.17). Cesium-137 did not differ statistically between sampling years 2000 and 2001 (ANOVA p = 0.397).

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Strontium-90 was not detected in any sediment samples and Cobalt-60 was detected in one sediment sample (BRA). None of these radionuclides had sufficient detections to justify statistical comparisons between locations or years.

Potassium-40 was detected, as expected, in all sediment samples (Table 4.17). Its lowest concentration was found at CBD ($2.49 \times 10^{-1} \pm 3.25 \times 10^{-2}$ Bq/g [$6.73 \times 10^0 \pm 8.78 \times 10^{-1}$ pCi/g]) and its highest concentration was found at TUT ($1.04 \times 10^0 \pm 1.34 \times 10^{-1}$ Bq/g [$2.81 \times 10^1 \pm 3.62 \times 10^{-1}$ pCi/g]). Potassium-40 did not vary significantly between years (ANOVA, $p = 0.977$). Overall, the concentrations measured in 2001 were similar to the average concentration of ^{40}K found in soils throughout the United States (4.00×10^{-1} Bq/g [1.08×10^1 pCi/g]; NCRP, 1994).

Duplicate analyses were performed for all the radionuclides in sediment samples IDN and TUT (Table 4.18). The RER was less than one for ^{241}Am and all uranium isotopes, indicating acceptable correspondence between the original and the duplicate samples. For ^{137}Cs and ^{40}K , it was greater than one for location TUT. However, a t-test indicated no significant difference between any of these duplicate measurements for ^{40}K ($p = 0.613$) and ^{137}Cs ($p = 0.723$).

**Table 4.15 - Uranium Concentrations (Bq/g) in Sediment Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	^{234}U			^{235}U			^{238}U		
	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
BRA	2.82×10^{-2}	4.81×10^{-3}	6.25×10^{-5}	1.51×10^{-3}	4.81×10^{-4}	7.73×10^{-5}	2.61×10^{-2}	4.48×10^{-3}	6.25×10^{-5}
BHT	2.15×10^{-2}	3.67×10^{-3}	5.99×10^{-5}	1.25×10^{-3}	4.18×10^{-4}	7.40×10^{-5}	2.32×10^{-2}	3.96×10^{-3}	1.62×10^{-4}
CBD	4.96×10^{-2}	8.33×10^{-3}	7.07×10^{-5}	2.12×10^{-3}	6.25×10^{-4}	8.70×10^{-5}	3.35×10^{-2}	5.74×10^{-3}	1.91×10^{-4}
HIL	1.92×10^{-2}	3.51×10^{-3}	7.18×10^{-5}	1.50×10^{-3}	5.11×10^{-4}	8.84×10^{-5}	2.09×10^{-2}	3.77×10^{-3}	1.94×10^{-4}
IDN	2.33×10^{-2}	3.89×10^{-3}	5.40×10^{-5}	1.23×10^{-3}	4.03×10^{-4}	1.81×10^{-4}	2.30×10^{-2}	3.85×10^{-3}	5.37×10^{-5}
LST	1.73×10^{-2}	3.10×10^{-3}	2.21×10^{-4}	1.15×10^{-3}	4.11×10^{-4}	7.96×10^{-5}	1.84×10^{-2}	3.27×10^{-3}	6.44×10^{-5}
NOY	2.32×10^{-2}	3.89×10^{-3}	5.81×10^{-5}	1.21×10^{-3}	4.07×10^{-4}	7.14×10^{-5}	2.43×10^{-2}	4.07×10^{-3}	5.77×10^{-5}
PCN	3.56×10^{-2}	6.29×10^{-3}	2.00×10^{-4}	1.91×10^{-3}	5.99×10^{-4}	9.07×10^{-5}	3.20×10^{-2}	5.66×10^{-3}	7.33×10^{-5}
PKT	2.55×10^{-2}	4.18×10^{-3}	1.53×10^{-4}	1.94×10^{-3}	5.37×10^{-4}	6.92×10^{-5}	2.70×10^{-2}	4.40×10^{-3}	5.59×10^{-5}
RED	1.94×10^{-2}	3.34×10^{-3}	1.74×10^{-4}	9.32×10^{-4}	3.60×10^{-4}	7.88×10^{-5}	1.92×10^{-2}	3.30×10^{-4}	6.36×10^{-5}
TUT	2.32×10^{-2}	3.89×10^{-3}	6.62×10^{-5}	1.63×10^{-3}	5.07×10^{-4}	8.18×10^{-5}	2.53×10^{-2}	4.18×10^{-3}	6.59×10^{-5}
UPR	2.60×10^{-2}	4.48×10^{-3}	6.40×10^{-5}	1.31×10^{-3}	4.51×10^{-4}	2.15×10^{-4}	2.69×10^{-2}	4.63×10^{-3}	6.36×10^{-5}

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

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**Table 4.16 - Americium and Plutonium Concentrations (Bq/g) in Sediment Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	²⁴¹ Am			²³⁸ Pu			²³⁹⁺²⁴⁰ Pu		
	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
BRA	7.10×10 ⁻⁴	4.03×10 ⁻⁴	1.37×10 ⁻⁴	1.23×10 ⁻⁴	1.25×10 ⁻⁴	8.33×10 ⁻⁵	2.46×10 ⁻³	6.85×10 ⁻⁴	8.33×10 ⁻⁵
BHT	2.04×10 ⁻⁴	2.18×10 ⁻⁴	3.16×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	3.03×10 ⁻⁴	1.64×10 ⁻⁴	1.67×10 ⁻⁴	1.11×10 ⁻⁴
CBD	3.06×10 ⁻⁵	1.37×10 ⁻⁴	2.84×10 ⁻⁴	1.02×10 ⁻⁴	1.04×10 ⁻⁴	6.96×10 ⁻⁵	7.70×10 ⁻⁵	8.95×10 ⁻⁵	6.96×10 ⁻⁵
HIL	1.51×10 ⁻⁴	1.62×10 ⁻⁴	2.22×10 ⁻⁴	-8.14×10 ⁻⁵	1.16×10 ⁻⁴	3.77×10 ⁻⁴	1.62×10 ⁻⁴	1.65×10 ⁻⁴	1.10×10 ⁻⁴
IDN	0.00×10 ⁰	0.00×10 ⁰	2.30×10 ⁻⁴	-3.96×10 ⁻⁵	1.38×10 ⁻⁴	3.68×10 ⁻⁴	7.92×10 ⁻⁴	3.85×10 ⁻⁴	1.07×10 ⁻⁴
LST	1.10×10 ⁻⁴	1.57×10 ⁻⁴	2.55×10 ⁻⁴	6.85×10 ⁻⁵	1.37×10 ⁻⁴	2.51×10 ⁻⁴	1.36×10 ⁻⁴	1.38×10 ⁻⁴	9.25×10 ⁻⁵
NOY	1.43×10 ⁻⁴	1.74×10 ⁻⁴	2.66×10 ⁻⁴	3.89×10 ⁻⁵	1.35×10 ⁻⁴	2.87×10 ⁻⁴	1.95×10 ⁻⁴	2.08×10 ⁻⁴	2.87×10 ⁻⁴
PCN	0.00×10 ⁰	0.00×10 ⁰	2.19×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	5.03×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	1.47×10 ⁻⁴
PKT	7.73×10 ⁻⁵	1.10×10 ⁻⁴	1.05×10 ⁻⁴	7.88×10 ⁻⁵	1.58×10 ⁻⁴	2.90×10 ⁻⁴	7.07×10 ⁻⁴	3.74×10 ⁻⁴	2.90×10 ⁻⁴
RED	8.25×10 ⁻⁵	1.24×10 ⁻⁴	2.02×10 ⁻⁴	7.77×10 ⁻⁵	1.16×10 ⁻⁴	1.90×10 ⁻⁴	7.73×10 ⁻⁵	9.03×10 ⁻⁵	6.99×10 ⁻⁵
TUT	3.05×10 ⁻⁵	1.06×10 ⁻⁴	2.25×10 ⁻⁴	-2.51×10 ⁻⁵	5.03×10 ⁻⁵	1.85×10 ⁻⁴	1.25×10 ⁻⁴	1.34×10 ⁻⁴	1.85×10 ⁻⁴
UPR	0.00×10 ⁰	0.00×10 ⁰	7.10×10 ⁻⁵	-5.22×10 ⁻⁵	1.05×10 ⁻⁴	2.81×10 ⁻⁴	7.81×10 ⁻⁵	9.10×10 ⁻⁵	7.07×10 ⁻⁵

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

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**Table 4.17 - Selected Radionuclide Concentrations (Bq/g) in Sediment Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	[RN] ^a	2 × TPU ^b	MDC ^c	[RN]	2 × TPU	MDC
	¹³⁷ Cs			⁶⁰ Co		
BRA	4.59×10 ⁻²	5.77×10 ⁻³	4.22×10 ⁻⁴	6.85×10 ⁻⁴	5.85×10 ⁻⁴	6.73×10 ⁻⁴
BHT	6.77×10 ⁻³	9.03×10 ⁻⁴	3.58×10 ⁻⁴	4.14×10 ⁻⁵	5.88×10 ⁻⁴	6.59×10 ⁻⁴
CBD	2.51×10 ⁻³	4.74×10 ⁻⁴	4.77×10 ⁻⁴	2.60×10 ⁻⁴	5.07×10 ⁻⁴	5.85×10 ⁻⁴
HIL	7.99×10 ⁻³	1.10×10 ⁻³	5.14×10 ⁻⁴	8.40×10 ⁻⁵	6.25×10 ⁻⁴	7.10×10 ⁻⁴
IDN	5.85×10 ⁻³	7.84×10 ⁻⁴	3.36×10 ⁻⁴	-1.18×10 ⁻⁴	2.50×10 ⁻⁴	2.74×10 ⁻⁴
LST	1.73×10 ⁻³	4.14×10 ⁻⁴	5.11×10 ⁻⁴	5.40×10 ⁻⁴	5.07×10 ⁻⁴	5.88×10 ⁻⁴
NOY	8.92×10 ⁻⁴	2.64×10 ⁻⁴	3.47×10 ⁻⁴	2.36×10 ⁻⁴	4.85×10 ⁻⁴	5.55×10 ⁻⁴
PCN	7.62×10 ⁻⁴	1.69×10 ⁻⁴	2.55×10 ⁻⁴	1.55×10 ⁻⁴	4.51×10 ⁻⁴	5.18×10 ⁻⁴
PKT	1.61×10 ⁻²	2.03×10 ⁻³	4.26×10 ⁻⁴	3.42×10 ⁻⁴	7.07×10 ⁻⁴	7.99×10 ⁻⁴
RED	4.07×10 ⁻³	5.77×10 ⁻⁴	3.70×10 ⁻⁴	5.00×10 ⁻⁴	5.48×10 ⁻⁴	6.33×10 ⁻⁴
TUT	3.81×10 ⁻³	5.62×10 ⁻⁴	4.44×10 ⁻⁴	3.81×10 ⁻⁴	7.29×10 ⁻⁴	8.25×10 ⁻⁴
UPR	4.14×10 ⁻⁴	1.60×10 ⁻⁴	3.57×10 ⁻⁴	5.37×10 ⁻⁴	5.33×10 ⁻⁴	6.18×10 ⁻⁴
	⁹⁰ Sr			⁴⁰ K		
BRA	1.70×10 ⁻²	1.55×10 ⁻²	2.49×10 ⁻²	5.51×10 ⁻¹	7.10×10 ⁻²	6.51×10 ⁻³
BHT	1.45×10 ⁻²	1.16×10 ⁻²	1.80×10 ⁻²	6.66×10 ⁻¹	8.55×10 ⁻²	5.96×10 ⁻³
CBD	1.79×10 ⁻³	6.59×10 ⁻³	1.11×10 ⁻²	2.49×10 ⁻¹	3.25×10 ⁻²	5.59×10 ⁻³
HIL	6.85×10 ⁻³	7.59×10 ⁻³	1.20×10 ⁻²	8.66×10 ⁻¹	1.11×10 ⁻¹	6.55×10 ⁻³
IDN	-5.48×10 ⁻⁴	8.03×10 ⁻³	1.35×10 ⁻²	4.81×10 ⁻¹	6.18×10 ⁻²	6.07×10 ⁻³
LST	-3.07×10 ⁻³	6.44×10 ⁻³	1.10×10 ⁻²	3.89×10 ⁻¹	5.03×10 ⁻²	6.03×10 ⁻³
NOY	-7.22×10 ⁻⁴	6.07×10 ⁻³	1.02×10 ⁻²	4.77×10 ⁻¹	6.18×10 ⁻²	6.25×10 ⁻³
PCN	1.54×10 ⁻³	6.66×10 ⁻³	1.10×10 ⁻²	3.27×10 ⁻¹	4.26×10 ⁻²	5.33×10 ⁻³
PKT	2.16×10 ⁻³	7.07×10 ⁻³	1.16×10 ⁻²	8.70×10 ⁻¹	1.10×10 ⁻¹	6.99×10 ⁻³
RED	1.32×10 ⁻³	6.92×10 ⁻³	1.15×10 ⁻²	4.85×10 ⁻¹	6.25×10 ⁻²	6.18×10 ⁻³
TUT	2.52×10 ⁻³	7.14×10 ⁻³	1.20×10 ⁻²	1.04×10 ⁰	1.34×10 ⁻¹	7.77×10 ⁻³
UPR	-2.64×10 ⁻⁴	6.99×10 ⁻³	1.20×10 ⁻²	4.81×10 ⁻¹	6.22×10 ⁻²	6.07×10 ⁻³

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

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**Table 4.18 - Results of Duplicate Sediment Sample Analysis. Units are Bq/g.
See Appendix B for the sampling locations.**

Location	²⁴¹ Am				¹³⁷ Cs				
	[RN] ^a	2×TPU ^b	MDC ^c	RER ^d	[RN]	2×TPU ^a	MDC ^b	RER ^c	
IDN	0.00×10 ⁰	0.00×10 ⁰	2.30×10 ⁻⁴	0.811	5.85×10 ⁻³	7.84×10 ⁻⁴	3.36×10 ⁻⁴	0.324	
IDN Dup.	1.20×10 ⁻⁴	1.48×10 ⁻⁴	2.20×10 ⁻⁴		6.22×10 ⁻³	8.29×10 ⁻⁴	3.24×10 ⁻⁴		
TUT	3.05×10 ⁻⁵	1.06×10 ⁻⁴	2.25×10 ⁻⁴	0.492	3.81×10 ⁻³	5.62×10 ⁻⁴	4.44×10 ⁻⁴	1.419	
TUT Dup.	6.59×10 ⁻⁵	9.40×10 ⁻⁵	8.92×10 ⁻⁵		2.80×10 ⁻³	4.37×10 ⁻⁴	4.22×10 ⁻⁴		
⁴⁰ K					²³⁴ U				
IDN	4.81×10 ⁻¹	6.18×10 ⁻²	6.07×10 ⁻³	0.520	2.33×10 ⁻²	3.89×10 ⁻³	5.40×10 ⁻⁵	0.261	
IDN Dup.	5.29×10 ⁻¹	6.85×10 ⁻²	5.18×10 ⁻³		2.19×10 ⁻²	3.69×10 ⁻³	5.55×10 ⁻⁵		
TUT	1.04×10 ⁰	1.34×10 ⁻¹	7.77×10 ⁻³	1.604	2.32×10 ⁻²	3.89×10 ⁻³	6.62×10 ⁻⁵	0.247	
TUT Dup.	7.73×10 ⁻¹	9.88×10 ⁻²	6.66×10 ⁻³		2.46×10 ⁻²	4.11×10 ⁻³	1.67×10 ⁻⁴		
²³⁵ U					²³⁸ U				
IDN	1.23×10 ⁻³	4.03×10 ⁻⁴	1.81×10 ⁻⁴	0.252	2.30×10 ⁻²	3.85×10 ⁻³	5.37×10 ⁻⁵	0.161	
IDN Dup.	1.09×10 ⁻³	3.81×10 ⁻⁴	1.86×10 ⁻⁴		2.39×10 ⁻²	4.03×10 ⁻³	5.55×10 ⁻⁵		
TUT	1.63×10 ⁻³	5.07×10 ⁻⁴	8.18×10 ⁻⁵	0.292	2.53×10 ⁻²	4.18×10 ⁻³	6.59×10 ⁻⁵	0.261	
TUT Dup.	1.43×10 ⁻³	4.59×10 ⁻⁴	7.59×10 ⁻⁵		2.69×10 ⁻²	4.48×10 ⁻³	6.14×10 ⁻⁵		

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

^d Relative Error Ratio



Figure 4.7 - Sediment Sampling Sites

4.8 Biota

4.8.1 Sample Collection

The concentration of radionuclides in plants is an important factor in estimating the intake of individual radionuclides by humans through ingestion. Therefore, rangeland vegetation samples were collected from the same six locations from where the soil samples were collected (Figure 4.6). The vegetation samples were chopped into 2.5-5-cm (1-2-in)-pieces, mixed together well, air dried at room temperature, and sent to the contract laboratory for analysis. Also collected were muscle tissues from two road-killed deer and one quail, both species commonly consumed by humans. Fish is also consumed in large amounts; therefore, fish samples from PCN, PEC, and BRA (three different locations on the Pecos River) were collected. The muscle tissues from the deer, quail, rabbit, and fish were sent to the laboratory for analysis.

4.8.2 Sample Preparation

Weighed aliquots were taken from the bulk of the chopped vegetation samples and animal tissue samples from each location. The aliquots were transferred into separate containers and dried at 100°C (212°F). Gamma spectrometric determinations of ⁴⁰K, ⁶⁰Co, and ¹³⁷Cs were performed directly from these aliquots. The samples were then dry-ashed, followed by wet-ashing and dissolution in 8M nitric acid. Aliquots from the dissolved samples were taken for the determinations of ⁹⁰Sr, ²³³⁺²³⁴U, ²³⁵U, ²³⁸U, ²³⁸Pu, ²³⁹⁺²⁴⁰Pu, and ²⁴¹Am.

4.8.3 Results and Discussions

Vegetation

Uranium-234 was detected in all vegetation samples; because of its naturally low concentration, ²³⁵U was not detected in any vegetation sample (Table 4.19). Concentrations of ²³⁴U ranged from $4.18 \times 10^{-4} \pm 3.34 \times 10^{-4}$ Bq/g ($1.13 \times 10^{-2} \pm 9.03 \times 10^{-3}$ pCi/g) at WSS to $8.21 \times 10^{-4} \pm 2.75 \times 10^{-4}$ Bq/g ($2.22 \times 10^{-2} \pm 7.43 \times 10^{-2}$ pCi/g) at WEE. Uranium-238 was detected all but one sample, WSS and varied between $2.54 \times 10^{-4} \pm 1.32 \times 10^{-4}$ Bq/g ($6.86 \times 10^{-3} \pm 3.57 \times 10^{-3}$ pCi/g) at MLR to $5.03 \times 10^{-4} \pm 2.05 \times 10^{-4}$ Bq/g ($1.36 \times 10^{-2} \pm 5.54 \times 10^{-3}$ pCi/g) at WEE. The concentration of ²³⁴U and ²³⁸U did not vary significantly between locations (ANOVA, ²³⁴U p = 0.548, ²³⁸U p = 0.527). The primary source for uranium in plant tissues is the soil, so this difference from the uranium results for soils may seem counterintuitive. However, uptake of radionuclides and contamination by resuspension are highly species dependent. Because of small-scale differences in soil type, shading, water availability, and other microenvironmental conditions, plants of the same species collected adjacent to one another will often have very different radionuclide concentrations.

Concentrations of ²³⁸Pu, ²³⁹⁺²⁴⁰Pu, and ²⁴¹Am were less than the minimum detectable concentrations in every vegetation sample (Table 4.19).

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Potassium-40 was detected in every vegetation sample (Table 4.19), ranging from $1.64 \times 10^{-1} \pm 2.75 \times 10^{-2}$ Bq/g ($4.43 \times 10^0 \pm 7.43 \times 10^{-1}$ pCi/g) at WEE to $4.29 \times 10^{-1} \pm 6.48 \times 10^{-2}$ Bq/g ($1.16 \times 10^1 \pm 1.75 \times 10^0$ pCi/g) at SMR. The concentration of ^{40}K in vegetation was not significantly different between years (ANOVA, $p = 0.348$). Like uranium, the primary source for potassium in plant tissues is the soil, and this difference from the ^{40}K results for soil is probably due to the same factors. Cesium-137 was not detected in vegetation samples. Cobalt-60 was detected in sample location SEC. Strontium-90 was not detected in any of the vegetation samples.

**Table 4.19 - Radionuclide Concentrations (Bq/g Wet Mass) in Vegetation Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	^{241}Am			^{238}Pu			^{239}Pu		
	[RN] ^a	2×TPU ^b	MDC ^c	[RN]	2×TPU	MDC	[RN]	2×TPU	MDC
MLR	4.48×10^{-5}	7.92×10^{-5}	1.38×10^{-4}	-1.59×10^{-5}	5.51×10^{-5}	1.47×10^{-4}	-1.58×10^{-5}	3.17×10^{-5}	1.17×10^{-4}
SEC	0.00×10^0	0.00×10^0	1.53×10^{-4}	1.31×10^{-5}	6.92×10^{-5}	1.40×10^{-4}	0.00×10^0	0.00×10^0	3.53×10^{-5}
SMR	1.05×10^{-4}	1.12×10^{-4}	1.64×10^{-4}	-6.48×10^{-5}	2.25×10^{-4}	5.99×10^{-4}	0.00×10^0	0.00×10^0	1.75×10^{-4}
WEE	1.49×10^{-5}	6.66×10^{-5}	1.39×10^{-4}	1.43×10^{-5}	6.40×10^{-5}	1.33×10^{-4}	1.43×10^{-5}	2.86×10^{-5}	3.89×10^{-5}
WFF	9.99×10^{-5}	9.77×10^{-5}	1.34×10^{-4}	2.80×10^{-5}	5.62×10^{-5}	1.03×10^{-4}	0.00×10^0	0.00×10^0	1.03×10^{-4}
WSS	3.22×10^{-5}	6.48×10^{-5}	1.19×10^{-4}	4.55×10^{-5}	6.81×10^{-5}	1.11×10^{-4}	0.00×10^0	0.00×10^0	4.11×10^{-5}
	^{234}U			^{235}U			^{238}U		
MLR	4.66×10^{-4}	1.79×10^{-4}	3.85×10^{-5}	0.00×10^0	0.00×10^0	1.62×10^{-4}	2.54×10^{-4}	1.32×10^{-4}	1.04×10^{-4}
SEC	6.25×10^{-4}	2.78×10^{-4}	1.77×10^{-4}	2.96×10^{-5}	5.96×10^{-5}	8.03×10^{-5}	4.55×10^{-4}	2.24×10^{-4}	6.48×10^{-5}
SMR	7.33×10^{-4}	2.67×10^{-4}	1.32×10^{-4}	6.62×10^{-5}	7.73×10^{-5}	5.99×10^{-5}	4.63×10^{-4}	1.99×10^{-4}	4.85×10^{-5}
WEE	8.21×10^{-4}	2.75×10^{-4}	4.74×10^{-5}	2.15×10^{-5}	7.47×10^{-5}	1.59×10^{-4}	5.03×10^{-4}	2.05×10^{-4}	4.70×10^{-5}
WFF	4.63×10^{-4}	1.84×10^{-4}	4.18×10^{-5}	1.90×10^{-5}	3.81×10^{-5}	5.14×10^{-5}	3.53×10^{-4}	1.58×10^{-4}	4.14×10^{-5}
WSS	4.18×10^{-4}	3.34×10^{-4}	1.62×10^{-4}	0.00×10^0	0.00×10^0	2.00×10^{-4}	4.18×10^{-4}	3.74×10^{-4}	4.40×10^{-4}
	^{137}Cs			^{60}Co					
MLR	6.77×10^{-4}	1.15×10^{-3}	1.39×10^{-3}	1.19×10^{-3}	1.54×10^{-3}	1.87×10^{-3}			
SEC	1.18×10^{-3}	2.73×10^{-3}	3.07×10^{-3}	4.44×10^{-3}	2.72×10^{-3}	3.08×10^{-3}			
SMR	6.14×10^{-4}	2.64×10^{-3}	2.96×10^{-3}	1.68×10^{-3}	2.71×10^{-3}	3.01×10^{-3}			
WEE	-2.75×10^{-6}	1.17×10^{-3}	1.37×10^{-3}	3.14×10^{-5}	1.53×10^{-3}	1.78×10^{-3}			
WFF	1.69×10^{-4}	1.18×10^{-3}	1.40×10^{-3}	6.73×10^{-4}	1.59×10^{-3}	1.88×10^{-3}			
WSS	9.66×10^{-4}	1.68×10^{-3}	1.95×10^{-3}	9.73×10^{-4}	1.86×10^{-3}	2.29×10^{-3}			
	^{90}Sr			^{40}K					
MLR	3.28×10^{-4}	4.39×10^{-3}	6.60×10^{-3}	2.16E-01	3.53×10^{-2}	1.78×10^{-2}			
SEC	1.94×10^{-3}	4.17×10^{-3}	6.15×10^{-3}	4.18E-01	6.36×10^{-2}	3.05×10^{-2}			
SMR	3.75×10^{-3}	4.11×10^{-3}	5.96×10^{-3}	4.29E-01	6.48×10^{-2}	2.76×10^{-2}			
WEE	-4.23×10^{-4}	4.42×10^{-3}	6.69×10^{-3}	1.64E-01	2.75×10^{-2}	1.36×10^{-2}			
WFF	-5.29×10^{-3}	4.20×10^{-3}	6.67×10^{-3}	2.93E-01	4.55×10^{-2}	1.72×10^{-2}			
WSS	1.47×10^{-3}	4.41×10^{-3}	6.54×10^{-3}	2.56E-01	4.22×10^{-2}	2.00×10^{-2}			

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

A duplicate analysis of the vegetation sample from WEE was performed for all the radionuclides of interest (Table 4.20). Concentrations of ^{234}U , ^{238}U , and ^{40}K were above detection limits in the duplicate sample. Relative Error Ratio values exceeded one for ^{234}U , ^{238}U , and ^{40}K , indicating a nonhomogenous sample.

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Animals

Of the radionuclides of interest, ²³⁴U, ²³⁸U, and ⁴⁰K were detected in deer, rabbit, and quail tissue (Table 4.21). The mean concentrations did not differ from year 2000. These results can be used only as a gross indication of uptakes, as the sample sizes are too small to provide a robust analysis.

**Table 4.20 - Results of Duplicate Vegetation Sample Analysis. Units are Bq/g.
See Appendix B for the sampling locations.**

Location	[RN] ^a	2×TPU ^b	MDC ^c	RER ^d	[RN]	2×TPU	MDC	RER
	²³⁴ U				⁴⁰ K			
WEE	8.21×10 ⁻⁴	2.75×10 ⁻⁴	4.74×10 ⁻⁵	1.839	1.64×10 ⁻¹	2.75×10 ⁻²	1.36×10 ⁻²	3.778
WEE Dup.	2.43×10 ⁻⁴	1.52×10 ⁻⁴	1.61×10 ⁻⁴		4.22×10 ⁻¹	6.25×10 ⁻²	1.79×10 ⁻²	
	²³⁸ U							
WEE	5.03×10 ⁻⁴	2.05×10 ⁻⁴	4.70×10 ⁻⁵	1.14				
WEE Dup.	2.25×10 ⁻⁴	1.30×10 ⁻⁴	4.70×10 ⁻⁵					

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

^d Relative Error Ratio

Table 4.21 - Radionuclide Concentrations (Bq/g Wet Mass) in Deer and Quail Near the WIPP Site

Sample Type	[RN] ^a	2×TPU ^b	MDC ^c	[RN]	2×TPU	MDC	[RN]	2×TPU	MDC
	²⁴¹ Am			²³⁸ Pu			²³⁹ Pu		
Deer ^d	3.14×10 ⁻⁷	1.42×10 ⁻⁶	1.32×10 ⁻⁶	2.74×10 ⁻⁷	1.04×10 ⁻⁶	1.59×10 ⁻⁶	-2.05×10 ⁻⁸	6.95×10 ⁻⁸	1.56×10 ⁻⁶
Quail ^e	1.23×10 ⁻⁶	3.40×10 ⁻⁶	3.03×10 ⁻⁵	-1.01×10 ⁻⁴	2.79×10 ⁻⁴	2.87×10 ⁻⁵	0.00×10 ⁰	0.00×10 ⁰	8.35×10 ⁻⁶
Rabbit ^f	1.84×10 ⁻⁶	2.13×10 ⁻⁶	1.65×10 ⁻⁶	0.00×10 ⁰	0.00×10 ⁰	1.67×10 ⁻⁶	-6.18×10 ⁻⁷	1.24×10 ⁻⁶	4.55×10 ⁻⁶
	²³⁴ U			²³⁵ U			²³⁸ U		
Deer	1.07×10 ⁻⁵	2.62×10 ⁻⁵	5.51×10 ⁻⁷	1.44×10 ⁻⁷	3.74×10 ⁻⁷	6.80×10 ⁻⁷	7.92×10 ⁻⁶	1.93×10 ⁻⁵	5.49×10 ⁻⁷
Quail	1.07×10 ⁻³	2.93×10 ⁻³	8.93×10 ⁻⁶	3.69×10 ⁻⁵	1.06×10 ⁻⁴	1.41×10 ⁻⁵	1.20×10 ⁻³	3.32×10 ⁻³	2.18×10 ⁻⁵
Rabbit	4.81×10 ⁻⁵	1.31×10 ⁻⁵	1.61×10 ⁻⁶	5.11×10 ⁻⁶	3.96×10 ⁻⁶	1.98×10 ⁻⁷	3.89×10 ⁻⁵	1.14×10 ⁻⁵	1.60×10 ⁻⁶
	¹³⁷ Cs			⁶⁰ Co					
Deer	-1.76×10 ⁻⁴	7.60×10 ⁻⁴	3.49×10 ⁻⁴	2.06×10 ⁻⁴	2.43×10 ⁻⁴	3.85×10 ⁻⁴			
Quail	2.09×10 ⁻⁴	2.02×10 ⁻³	3.95×10 ⁻³	1.77×10 ⁻³	2.04×10 ⁻³	5.16×10 ⁻³			
Rabbit	-1.59×10 ⁻⁴	5.59×10 ⁻⁴	6.40×10 ⁻⁴	-4.85×10 ⁻⁴	7.70×10 ⁻⁴	8.21×10 ⁻⁴			
	⁹⁰ Sr			⁴⁰ K					
Deer	-9.77×10 ⁻⁶	3.03×10 ⁻⁵	7.29×10 ⁻⁵	9.34×10 ⁻²	3.85×10 ⁻²	3.22×10 ⁻³			
Quail	1.55×10 ⁻³	2.16×10 ⁻³	1.54×10 ⁻³	1.41×10 ⁻¹	3.66×10 ⁻¹	4.23×10 ⁻²			
Rabbit	-9.95×10 ⁻⁵	1.38×10 ⁻⁴	2.33×10 ⁻⁴	1.07×10 ⁻¹	1.74×10 ⁻²	9.29×10 ⁻³			

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

^d Mean of three samples collected near WIPP. TPU represents the standard deviation of the mean.

^e Mean of two samples collected near WIPP. TPU represents the standard deviation of the mean.

^f Single Sample

Uranium-234 and ²³⁸U were detected in all the fish samples. Uranium-235 was detected in 67 percent of the fish samples (Table 4.22). Neither plutonium or ²⁴¹Am isotope was detected in fish.

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Cesium-137, ⁶⁰Co, and ⁹⁰Sr were not detected in any of the fish samples (Table 4.22). Potassium-40 was detected in all fish (Table 4.22). It was lowest in the sample from BRA ($5.66 \times 10^{-2} \pm 9.40 \times 10^{-3}$ Bq/g [$1.53 \times 10^0 \pm 2.54 \times 10^{-1}$ pCi/g]), and highest in the sample from PCN ($1.03 \times 10^{-1} \pm 1.55 \times 10^{-2}$ Bq/g [$2.78 \times 10^1 \pm 4.19 \times 10^{-1}$ pCi/g]).

**Table 4.22 - Radionuclide Concentrations (Bq/g Wet Mass) in Fish Near the WIPP Site.
See Appendix B for the sampling locations.**

Location	[RN] ^a	2×TPU ^b	MDC ^c	[RN]	2×TPU	MDC	[RN]	2×TPU	MDC
	²⁴¹ Am			²³⁸ Pu			²³⁹ Pu		
BRA	1.65×10^{-6}	1.93×10^{-6}	1.49×10^{-6}	9.95×10^{-7}	1.42×10^{-6}	1.35×10^{-6}	4.96×10^{-7}	9.99×10^{-7}	1.35×10^{-6}
BRA	1.03×10^{-6}	1.20×10^{-6}	9.29×10^{-7}	1.10×10^{-6}	1.57×10^{-6}	1.49×10^{-6}	0.00×10^0	0.00×10^0	1.49×10^{-6}
PCN	6.48×10^{-7}	1.30×10^{-6}	1.75×10^{-6}	5.96×10^{-7}	1.20×10^{-6}	1.61×10^{-6}	5.92×10^{-7}	1.19×10^{-6}	1.61×10^{-6}
PCN	1.28×10^{-6}	1.82×10^{-6}	1.73×10^{-6}	1.26×10^{-6}	1.47×10^{-6}	1.14×10^{-6}	0.00×10^0	0.00×10^0	3.09×10^{-6}
PEC	7.03×10^{-7}	2.44×10^{-6}	5.18×10^{-6}	3.50×10^{-6}	5.25×10^{-6}	8.58×10^{-6}	0.00×10^0	0.00×10^0	8.58×10^{-6}
PEC	0.00×10^0	0.00×10^0	4.92×10^{-6}	-1.22×10^{-6}	1.74×10^{-6}	5.67×10^{-6}	0.00×10^0	0.00×10^0	4.48×10^{-6}
	²³⁴ U			²³⁵ U			²³⁸ U		
BRA	8.70×10^{-5}	1.68×10^{-5}	8.29×10^{-7}	3.02×10^{-6}	2.18×10^{-6}	1.02×10^{-6}	3.77×10^{-5}	8.92×10^{-6}	8.25×10^{-7}
BRA	5.48×10^{-5}	1.08×10^{-5}	5.88×10^{-7}	1.07×10^{-6}	1.08×10^{-6}	7.25×10^{-7}	3.26×10^{-5}	7.29×10^{-6}	5.85×10^{-7}
PCN	1.03×10^{-4}	2.19×10^{-5}	4.33×10^{-6}	4.00×10^{-6}	3.10×10^{-6}	1.55×10^{-6}	5.37×10^{-5}	1.32×10^{-5}	1.25×10^{-6}
PCN	1.58×10^{-4}	2.99×10^{-5}	9.88×10^{-7}	3.59×10^{-6}	2.60×10^{-6}	1.22×10^{-6}	8.51×10^{-5}	1.79×10^{-5}	2.67×10^{-6}
PEC	1.32×10^{-4}	2.70×10^{-5}	1.65×10^{-6}	2.25×10^{-6}	2.62×10^{-6}	2.04×10^{-6}	6.73×10^{-5}	1.64×10^{-5}	1.64×10^{-6}
PEC	1.96×10^{-4}	3.63×10^{-5}	1.11×10^{-6}	5.07×10^{-6}	3.31×10^{-6}	1.37×10^{-6}	9.62×10^{-5}	2.00×10^{-5}	3.81×10^{-6}
	¹³⁷ Cs			⁶⁰ Co					
BRA	9.99×10^{-5}	6.55×10^{-4}	7.62×10^{-4}	-1.65×10^{-4}	7.33×10^{-4}	7.81×10^{-4}			
BRA	-4.29×10^{-4}	5.33×10^{-4}	5.59×10^{-4}	1.66×10^{-4}	5.00×10^{-4}	5.77×10^{-4}			
PCN	3.92×10^{-4}	1.01×10^{-3}	1.18×10^{-3}	-5.07×10^{-4}	1.13×10^{-3}	1.18×10^{-3}			
PCN	-3.45×10^{-4}	5.44×10^{-4}	5.77×10^{-4}	2.06×10^{-4}	5.25×10^{-4}	6.07×10^{-4}			
PEC	1.47×10^{-3}	1.39×10^{-3}	1.63×10^{-3}	3.89×10^{-5}	1.49×10^{-3}	1.62×10^{-3}			
PEC	2.12×10^{-4}	5.29×10^{-4}	6.03×10^{-4}	-2.85×10^{-4}	6.29×10^{-4}	6.85×10^{-4}			
	⁹⁰ Sr			⁴⁰ K					
BRA	1.45×10^{-5}	9.40×10^{-5}	1.54×10^{-4}	9.51×10^{-2}	1.69×10^{-2}	1.51×10^{-2}			
BRA	3.35×10^{-5}	7.84×10^{-5}	1.26×10^{-4}	5.66×10^{-2}	9.40×10^{-3}	6.29×10^{-3}			
PCN	2.20×10^{-4}	1.69×10^{-4}	2.60×10^{-4}	8.88×10^{-2}	1.98×10^{-2}	2.29×10^{-2}			
PCN	8.55×10^{-5}	7.29×10^{-5}	1.13×10^{-4}	1.03×10^{-1}	1.55×10^{-2}	6.66×10^{-3}			
PEC	7.03×10^{-5}	1.76×10^{-4}	2.83×10^{-4}	9.14×10^{-2}	2.46×10^{-2}	3.18×10^{-2}			
PEC	-2.73×10^{-5}	1.02×10^{-4}	1.70×10^{-4}	8.81×10^{-2}	1.47×10^{-2}	8.62×10^{-3}			

^a [RN] = Radionuclide concentration

^b Total propagated uncertainty

^c Minimum detectable concentration

Neither ²⁴¹Am nor any plutonium isotopes were detected in fish.

4.9 Summary and Conclusion

The Environmental Monitoring Program collected samples of air particulates, soil, sediment, groundwater, surface water, and biota and analyzed them for radionuclides considered to be indicators of potential contamination from the WIPP facility, as well as other radionuclides of potential interest. Measured concentrations were examined for evidence of WIPP-related contamination, such as higher concentrations of TRU

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radionuclides after 1998, or higher concentrations in downwind or down gradient directions. Radionuclide concentrations observed were highly variable in space and time and between media. However, no time or space relationships related to WIPP were observed, and concentrations were consistent with background levels. In no case, could environmental concentrations be attributed to WIPP releases. In addition, no events occurred at WIPP, which would lead one to suspect that a release had occurred.

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CHAPTER 5 - ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

This chapter discusses nonradiological environmental surveillance data collected between January 1 and December 31, 2001. Nonradiological programs at WIPP include wildlife population monitoring, meteorological monitoring, and seismic monitoring. In addition, VOCs were monitored to comply with the provisions of WIPP's hazardous waste permit, and liquid effluent monitoring was conducted in accordance with WIPP's Discharge Plan (DP-831).

5.1 Principal Functions of Nonradiological Sampling

The principal functions of the nonradiological environmental surveillance program are to:

- Assess the impacts of WIPP operations on the surrounding ecosystem;
- Monitor ecological conditions in the Los Medaños region;
- Investigate unusual or unexpected elements in the ecological databases;
- 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; and
- Comply with applicable commitments identified with existing agreements (e.g., BLM/DOE MOU, Interagency Agreements, Agreements in Principle, etc.).

5.2 WIPP Raptor Program

WIPP, and the region surrounding it, is widely recognized for its concentration and diversity of raptors. The area is home to several raptor species of special concern, including Harris' hawks, Swainson's hawks, burrowing owls, and barn owls, as well as other species.

The DOE, the BLM, and other government agencies are aware of the value and importance of protecting and monitoring raptor populations. To assist in this effort at WIPP, the BLM and the DOE established the WRP in the early 1990s to monitor and protect raptors on the WIPP site, and to educate site workers and the public about these birds. The WRP is administrated by the WIPP Environmental Monitoring Program with input from the BLM and others. Scientific consultation, research direction, and field operations are conducted by scientists from the Department of Biology at Rocky Mountain College (Restani, 2001).

Raptor research at WIPP began in 1981 when the DOE initiated a study of the social behavior of Harris' hawks conducted by the University of New Mexico. Research results revealed the extent of the overall raptor population, and provided new information about raptor species in the area. In the late 1980s, the BLM designated the Los Medaños Raptor Area, which included the WIPP site, as a National Key Raptor Area. This

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designation served as a catalyst for the development of the WRP. Simultaneously, the DOE reorganized its program to encompass expanded objectives.

The WRP presently serves four significant functions:

- **Wildlife Monitoring.** The WRP provides the DOE, the BLM, and other agencies with current information about the status of raptor populations in and around WIPP.
- **Scientific Research.** WRP staff conduct research on topics that contribute to the understanding of raptors in the desert southwest.
- **Interagency Cooperation.** The WRP is funded by the DOE, but works closely with several other federal and state agencies.

In 2001, long-term studies of productivity and population demographics of the raptor community in and around WIPP continued. The primary objective for the 2001 nesting season was to locate all raptor and raven nests within the 3000 km² study area, centered on WIPP. Secondary objectives were to estimate raptor productivity in the area and to determine causes of raptor mortality.

Research ornithologists located 98 raptor territories in 2001. As in CY 2000, the number of nests far surpassed those found in previous years' studies.

Electrocution by power poles continues to be an important cause of raptor mortality and is predicted to increase as oil and gas exploration increases in the area. In one case, however, a nest was deliberately destroyed by an unknown person or persons. For more information on the WRP, see the Waste Isolation Pilot Plant WIPP Raptor Program 2001 Annual Report (Restani, 2001).

5.3 Meteorology

The primary WIPP meteorological station is located 600 m (1,970 ft) northeast of the Waste Handling Building. The main function of the station is to provide data for atmospheric dispersion modeling. The station measures and records wind speed, wind direction, and temperature at elevations of 2, 10, and 50 m (6.5, 33, and 165 ft). The station records ground-level measurements of barometric pressure, relative humidity, precipitation, and solar radiation.

In addition to the primary meteorological station, the WIPP Far Field Station is located 1,000 m (3,300 ft) northwest of the Waste Handling Building. At the WIPP Far Field Station, a secondary meteorological station measures and records temperature and atmospheric pressure at ground level and wind speed and wind direction at 10 m (33 ft).

5.3.1 Climatic Data

The annual precipitation at the WIPP site for 2001 was 240 mm (9.5 in), which was 65 mm (2.5 in) less than the previous year's rainfall. Figure 5.1 displays the monthly precipitation at WIPP.

The mean annual temperature for the WIPP area in 2001 was 17°C (64°F). The mean monthly temperatures for the WIPP area ranged from 10°C (50°F) during December to 25°C (78°F) in July. Generally, maximum temperatures occurred from May through September, while minimum temperatures occurred in January, November, and December, as illustrated in Figures 5.2, 5.3, and 5.4 and Tables 5.1, 5.2, and 5.3. The lowest recorded temperature was -9°C (16°F) in January. The maximum recorded temperature was 40°C (105°F) in May.

5.3.2 Wind Direction and Wind Speed

Winds in the WIPP area in 2001 blew predominantly from the southeast (135°). Seasonal weather systems move through this area, briefly altering the predominant southeasterly winds and sometimes resulting in violent convective storms. Wind speed measured at the 10-m (33-ft) level were calm (less than 0.5 meters per second [m/s]) (1.1 miles per hour [mph]) about 0.5 percent of the time. At the 10-m level, winds of 3.7 through 6.3 m/s (8.3 to 14.1 mph) were the most prevalent over 2001, occurring 40 percent of the time. Figures 5.5, 5.6, and 5.7 and Tables 5.4, 5.5, and 5.6 display the annual wind data at WIPP for 2001.

5.4 Volatile Organic Compound Monitoring

Volatile organic compound monitoring was implemented on April 21, 1997, in accordance with WP12-VC.01, Confirmatory Volatile Organic Compound Monitoring Program. This program was implemented as a requirement of the HWFP, Module IV, Section D and Attachment N, and is intended to demonstrate that regulated VOCs are not being emitted by the waste at concentrations in excess of concentrations of concern as prescribed in the permit.

Nine target compounds, which contribute approximately 99 percent of the calculated human health risks from RCRA constituents, were chosen for monitoring. These target compounds are 1,1-dichloroethylene, methylene chloride, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, 1,2-dichloroethane, toluene, chlorobenzene, and 1,1,2,2-tetrachloroethane.

Sampling for target compounds is done at two air monitoring stations. The stations are identified as VOC-A, located downstream from hazardous waste disposal unit Panel 1 in Drift E300, and VOC-B, located upstream from Panel 1. In 2001, VOC-B was located in Drift S1950. As waste is placed in new panels, VOC-B will be relocated to ensure that it samples underground air before it passes the waste panels. The location of VOC-A is not anticipated to change.

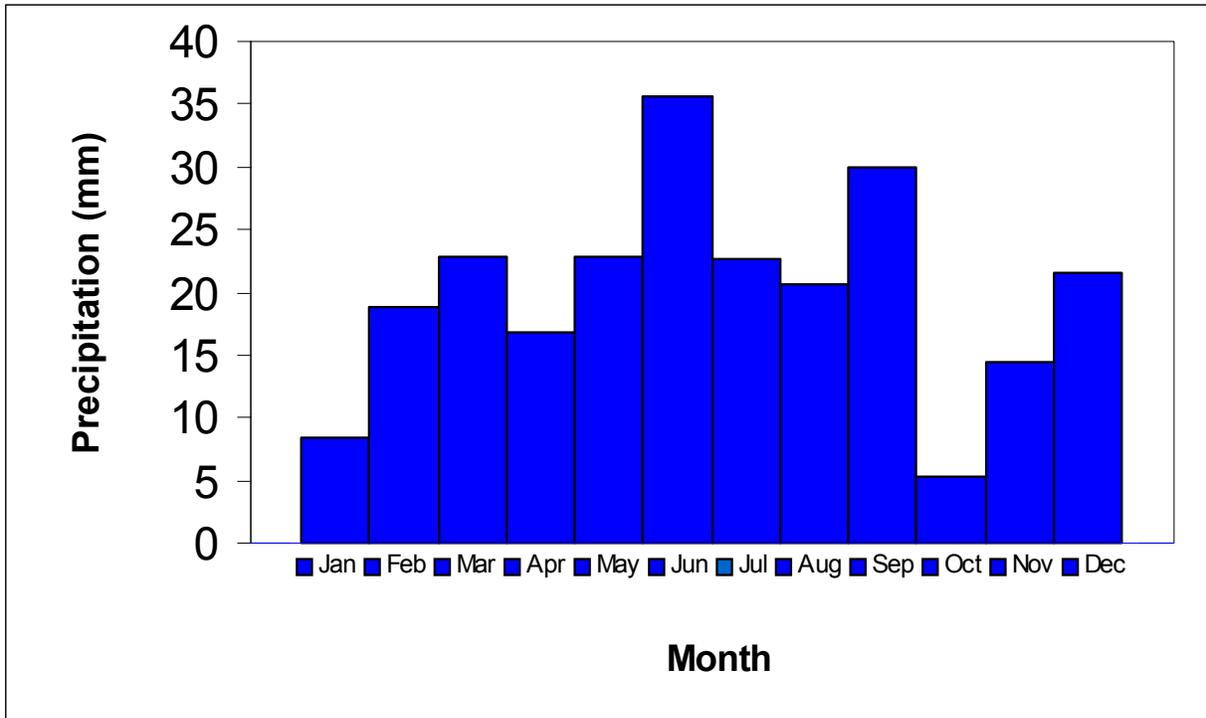


Figure 5.1 - 2001 Precipitation at WIPP

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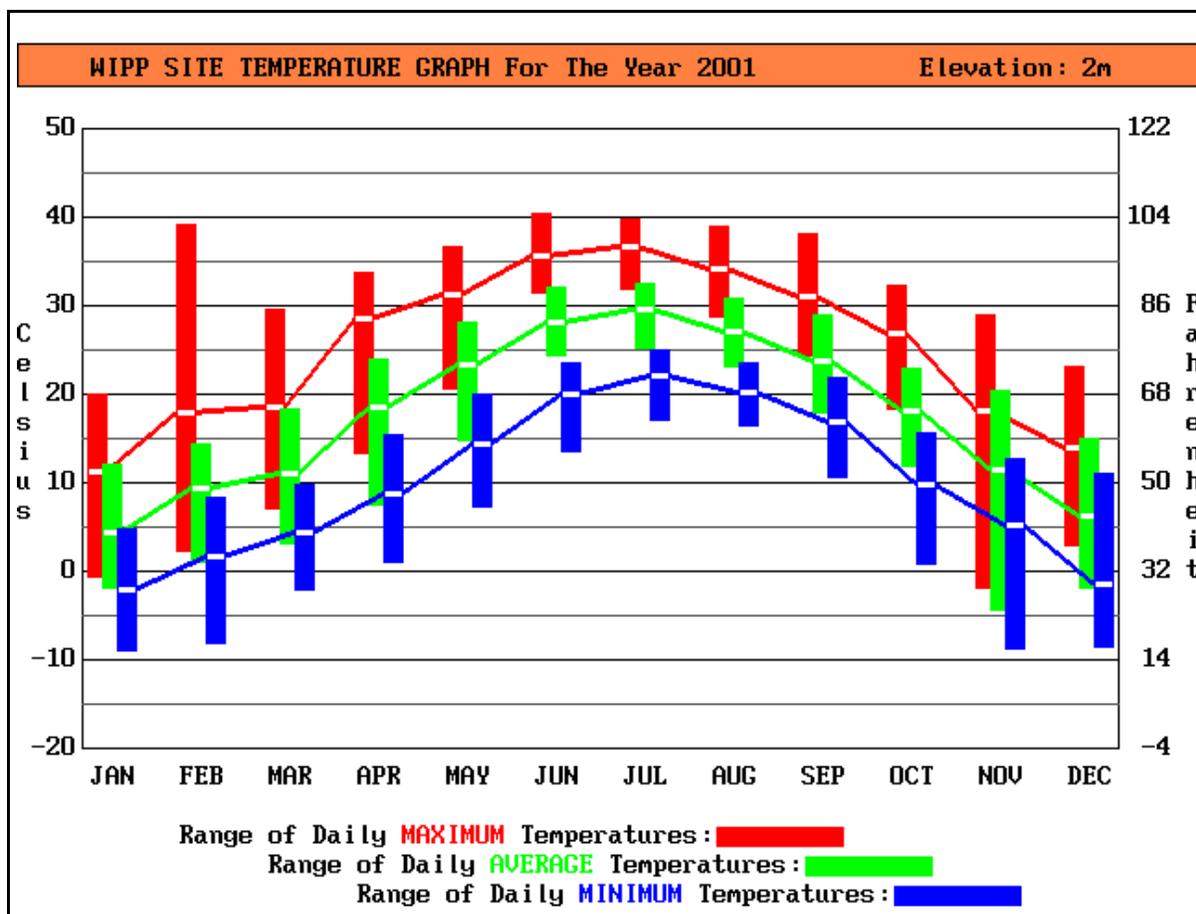


Figure 5.2 - 2001 WIPP Site Temperature at 2-Meter Height

Table 5.1 - A Summary of 2001 Temperature Observations at 2-Meter Height

Month	Max of Daily Highs (°C)	Avg of Daily Highs (°C)	Min of Daily Highs (°C)	Max of Daily Averages (°C)	Avg of Daily Averages (°C)	Min of Daily Averages (°C)	Max of Daily Lows (°C)	Avg of Daily Lows (°C)	Min of Daily Lows (°C)
Jan	19.97	11.24	-0.68	12.15	4.43	-1.96	4.81	-2.08	-8.93
Feb	39.15	17.99	2.34	14.47	9.28	0.95	8.24	1.69	-8.16
Mar	29.51	18.63	7.04	18.30	11.13	3.14	9.87	4.44	-2.06
Apr	33.77	28.50	13.40	23.87	18.63	7.56	15.39	8.83	0.94
May	36.76	31.29	20.56	28.10	23.23	14.84	19.98	14.31	7.22
Jun	40.47	35.58	31.53	32.02	28.14	24.36	23.51	19.98	13.49
Jul	39.85	36.66	31.88	32.47	29.68	25.23	25.09	22.17	17.17
Aug	39.04	34.23	28.66	30.84	27.09	23.15	23.49	20.16	16.56
Sep	38.20	31.08	24.28	28.87	23.74	17.89	21.79	16.84	10.65
Oct	32.20	26.79	18.23	22.86	18.18	11.82	15.67	9.81	0.87
Nov	28.96	18.16	-1.84	20.35	11.49	-4.39	12.81	5.18	-8.69
Dec	23.20	14.00	2.94	15.02	6.17	-1.97	10.95	-1.47	-8.60
Annual	40.47	25.35	-1.84	32.47	17.60	-4.39	25.09	9.99	-8.93

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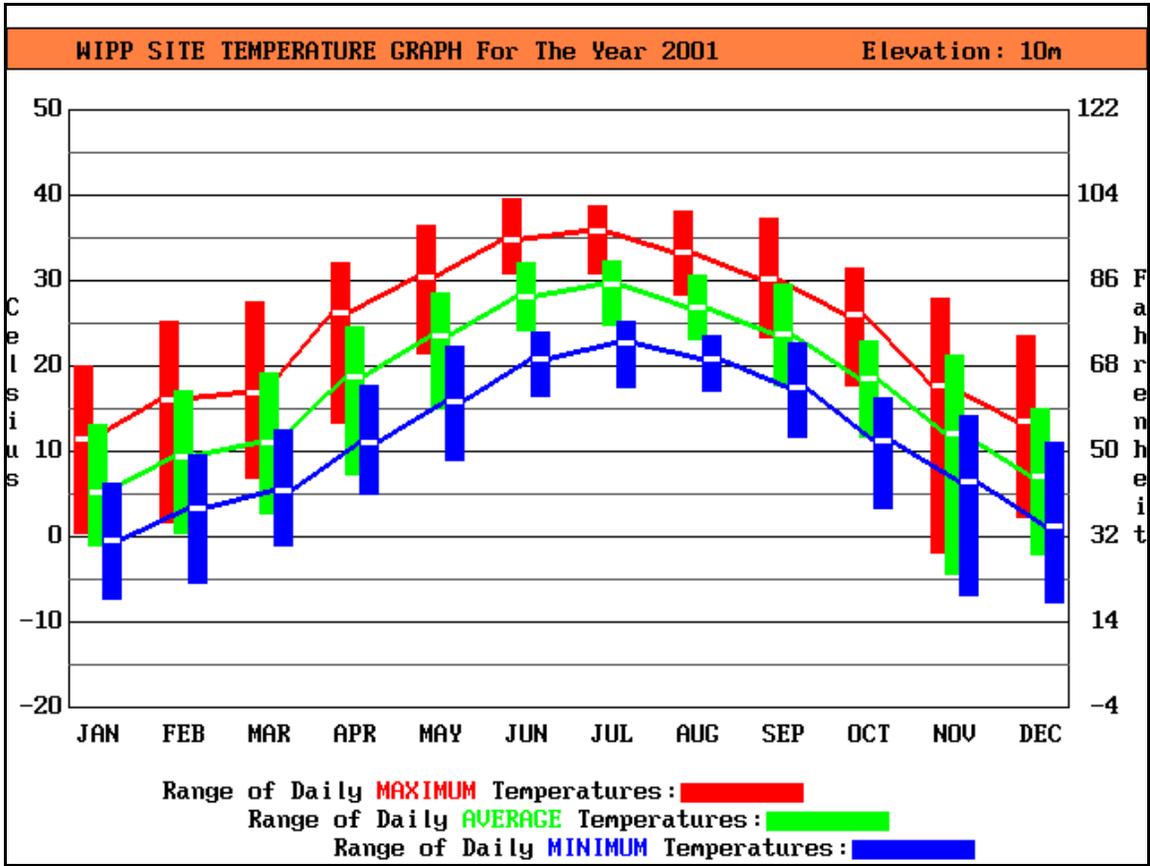


Figure 5.3 - 2001 WIPP Site Temperature at 10-Meter Height

Table 5.2 - A Summary of 2001 Temperature Observations at 10-Meter Height

Month	Max of Daily Highs (°C)	Avg of Daily Highs (°C)	Min of Daily Highs (°C)	Max of Daily Averages (°C)	Avg of Daily Averages (°C)	Min of Daily Averages (°C)	Max of Daily Lows (°C)	Avg of Daily Lows (°C)	Min of Daily Lows (°C)
Jan	20.02	11.43	0.37	13.10	5.20	-1.02	6.28	-3.6	-7.32
Feb	25.19	16.00	1.71	17.11	9.42	0.52	9.51	3.23	-5.42
Mar	27.55	16.88	6.90	19.18	11.01	2.64	12.46	5.47	-1.10
Apr	32.16	26.31	13.27	24.67	18.79	7.26	17.77	10.95	4.99
May	36.41	30.50	21.55	28.60	23.55	14.98	22.23	15.82	9.03
Jun	39.53	34.74	30.75	32.02	28.09	24.26	24.05	20.76	16.38
Jul	38.77	35.80	30.90	32.29	29.54	24.78	25.30	22.81	17.54
Aug	38.14	33.34	28.42	30.53	26.97	23.06	23.62	20.88	17.11
Sep	37.27	30.27	23.40	29.50	23.74	17.81	22.72	17.42	11.62
Oct	31.37	25.98	17.79	22.82	18.51	11.66	16.19	11.26	3.34
Nov	27.89	17.80	-0.92	21.18	12.04	-0.37	14.10	6.45	-6.84
Dec	23.59	13.56	2.21	14.95	7.18	-2.08	10.97	1.23	-7.77
Annual	39.53	24.38	-1.92	32.29	17.84	-4.37	25.30	11.33	-7.77

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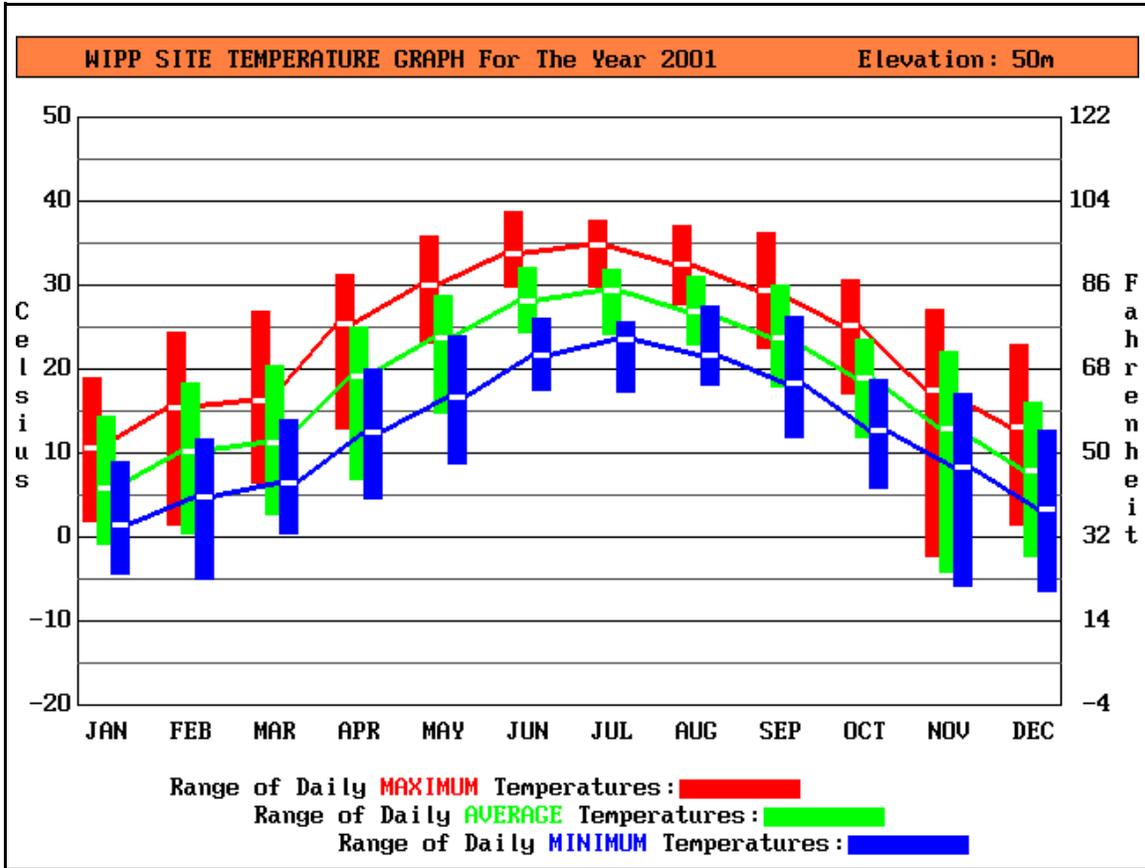


Figure 5.4 - 2001 WIPP Site Temperature at 50-Meter Height

Table 5.3 - A Summary of 2001 Temperature Observations at 50-Meter Height

Month	Max of Daily Highs (°C)	Avg of Daily Highs (°C)	Min of Daily Highs (°C)	Max of Daily Averages (°C)	Avg of Daily Averages (°C)	Min of Daily Averages (°C)	Max of Daily Lows (°C)	Avg of Daily Lows (°C)	Min of Daily Lows (°C)
Jan	19.02	10.60	1.93	14.37	5.82	-0.88	8.89	1.42	-4.45
Feb	24.38	15.43	1.45	18.33	10.12	0.43	11.75	4.76	-4.98
Mar	26.87	16.31	6.50	20.45	11.21	2.61	14.06	6.44	0.42
Apr	31.29	25.51	12.82	24.95	19.12	6.83	19.93	12.57	4.64
May	35.83	29.91	23.20	28.84	23.69	14.79	23.93	16.67	8.68
Jun	38.65	33.79	29.87	32.02	28.03	24.46	26.03	21.64	17.53
Jul	37.70	34.79	29.85	31.93	29.36	24.23	25.67	23.50	17.35
Aug	37.16	32.42	27.79	31.05	26.91	22.87	27.40	21.68	18.04
Sep	36.27	29.42	22.58	30.09	23.82	17.88	26.18	18.37	11.96
Oct	30.63	25.26	17.00	23.53	18.95	11.97	18.82	12.79	5.86
Nov	27.01	17.44	-2.26	22.10	12.91	-4.16	17.00	8.41	-5.73
Dec	22.98	13.13	1.44	16.00	7.99	-2.35	12.79	3.29	-6.43
Annual	38.65	23.67	-2.26	32.02	18.16	-4.16	27.40	12.63	-6.43

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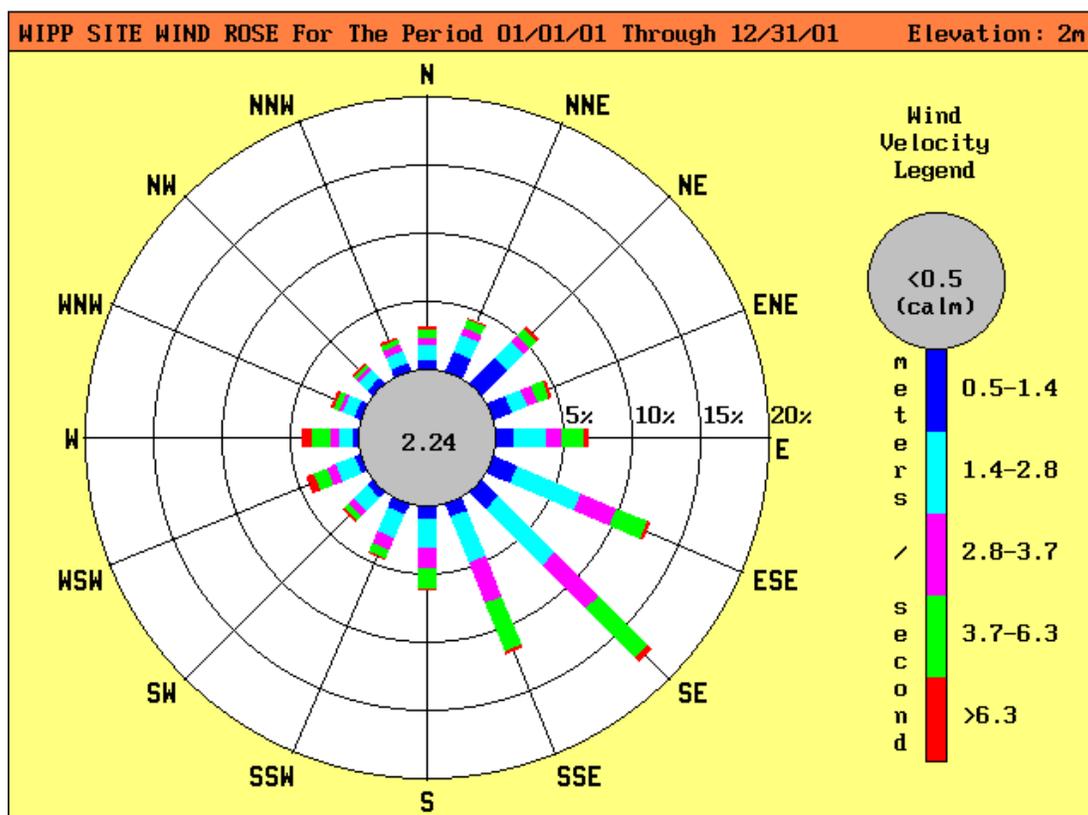


Figure 5.5 - 2001 WIPP Site Wind Rose at 2-Meter Height

Table 5.4 - 2001 Wind Frequencies at 2-Meter Height, Stratified by Direction and Speed (%)

Direction	Wind Speed Range, Meters/Second						Totals
	<0.5	0.5-1.4	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	
N	0.123 ^a	0.679	1.224	0.557	0.722	0.243	3.547
NNE	0.171	1.590	1.404	0.517	0.779	0.103	4.563
NE	0.217	2.506	1.784	0.659	0.811	0.228	6.204
ENE	0.268	1.393	1.370	0.759	0.962	0.168	4.920
E	0.297	1.310	2.392	1.233	1.681	0.288	7.200
ESE	0.265	1.809	5.186	2.780	2.551	0.223	12.814
SE	0.231	1.652	5.965	4.566	5.126	0.251	17.791
SSE	0.166	1.082	3.647	3.193	3.981	0.245	12.314
S	0.091	0.885	2.178	1.530	1.612	0.111	6.407
SSW	0.083	0.788	1.895	1.005	0.674	0.054	4.498
SW	0.057	0.517	1.484	0.591	0.545	0.154	3.348
WSW	0.026	0.494	1.601	0.759	1.110	0.511	4.501
W	0.071	0.491	1.124	0.628	1.416	0.625	4.355
WNW	0.049	0.534	0.933	0.283	0.502	0.160	2.460
NW	0.051	0.531	0.876	0.342	0.371	0.051	2.223
NNW	0.071	0.537	1.053	0.531	0.497	0.166	2.854
Total	2.237	16.795	34.115	19.932	23.339	3.582	100.000

^a Percentage of time in which wind blew from this direction at this speed

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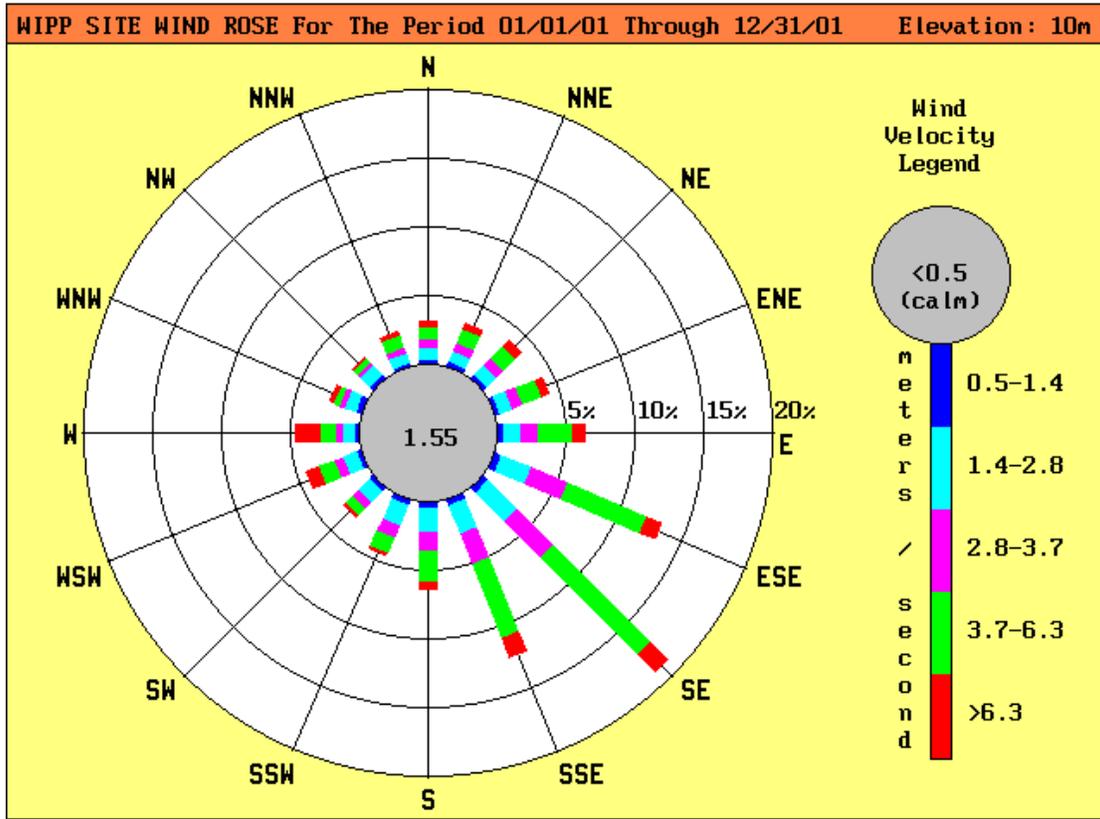


Figure 5.6 - 2001 WIPP Site Wind Rose at 10-Meter Height

Table 5.5 - 2001 Wind Frequencies at 10-Meter Height, Stratified by Direction and Speed (%)

Direction	Wind Speed Range, Meters/Second						Totals
	<0.5	0.5-1.4	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	
N	0.037	0.263	0.928	0.645	0.902	0.454	3.228
NNE	0.108	0.342	0.962	0.736	1.150	0.411	3.710
NE	0.108	0.311	1.119	0.773	1.264	0.585	4.161
ENE	0.057	0.365	1.124	0.839	1.564	0.528	4.478
E	0.180	0.425	1.327	1.293	2.566	0.993	6.784
ESE	0.154	0.454	2.417	2.897	6.318	1.236	13.476
SE	0.214	0.491	3.045	3.776	10.017	1.718	19.261
SSE	0.205	0.494	2.266	2.397	5.796	1.581	12.740
S	0.077	0.471	1.818	1.413	2.334	0.594	6.707
SSW	0.054	0.368	1.630	1.005	1.341	0.228	4.626
SW	0.040	0.317	1.247	0.748	0.868	0.294	3.513
WSW	0.063	0.311	1.144	0.722	1.341	0.970	4.552
W	0.051	0.317	0.910	0.531	1.233	1.781	4.823
WNW	0.103	0.408	0.930	0.414	0.591	0.348	2.794
NW	0.071	0.357	1.005	0.340	0.557	0.097	2.426
NNW	0.031	0.237	0.762	0.528	0.905	0.260	2.723
Total	1.555	5.930	22.634	19.055	38.747	12.078	100.000

^a Percentage of time in which wind blew from this direction at this speed

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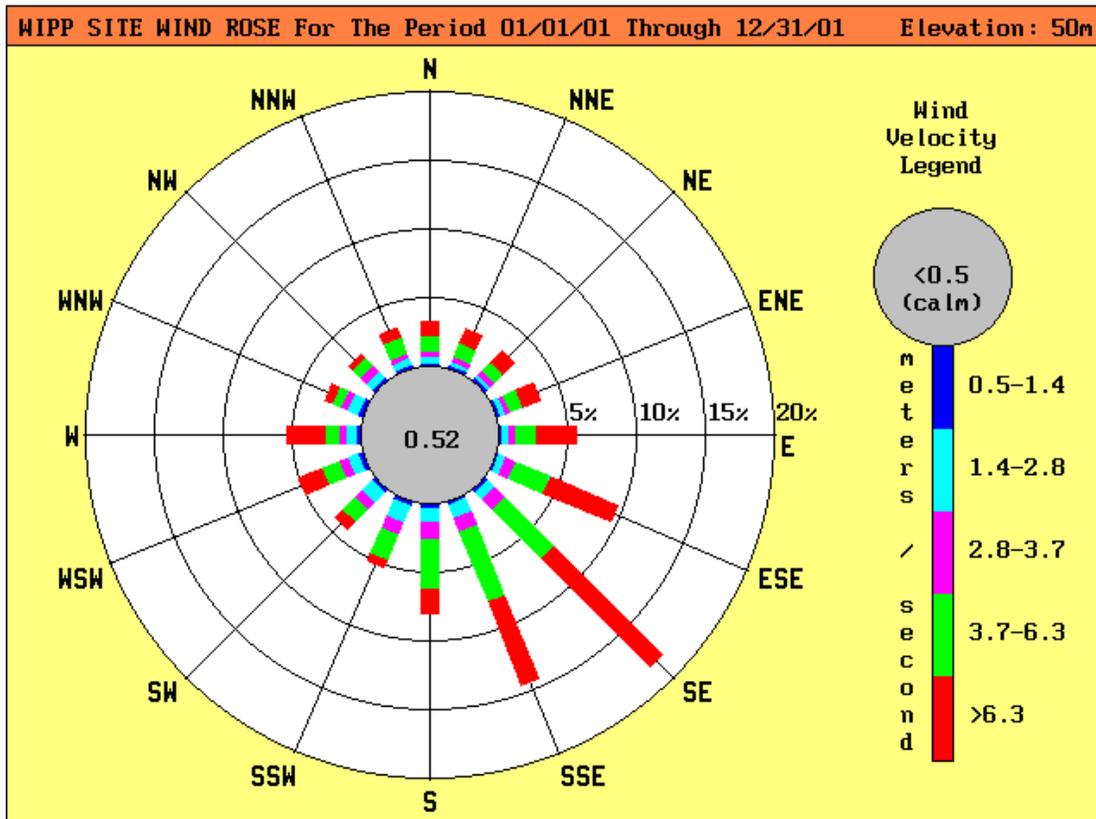


Figure 5.7 - 2001 WIPP Site Wind Rose at 50-Meter Height

Table 5.6 - 2001 Wind Frequencies at 50-Meter Height, Stratified by Direction and Speed (%)

Direction	Wind Speed Range, Meters/Second						Totals
	<0.5	0.5-1.4	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	
N	0.023	0.188	0.554	0.471	1.224	1.025	3.485
NNE	0.014	0.134	0.431	0.422	1.093	1.144	3.239
NE	0.006	0.171	0.442	0.385	0.965	1.273	3.242
ENE	0.026	0.151	0.411	0.328	1.142	1.444	3.502
E	0.014	0.137	0.548	0.568	1.535	2.894	5.696
ESE	0.063	0.103	0.696	0.773	2.837	5.283	9.755
SE	0.111	0.163	0.816	1.053	5.186	11.184	18.513
SSE	0.091	0.191	1.130	1.110	5.562	6.501	14.586
S	0.031	0.263	1.062	1.284	3.627	1.809	8.076
SSW	0.026	0.300	1.318	1.062	2.103	0.585	5.394
SW	0.009	0.254	1.019	0.671	1.473	0.848	4.272
WSW	0.020	0.280	0.890	0.628	1.464	1.835	5.117
W	0.031	0.305	0.848	0.539	1.093	2.768	5.585
WNW	0.023	0.277	0.953	0.545	0.819	0.611	3.228
NW	0.034	0.191	0.865	0.508	0.928	0.445	2.971
NNW	0.003	0.148	0.594	0.468	1.267	0.859	3.339
Total	0.525	3.256	12.577	10.816	32.317	40.508	100.000

^a Percentage of time in which wind blew from this direction at this speed

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Target compounds found in VOC-B represent air found in the underground before the air passes through the panels containing waste. The VOC concentrations measured at this location are the sum of background concentrations entering the mine through the air intake shaft plus additional concentrations contributed by facility operations upstream of the waste panels. Concentrations measured at VOC-A will be equal to those found at VOC-B plus any contributions from the waste panels. Differences measured between the two stations will then represent any VOC contributions from the waste panels. Any concentration differences between the two stations must be less than the concentrations of concern listed in Attachment N of the HWFP (Table 5.7).

Table 5.7 - Concentrations of Concern for Volatile Organic Compounds, from Attachment N of the HWFP (No. NM4890139088)

Compound	Concentration of Concern ppbv^a
1,1,1-Trichloroethane	590
1,1,2,2-Tetrachloroethane	50
1,1-Dichloroethylene	100
1,2-Dichloroethane	45
Carbon tetrachloride	165
Chlorobenzene	220
Chloroform	180
Methylene chloride	1,930
Toluene	190

^a Parts per billion by volume

Sample pair differences are calculated by subtracting the concentration of a compound of interest observed at VOC-B from that measured at VOC-A for the given sampling period (Table 5.8). Negative values indicate ambient air concentrations of a compound (VOC-B) were greater than concentrations in the air passing out of the panel (VOC-A). Negative values could be caused by emissions from normal mining activities near VOC-B which quickly dispersed in the mine ventilation flow and were not detected at VOC-A. The annual averages shown in Table 5.8 were calculated by averaging all sample pair differences from January 1, 2001, to December 31, 2001. Samples in which a compound of interest was non-detectable (less than the 0.5 parts per billion by volume [ppbv] minimum detection limit [MDL]) were assigned a value of zero for the purposes of computing this average.

During 2001, four of the nine target compounds (1,2-dichloroethane, chloroform, methylene chloride, and toluene) were measured above the 0.5 ppbv MDL. For each of the detected target compounds, the annual average was less than 0.5 percent of the respective concentration of concern listed in Table 5.7 and were, therefore, at insignificant levels with respect to human health and the environment.

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Positive sample pair differences for methylene chloride were found in 16 of 103 sample pairs. The 2001 annual average sample pair difference for methylene chloride was 0.0 ppbv, with a minimum difference value of -2.76 ppbv and a maximum value of 5.23 ppbv. Methylene chloride, a common laboratory contaminant, can also be found in paint remover, aerosol propellant, degreasing and metal cleaning agents, and adhesives.

Positive sample pair differences for toluene were found in 31 of the 103 sample pairs. The overall 2001 average for toluene sample pair differences was 0.97 ppbv, with a minimum difference value of -1.45 and a maximum difference value of 75.16 ppbv. Possible sources of toluene contamination could be products of incomplete combustion of diesel fuel, cleaning solvents, or paint. The maximum toluene concentration measured in 2001 occurred on August 14. On that day, Underground Operations was painting some equipment located in Panel II, Room 7, using a paint with a very high toluene concentration. The painting location is upstream in the ventilation air flow from VOC Sampling Station A.

One negative sample pair difference for 1,2-dichloroethane was found out of 103 sample pairs in 2001. The overall 2001 average for 1,2-dichloroethane sample differences was 0.00 ppbv, with a minimum difference of -0.78 and a maximum difference value of 0.00 ppbv. This compound has not been detected previously. The 1,2-dichloroethane can be found as a tar and grease remover in cleaning and degreasing operations and is used in paint and varnish removers.

One positive sample pair difference was observed for chloroform in 2001. The overall 2001 average sample difference for this compound was 0.00 ppbv, with a minimum difference of 0.00 ppbv, and a maximum difference of 0.94 ppbv. Chloroform was not detected in 2000. This compound can be found in electronics and metals cleaning solvent solutions and insecticides.

The routine laboratory reporting limit was 5.0 ppbv for 1,1,1-trichloroethane, 1,1-dichloroethylene, methylene chloride, and toluene and 2.0 ppbv for 1,1,2,2-tetrachloroethane, 1,2-dichloroethane, carbon tetrachloride, chlorobenzene, and chloroform. For dilution factors greater than one, the 5.0 ppbv and 2.0 ppbv values are multiplied by the dilution factor to calculate the laboratory reporting limits for the diluted sample.

The MDL is defined as the minimum concentration of a substance that can be measured and reported with a 99 percent confidence to be greater than zero. Values were estimated for constituents detected at concentrations less than the laboratory reporting limits but above the 0.5 ppbv MDL.

Volatile organic compound sampling reported in this section was performed using guidance included in Compendium Method TO-14A, *Determination of Volatile Organic Compounds (Volatile organic compounds) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis By Gas Chromatography* (EPA 1997). The samples were analyzed using gas chromatography/mass spectrometry under an

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established QA/QC program. Laboratory analytical procedures were developed based on the concepts contained in both TO-14A and the draft *EPA Contract Laboratory Program Volatile Organics Analysis of Ambient Air in Canisters* (EPA 1994). The results of year 2001 VOC monitoring did not indicate a noticeable increase in VOCs in air downstream of Panel I. The only measurement of significance occurred on August 14 for toluene, the same day that a high toluene spray paint was being used in the underground. Thus, waste stored at WIPP did not release significant amounts of VOCs.

Table 5.8 - Volatile Organic Compound Sample Pair Differences Measured at WIPP in 2001

Compound	No. of Sample Pairs (A and B)	2001 Annual Average of Sample Pair Differences (ppbv ^a)	Minimum of Sample Pair Differences (ppbv ^a)	Maximum of Sample Pair Differences (ppbv ^a)
1,1,1-Trichloroethane	103	0	0	0
1,1,2,2-Tetrachloroethane	103	0	0	0
1,1-Dichloroethylene	103	0	0	0
1,2-Dichloroethane	103	0	-0.78	0
Carbon Tetrachloride	103	0	0	0
Chlorobenzene	103	0	0	0
Chloroform	103	0	0	0.94
Methylene Chloride	103	0	-2.76	5.23
Toluene	103	0.97	-1.45	75.16

^a Parts per billion by volume

5.5 Seismic Activity

WIPP is located about 60 miles east of the western margin of the Permian Basin. The geologic structure and tectonic pattern of the Permian Basin are chiefly the result of large-scale subsidence and uplift during the Paleozoic era. The broad basin is divided into a series of sub-basins which passed through their last stage of significant subsidence during the Late Permian age. The Delaware sub-basin occupies the southwestern portion of the Permian Basin and hosts the WIPP site. It is bordered by the Roosevelt Uplift to the north, the Marathon Thrust Belt to the south, the Central (Permian) Basin Platform to the east, and the Sierra Diablo Platform and Guadalupe and Sacramento Mountains to the west. The Delaware Basin contains a thick sequence of evaporite layers.

All major tectonic elements of the Delaware Basin were essentially formed before deposition of the Permian evaporites, and the region has been relatively stable since then. Deep-seated faults are rare, except along the western and eastern basin margins, and there is no evidence of young, deep-seated faults inside the basin.

Researchers suspect that some low-magnitude earthquakes may result from secondary oil recovery (water flooding). Their foci are about as deep as the bottom of relatively shallow hydrocarbon wells.

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Significant recent seismic events near WIPP on January 2, 1992, and April 14, 1995, had magnitudes of 5.0 and 5.3 respectively. The January 2, 1992, Rattlesnake Canyon earthquake had an epicenter 60 km (36 mi) east-southeast of the WIPP site, while an April 14, 1995, event's epicenter was located about 240 km (144 mi) southwest of WIPP, near Alpine, Texas. Neither earthquake had any effect on WIPP structures, as documented by post-event inspections by WIPP staff and the NMED. The magnitudes of both events were within the parameters used to develop the seismic risk assessment of the WIPP structures.

Seismic information for the WIPP region before 1962 was derived from chronicles of the effects of those tremors on people, structures, and surface features. Seismicity in New Mexico reported prior to 1962 was mostly limited to the corridor between Albuquerque and Socorro, part of a structure known as the Rio Grande Rift. Since 1962, most seismic information has been based on instrumental data recorded at various seismograph stations.

Currently, seismicity within 300 km (186 mi) of the WIPP site is being monitored by the New Mexico Institute of Mining and Technology (NMIMT), in Socorro, New Mexico, using data from a seven-station network approximately centered on the site (Figure 5.8). Station signals are transmitted to the NMIMT Seismological Observatory in Socorro. When appropriate, readings from the WIPP network stations are combined with readings from an additional NMIMT network in the central Rio Grande Rift. Occasionally, data are also exchanged with the University of Texas at El Paso and Texas Tech University in Lubbock, both of which operate stations in west Texas.

The mean operational efficiency of the WIPP seismic monitoring stations during 2001 was approximately 96.2 percent. From January 1 through December 31, 2001, locations for 129 seismic events were recorded within 300 km (186 mi) of WIPP. These data included origin times, epicenter coordinates, and magnitudes. The strongest recorded event (magnitude 3.1) occurred on June 2 and was located approximately 65 km (40 mi) east of the site. The event closest to the site occurred on September 21, and was probably an aftershock of the June 2 event. This event had a magnitude of 1.6 and was located about 61 km (38 mi) east of the site. These events had no effect on WIPP structures.

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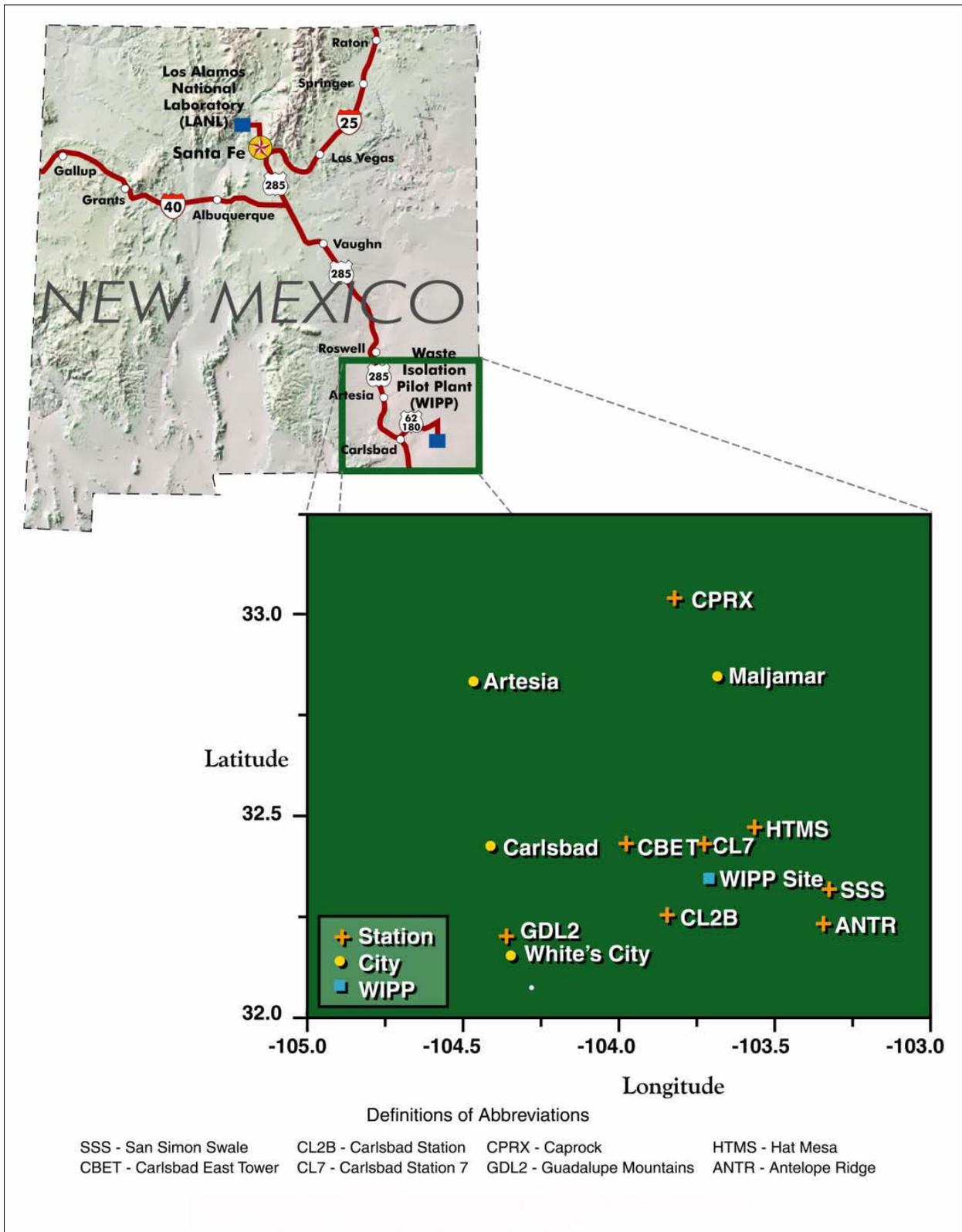


Figure 5.8 - WIPP Seismograph Station Locations

5.6 Liquid Effluent Monitoring

The WIPP sewage lagoon system is a zero-discharge facility consisting of two primary settling lagoons, two polishing lagoons, a chlorination system, and three evaporation basins. The entire facility is lined with 30-mil synthetic liners and is designed to dispose of domestic sewage as well as site-generated brine waters from observation well pumping and underground dewatering activities at the site.

The WIPP sewage facility is operated under Discharge Permit No. 831 (DP-831), issued by the state of New Mexico in accordance with the Clean Water Act, and is managed in accordance with EPA sewage sludge regulations (40 CFR Part 503), New Mexico Water Quality Control Regulations (20.6.2.3 NMAC), and applicable WIPP controlled procedures. These requirements provide the framework for disposal of domestic sewage, site-generated brine waters, and non-hazardous waste waters.

DP-831 allows for the disposal of 7,570 l (2,000 gal) per day of nonhazardous brines to H-19 pond. Nonhazardous brines are discharged only to Evaporation Pond B of the Sewage Lagoon System. The DOE submits quarterly discharge monitoring reports to NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan. Because effluent is not discharged from the facility, no effluent limits were established in DP-831. The NMED Groundwater Protection and Remediation Bureau established a list of analytes to be sampled on a quarterly basis as indicators of sewage system performance.

CHAPTER 6 - GROUNDWATER MONITORING

Current groundwater monitoring activities at WIPP are outlined in the WIPP Groundwater Monitoring Program Plan (WP 02-1). This is a QA document containing program plans for each activity performed by groundwater monitoring personnel. In addition, WIPP has detailed procedures for performing specific activities, such as pumping system installations, field parameter analyses and documentation, and QA records management. Groundwater monitoring activities are also defined in the EMP.

The objectives of the Groundwater Monitoring Program are to:

- Determine the physical and chemical characteristics of groundwater;
- Maintain surveillance of groundwater levels surrounding the WIPP facility, both before and throughout the operational lifetime of the facility;
- Document and identify effects, if any, of WIPP operations on groundwater parameters; and
- Fulfill the requirements of the RCRA Operating Permit, the EPA Compliance Certification Application (CCA) and DOE Order 5400.1.

The data obtained by the WIPP Groundwater Monitoring Program supported two major programs at WIPP: (1) the RCRA Detection Monitoring Program supporting the RCRA Part B Permit in compliance with 40 CFR Part 264 and 20.4.1 NMAC, and (2) performance assessment supporting the Compliance Certification (DOE/CAO 96-2184) in compliance with 40 CFR Part 191 and 40 CFR Part 194. Each of these programs requires a unique set of analyses and data. Particular sample needs are defined by each program.

Background data were collected from 1995 through 1997 and reported in the Waste Isolation Pilot Plant RCRA Background Groundwater Quality Baseline Report (DOE/WIPP 98-2285). The Background data were expanded in 2000 to include ten rounds of sampling instead of five. The data were published in Addendum 1 Waste Isolation Pilot Plant RCRA Background Groundwater Quality Baseline Update Report. These background data will be compared to water quality data collected throughout the operational life of the facility.

Groundwater monitoring activities during 2001 included groundwater quality sampling and groundwater level surveillance. Groundwater quality data were gathered from six wells completed in the Culebra Member of the Rustler Formation (wells WQSP-1 through WQSP-6) and one well completed in the Dewey Lake Formation (well WQSP-6A; Figure 6.1). Groundwater surface elevation data were gathered from 70 well bores, five of which were equipped with production-inflated packers to allow groundwater level surveillance of more than one producing zone through the same well bore (Figure 6.2).

6.1 Groundwater Quality Sampling

The RCRA Permit Module V requires groundwater quality sampling twice a year, from March through May (Round 12 for 2001) and, again, from September through November (Round 13 for 2001). Sampling for groundwater quality was performed at seven well sites during 2001 (Figure 6.1). Field analysis for Eh (Intensity Factor: an indicator of oxidation or reduction of chemical species), specific gravity, specific conductance, acidity or alkalinity, chloride, divalent cations, and total iron were performed periodically during the sampling.

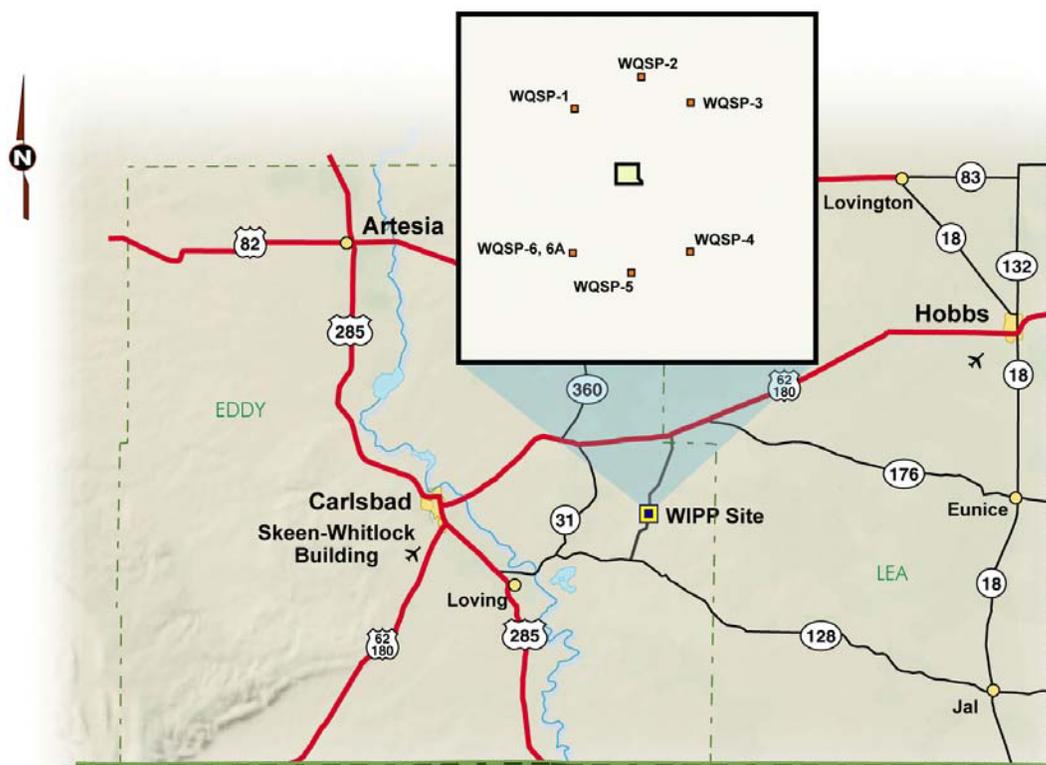


Figure 6.1 - Water Quality Sampling Program Wells

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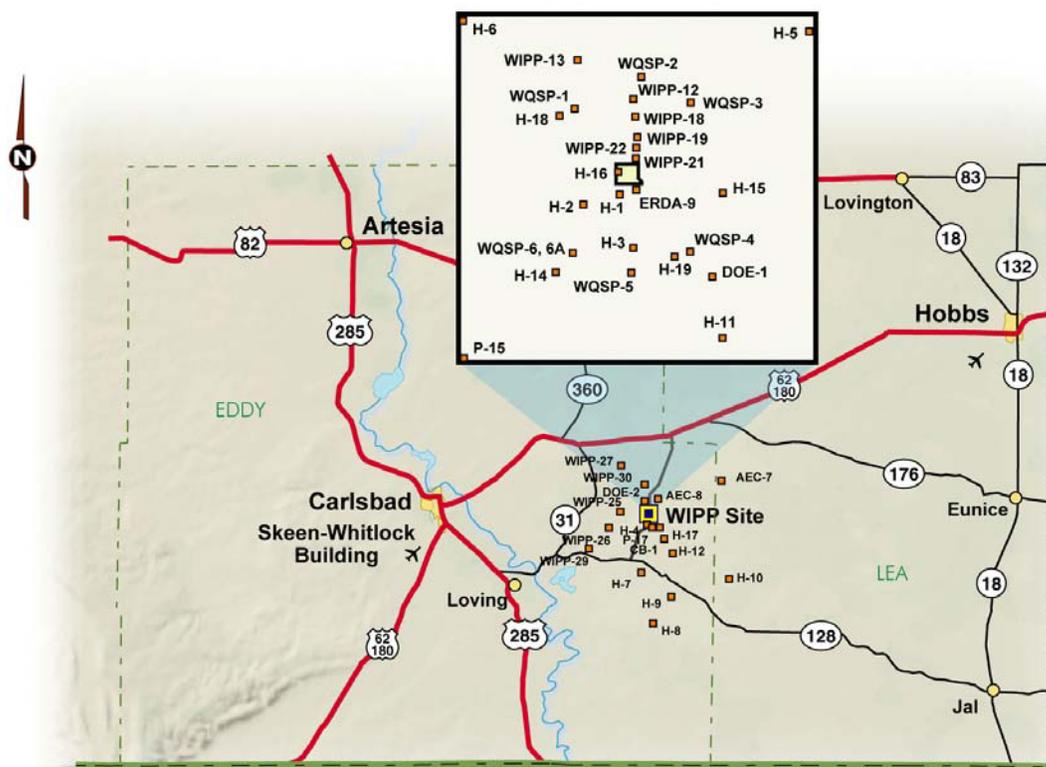


Figure 6.2 - Groundwater Level Surveillance Wells

Table 6.1 lists the analytical parameters included in the year 2001 groundwater sampling program.

During 2001, groundwater surveillance activities removed approximately 77,166 l (20,385 gal) of water from the Culebra member of the Rustler Formation and 18,571 l (4,906 gal) from the Dewey Lake Formation. The quality of the Culebra water sampled near WIPP is naturally poor and not suitable for human consumption or for agricultural purposes. Historically TDS concentrations measured in the Culebra ranged from 17,000 to over 280,000 mg/l. The groundwater of the Culebra is considered to be Class III water by EPA guidelines.

Water quality measurements performed in the Dewey Lake Formation indicate the waters are considerably better quality than the Culebra water. The TDS values were below 10,000 mg/l. The water is suitable for livestock consumption, and classified as Class II water according to EPA guidance. Saturation of the Dewey Lake Formation in the area of WIPP is discontinuous. No hydrologic connection has been established that would indicate WIPP activities would have a potential impact on the Dewey Lake Formation.

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Because of the highly variable transmissivity and TDS values within the Culebra, baseline groundwater quality was defined for each individual well. Tables 6.2 through 6.8 summarize the results of analyses for each parameter or constituent for the two sampling sessions in 2001 (rounds 12 and 13).

In these tables, either the 95th upper tolerance limit value (UTLV) or the 95th percentile value is presented depending on the type of distribution exhibited by the parameter. Both values represent the value beneath which 95 percent of the values in a population are expected to occur. The UTLVs were calculated for data that exhibited a normal or a lognormal distribution. The 95th percentile was determined for data that were considered nonparametric; having neither a normal nor a lognormal distribution. Due to the large number of nondetectable concentrations of organic compounds, the limits for organic compounds were considered nonparametric and based on the method detection limit reported by the laboratory. These values have been recomputed after baseline sampling was completed in 2000, and were used for sampling rounds 12 and 13 to evaluate potential contamination of the groundwater wells.

As stated above, TDS, measured as filterable residue, of the Culebra Member in the WIPP area ranged from 17,000 to over 280,000 mg/l. High TDS samples require dilution prior to analysis. The dilution factors have varied between sampling rounds and wells. Historically, three different contract laboratories have been employing EPA methods to perform the groundwater chemistry analyses. Due to the variability in dilution factors and sensitivity of instruments, the concentrations and method detection limits from different laboratories were also different.

The analytical results for detectable constituents are plotted as Time Trend Plots compared to the baseline established prior to 2000 (Appendix F, Figures F.1 through F.126).

In a few isolated cases, reported concentrations of some parameters, such as potassium, magnesium, and lithium, slightly exceeded the calculated 95th percentile or the 95th UTLV. Such exceedences do not indicate the presence of contamination. The 95th UTLV or percentile is a value representing where 5 percent of the concentration in the population will be greater than the UTLV or percentile. WIPP groundwater in the Culebra Dolomite Member of the Rustler Formation has very high concentrations of dissolved solids. The contract analytical laboratory has had some difficulty performing the analyses for some of the cations found in the highly concentrated brines.

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Table 6.1- Analytical Parameters for Which Groundwater Was Analyzed

CAS No. ^a	Parameter	EPA Method Number	CAS No.	Parameter	EPA Method Number
71-55-6	1,1,1-Trichloroethane	8260B	7727-37-9	Nitrate (as N)	300.0
79-34-5	1,1,2,2-Tetrachloroethane	8260B		Orthophosphate (as P)	365.2
79-00-5	1,1,2-Trichloroethane	8260B		pH	150.1
75-34-3	1,1-Dichloroethane	8260B		Specific conductance	120.1
75-35-4	1,1-Dichloroethylene	8260B		Sulfate	300.0
107-06-2	1,2-Dichloroethane	8260B		Total dissolved solids (TDS)	160.1
56-23-5	Carbon tetrachloride	8260B		Total organic carbon (TOC)	415.1
108-90-7	Chlorobenzene	8260B		Total organic halogen (TOH)	9020B
67-66-3	Chloroform	8260B		Total phenols	420.1
540-59-0	<i>cis</i> -1,2-Dichloroethylene	8260B		Total suspended solids (TSS)	160.2
78-93-3	Methyl ethyl ketone	8260B			
75-09-2	Methylene chloride	8260B			
127-18-4	Tetrachloroethylene	8260B	7440-36-0	Antimony	6010B
108-88-3	Toluene	8260B	7440-38-2	Arsenic	6010B
79-01-6	Trichloroethylene	8260B	7440-39-3	Barium	6010B
75-69-4	Trichlorofluoromethane	8260B	7440-41-7	Beryllium	6010B
75-01-4	Vinyl chloride	8260B	7440-42-8	Boron	6010B
1330-20-7	Xylene	8260B	7440-43-9	Cadmium	6010B
95-50-1	1,2-Dichlorobenzene	8270C	7440-70-2	Calcium	6010B
106-46-7	1,4-Dichlorobenzene	8270C	7440-47-3	Chromium	6010B
51-28-5	2,4-Dinitrophenol	8270C	7440-48-4	Cobalt	6010B
121-14-2	2,4-Dinitrotoluene	8270C	7440-50-8	Copper	6010B
95-48-7	2-Methylphenol	8270C	7439-89-6	Iron	6010B
108-39-4/ 106-44-5	3-Methylphenol/ 4-Methylphenol	8270C	7439-92-1	Lead	6010B
			7439-93-2	Lithium	6010B
118-74-1	Hexachlorobenzene	8270C	7439-95-4	Magnesium	6010B
67-72-1	Hexachloroethane	8270C	7439-97-6	Mercury	7470A
98-95-3	Nitrobenzene	8270C	7440-02-0	Nickel	6010B
87-86-5	Pentachlorophenol	8270C	7440-09-7	Potassium	6010B
110-86-1	Pyridine	8270C	7782-49-2	Selenium	6010B
78-83-1	Isobutanol	8015B	7631-86-9	Silica	6010B
	Alkalinity	310.1	7440-22-4	Silver	6010B
7726-95-6	Bromide	300.0	7440-23-5	Sodium	6010B
7782-50-5	Chloride	300.0	7440-28-0	Thallium	6010B
	Density ^b		7440-31-5	Tin	6010B
	Fluoride	300.0	7440-62-2	Vanadium	6010B
	Iodide	345.1	7440-66-6	Zinc	6010B

^a Chemical Abstract Service Registry Number

^b Analysis method was ASTM (American Society for Testing and Materials) D854-92

6.2 Groundwater Level Surveillance

Groundwater surface elevations in the vicinity of WIPP may be influenced by site activities, such as pumping tests for site characterization, water quality sampling, or shaft sealing. Other influences on groundwater surface elevations may be caused by natural groundwater level fluctuations and industrial influences from agriculture, mining, and resource exploration.

In October 1988, WIPP was tasked with conducting a Groundwater Level Surveillance Program. Seventy well bores were used to perform surveillance of seven water-bearing zones in the WIPP area (Figure 6.2). The two zones of primary interest were the Culebra and Magenta members of the Rustler Formation (see Figure 1.1). Fifty-eight measurements were taken in the Culebra and ten in the Magenta. Three measurements were taken in the Dewey Lake Formation. One measurement each was taken in the Bell Canyon formation, Forty-niner, Rustler/Salado contact and an unnamed lower member of the Rustler formation. In 2001, groundwater level measurements were taken monthly in at least one accessible well bore at each well site for each available formation. Redundant well bores at each well site were measured on a quarterly basis.

Five well bores (WIPP-30 Culebra/Magenta, H-01 Culebra/Magenta, H-03d Dewey Lake/Forty-niner, Cabin Baby Culebra/Bell Canyon, and WIPP-25 Culebra/Magenta) were completed at multiple depths. By using packers, these well bores may be monitored in more than one formation.

Groundwater elevation measurements in the Culebra member indicated the generalized directional flow of groundwater was north to south in the vicinity of WIPP (Figure 6.3). Regional groundwater levels taken in Culebra observation wells with four or more data points for the year showed rising trends in water levels in 43 wells and falling trends in eight wells.

Total fluctuations of more than 0.6 m (2 ft) in groundwater levels occurred in nine wells completed to the Culebra. Two wells with fluctuations of more than 0.6 m (2 ft) (WQSP-3 and WQSP-6) may have been influenced by groundwater sampling activities. One well (H-9b) experienced water-level fluctuations due to maintenance activities. Two wells (ERDA-9 and WIPP-21) may have been influenced by plant activities, each of these wells is located in close proximity to the site property protection fence. C-2737 is a newly completed well. Fluctuations in C-2737 were caused by development activities. Two wells (WIPP-25 and WIPP-30) are recovering to previous water levels established prior to maintenance activities in August and September of 2000. One well with fluctuations more than 0.6 m (2 ft) (WIPP-27) is unexplained; however, WIPP-27 is located near local potash mining institutions and may be influenced by mining activities.

Groundwater level data were transmitted on a monthly basis to the NMED, EEG, Sandia National Laboratories, the Carlsbad Field Office Technical Assistance Contractor, and technical subcontractors as requested by the CBFO. A copy of the data was placed in the operating record for inspection by authorized agencies.

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Calculated Culebra flow rates across the Land Withdrawal Area range from 2.6×10^{-5} feet per day (ft/d) in the northern section of the eastern third of the Land Withdrawal Area to 1.7×10^{-3} ft/d in the western and central sections of the WIPP site. Calculated flow rates in the southeastern section of the WIPP site was 1.1×10^{-3} ft/d (Figure 6.4).

The interpretation of groundwater data collected in 2001 are similar to previous years. To date there is no indication WIPP operations have had a measurable or significant impact on either the elevation or the quality of groundwater underlying WIPP.

Culebra groundwater in the vicinity of WIPP exhibits highly variable TDS concentrations. These variable TDS concentrations are reflected in a commensurate variability in groundwater density. Each year the WIPP conducts a program to measure the density of well-bore fluids in water level monitoring wells. Due to the high concentration of TDS in WIPP groundwater, density must be taken into account to accurately determine relative water levels between wells. Measured water levels are adjusted to equivalent fresh-water head values, considering fluid density differences between measuring points.

For the year 2001, the Pressure-Density Survey measured well-bore fluid density in eighteen wells. The following wells have had Pressure-Density Surveys completed.

WELL NAME	DATE	FORMATION	DENSITY
H-06b	5/16/01	Culebra	1.0371 g/cc
DOE-1	5/18/01	Culebra	1.093 g/cc
H-11b2	5/31/01	Magenta	1.070 g/cc
H-04b	6/4/01	Culebra	1.0154 g/cc
H-03b2	6/4/01	Culebra	1.0334 g/cc
H-19b0	6/5/01	Culebra	1.0620 g/cc
H-11b4	6/11/01	Culebra	1.061 g/cc
H-17	6/11/01	Culebra	1.140 g/cc
H-09b	6/13/01	Culebra	1.000 g/cc
H-14	7/9/01	Magenta	1.0294 g/cc
H-15	7/9/01	Magenta	1.0294 g/cc
H-18	7/11/01	Magenta	1.0294 g/cc
DOE-2	7/11/01	Magenta	1.0553 g/cc
WIPP-18	7/12/01	Magenta	1.0423 g/cc
H-06c	9/26/01	Magenta	1.003 g/cc
H-05b	10/8/01	Culebra	1.0981 g/cc
H-05c	10/8/01	Magenta	1.0045 g/cc
H-03b1	10/9/01	Magenta	1.0051 g/cc

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6.3 Well Maintenance Activities

Maintenance activities were performed on nine wells in CY 2001. Maintenance is performed to prepare wells for future experiments, repair nonfunctioning wells, recomplate wells to monitor additional zones of interest, and plugging and abandonment of wells that were no longer useful.

In 2001, SNL recompleted six Culebra wells (DOE-2, H-11b2, H-15, H-18, WIPP-18, and H-14) as Magenta wells to support the compliance monitoring program for the CCA.

During the month of January well casings were brushed to clean scale off the side of the casing in wells DOE-2, H-11b2, H-15, H-18, WIPP-18, and P-15. P-15 well casing was discovered to have holes in the casing near the surface. As a result, P-15 has been moved to the plugging and abandonment priority list.

In March 2001, the well casing at H-14 was brushed to remove scale from the casing wall. Bridge plugs were set below the Magenta at DOE-2 (736 ft), H-11b2 (663 ft), H-14 (459 ft), H-15 (792 ft), H-18 (613 ft), and WIPP-18 (713 ft). All measurements are to the top of the bridge plug below land surface (BLS).

The well casings at H-7b1 and H-7c were brushed and circulated in an attempt to remove obstructions in the well casings. The operations were successful in H-7b1, however, H-7c remains obstructed, thus preventing groundwater level measurements.

During April 2001, Natural Gamma logs were run on wells DOE-2, H-11b2, H-15, H-18, WIPP-18, and H-14. After the gamma logs were completed each of the wells were jet perforated across the Magenta member of the Rustler formation.

Perforation depths in each of the wells are as follows:

DOE -2	702-728 ft BLS
H-11b2	622-650 ft BLS
H-15	751-780 ft BLS
H-18	575-601 ft BLS
WIPP-18	676-702 ft BLS
H-14	428-455 ft BLS

After perforation was completed one well bore volume was bailed from each well.

Plugging and abandonment activities took place at H-1 in February 2001. After cleaning and logging the well bore, 175 ft of casing were removed from the well bore. The well was then cemented from the bottom of the well to the surface and a monument was placed at the surface in the top of the well bore.

New well construction was completed at C-2737 from February 14 through March 8, 2001. Well C-2737 is located in Southeastern Eddy County Section 29, T22S, R31E, 527 ft from the east section line and 1,513 ft from the north section line. Well C-2737

was drilled to provide hydrological monitoring of the Culebra and Magenta members of the Rustler Formation. Well C-2737 is a replacement for H-1, which was plugged and abandoned as C-2737 was being completed. Well C-2737 was drilled to a total depth of 710 ft BLS. Two screens were placed in the borehole one across the Magenta from 561 to 584 ft BLS and the second across the Culebra from 675 to 698 ft BLS. Full details on the C-2737 well are available in DOE/WIPP 01-3210, Basic Data Report for Drillhole C-2737.

6.4 Shallow Water Monitoring Program

A third program included in this year's Site Environmental Report, is the Shallow Water Monitoring Program formerly titled the Exhaust Shaft Hydraulic Assessment Program. Investigations were conducted in 1996 and 1997 and described in DOE/WIPP 97-2119 and DOE/WIPP 97-2278 establishing a monitoring network for a shallow perched water-bearing horizon located at the base of the Santa Rosa Formation at the Dewey Lake contact (Figure 6.5). Additional background data has been presented in DOE/WIPP 99-2302, 99-3120, 00-2013, 01-3177 and 02-3177.

Groundwater monitoring activities during 2001 included groundwater quality sampling and groundwater level surveillance. Data were gathered from 16 wells and piezometers (Figure 6.6) completed through the Santa Rosa into the upper few feet of the Dewey Lake Formation.

6.4.1 Groundwater Quality Sampling

One round of water-quality samples involving the sampling of fifteen wells/piezometers was collected in year 2001 from the Shallow Water Monitoring Program. During groundwater surveillance activities removed less than twenty gallons per well/piezometer from the Santa Rosa Formation at the Dewey Lake contact. The water-bearing horizon in the Santa Rosa is transient (limited in areal extent). Wells are poor producers with flow rates of less than 2.0 gpm. The quality of the shallow water system sampled near the WIPP is poor and not suitable for human consumption. TDS concentrations measured in the Santa Rosa range from 2,300 mg/l to 134,000 mg/l (Tables 6.2 through 6.8). Three locations have TDS values of less than 10,000 mg/l: C-2507, PZ-10 and C-2811; all other locations have TDS values in excess of 10,000 mg/l.

6.4.2 Shallow Water Level Surveillance

Sixteen wells were used to perform surveillance of the shallow perched water-bearing horizon in the Santa Rosa at the Dewey Lake contact. Water-level measurements were collected monthly. Fluctuations varied by less than 1.5 feet, with only PZ-12 and PZ-10 changing by more than one foot. Changes in the fluid levels appear to be in response decreased precipitation resulting in less recharge to the perched water-bearing horizon through surface runoff.

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Groundwater elevation measurements in the Santa Rosa at the Dewey Lake contact indicate that flow moves radially away from a potentiometric high located near PZ-7 adjacent to the Salt Water Evaporation Pond (Figure 6.7). A potentiometric low is located near PZ-12 between two retention ponds. A second low is PZ-8 located east of the site, which is presently a dry hole. Data from piezometer C-2811 located approximately 2,500 feet south of the site is not included in the contour plots because of a lack of sufficient data characterize the hydrology to the south. Projected work in year 2003 is intended to investigate the conditions to the south of the site.

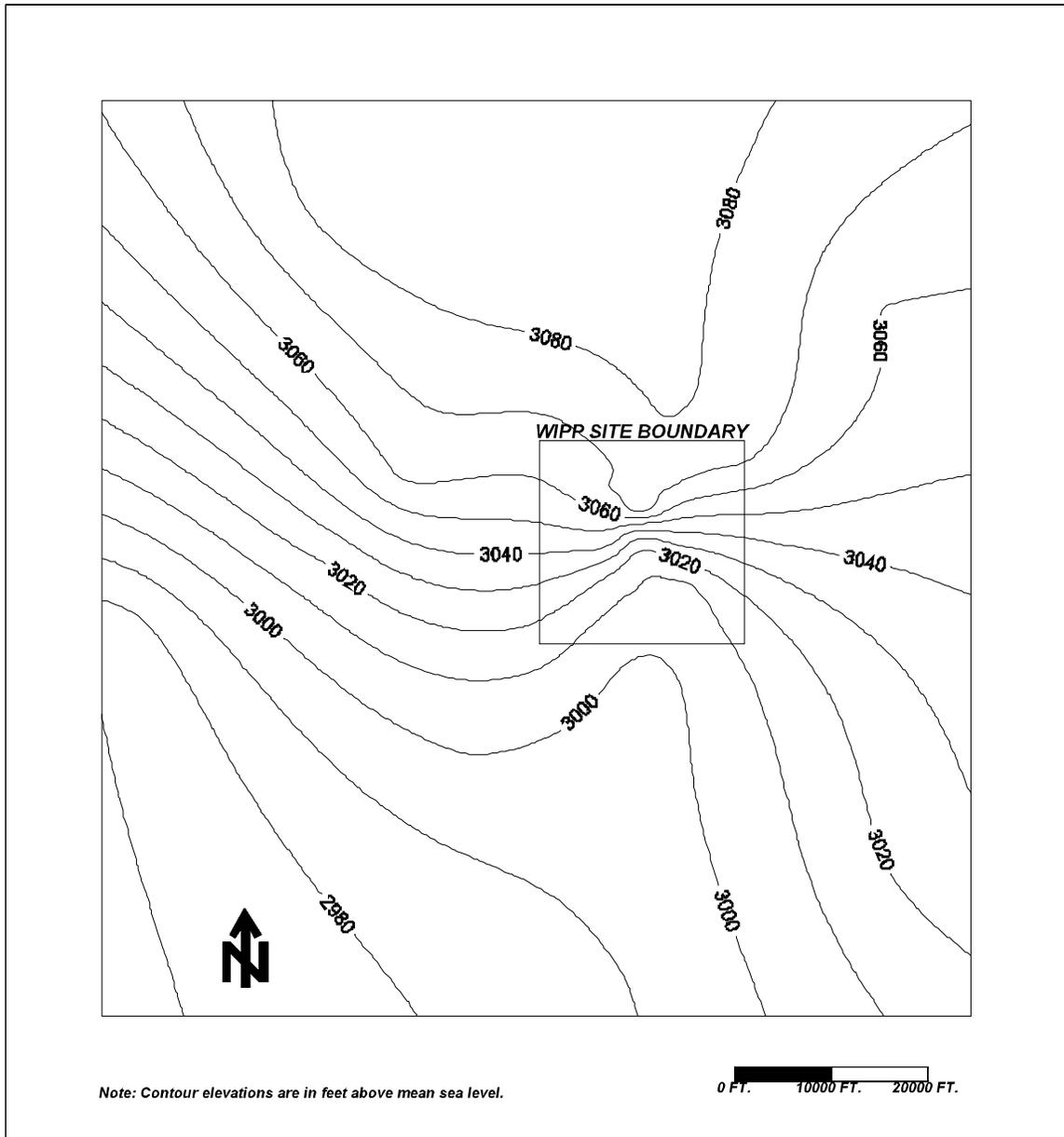


Figure 6.3 - Potentiometric Surface, Adjusted to Equivalent Freshwater Head, of the Culebra Dolomite Member of the Rustler Formation near the WIPP Site, December, 2001

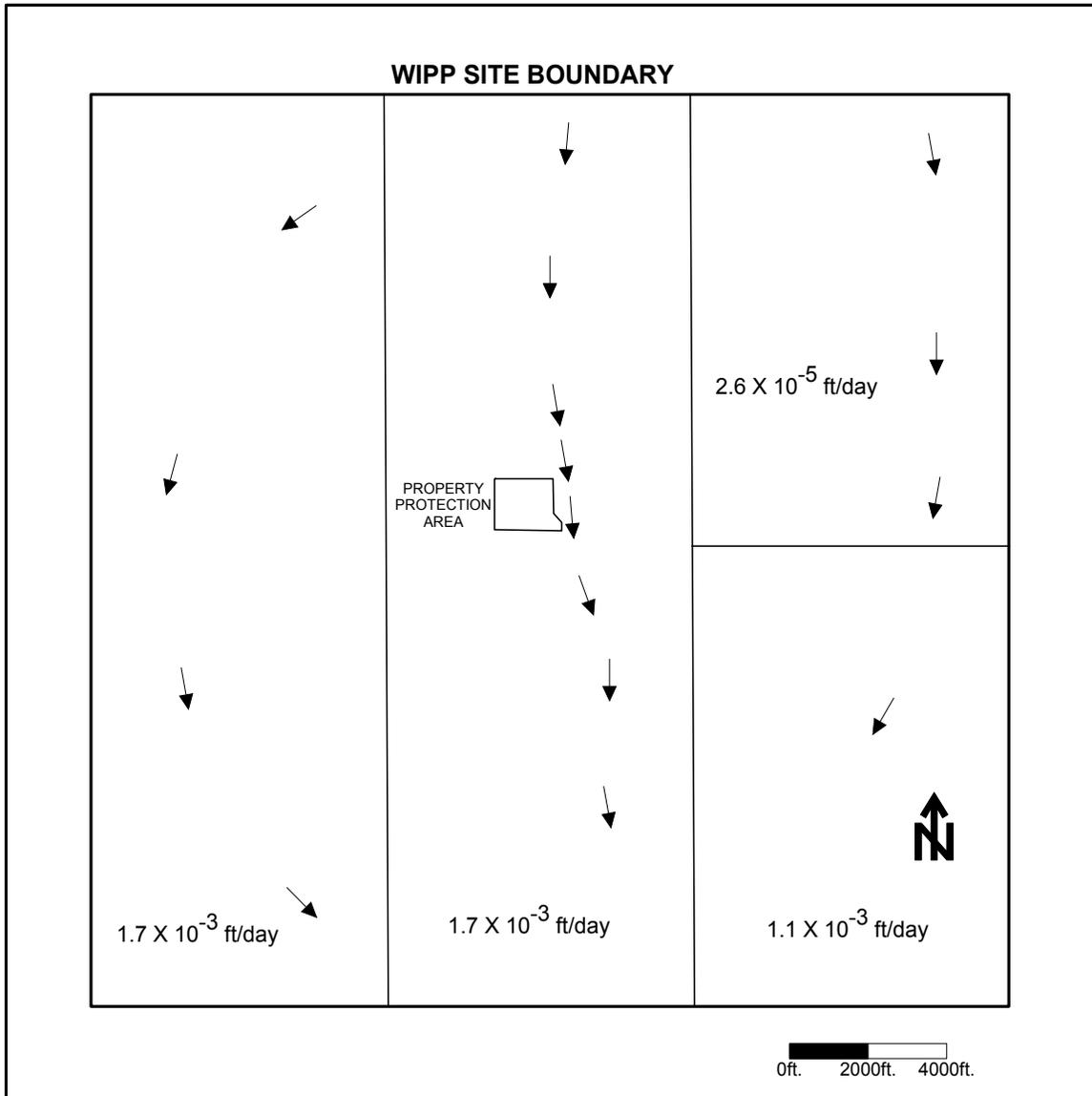


Figure 6.4 - Flow Rate and Direction of Groundwater Flowing Across the WIPP Site from the Culobra Formation, December 2001

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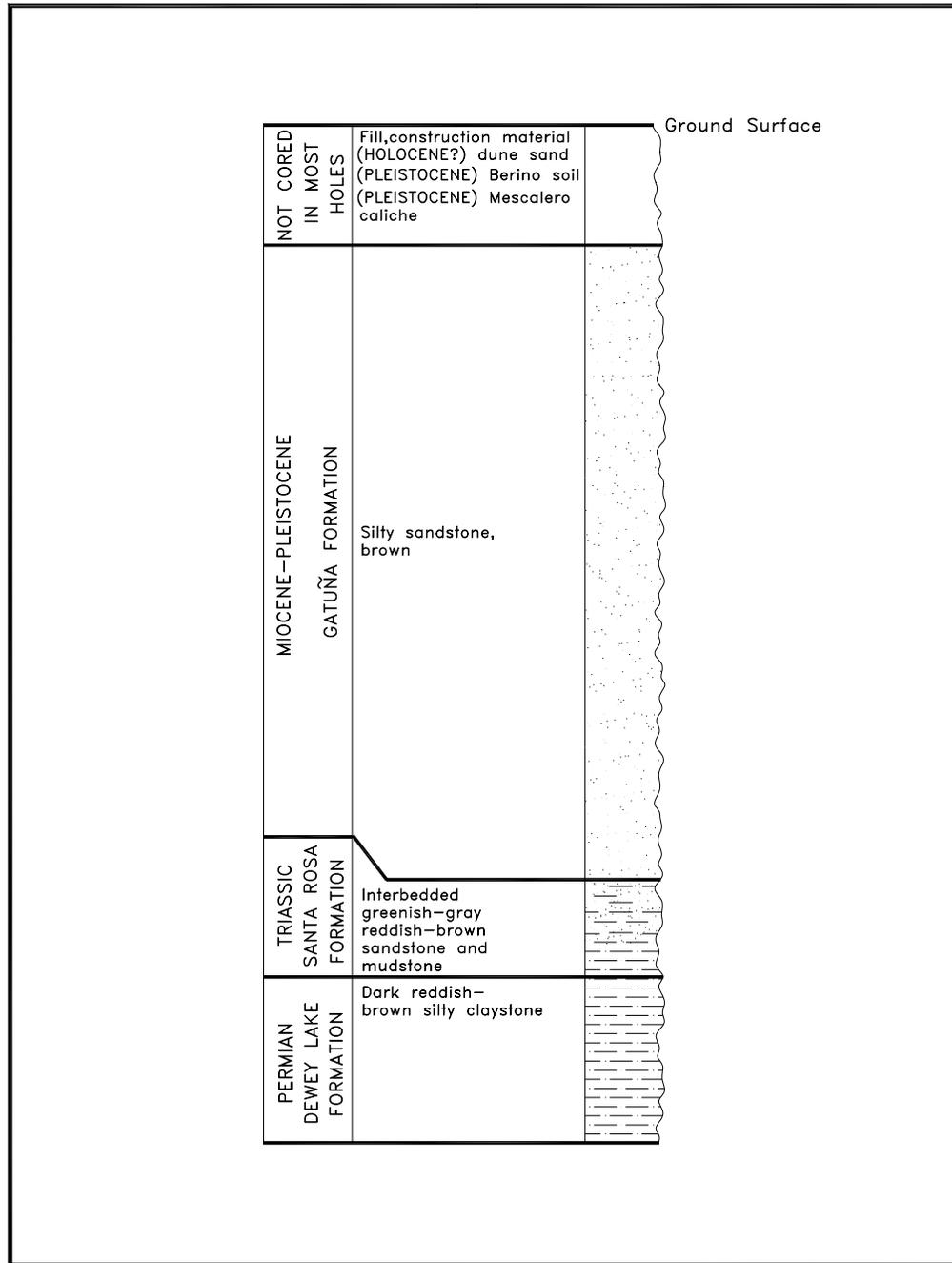


Figure 6.5 - Units Commonly Encountered During Shallow Drilling at WIPP

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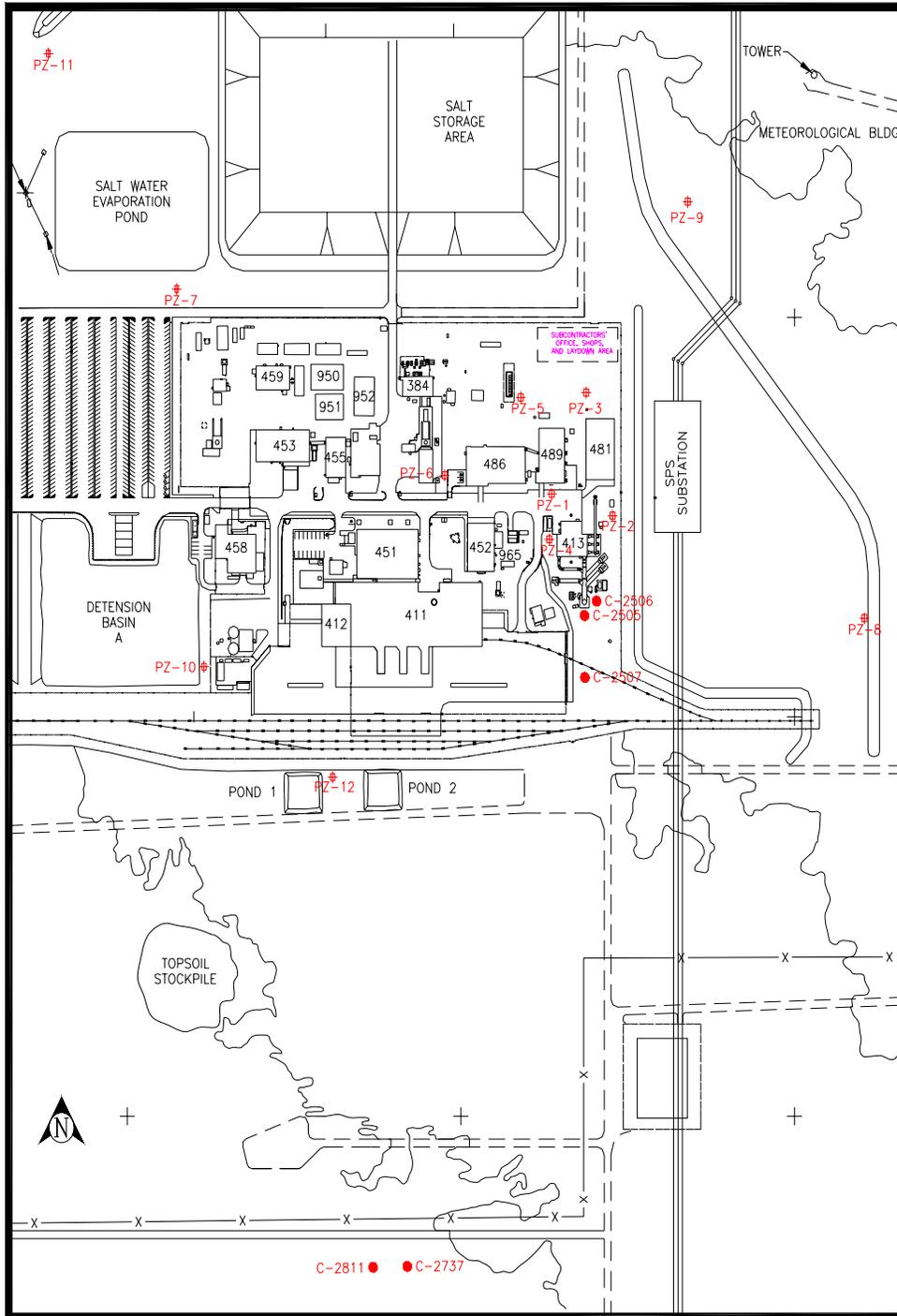


Figure 6.6 - Locations of Piezometers PZ-1 and C-2811, and Wells C-2505, C-2506, and C-2507

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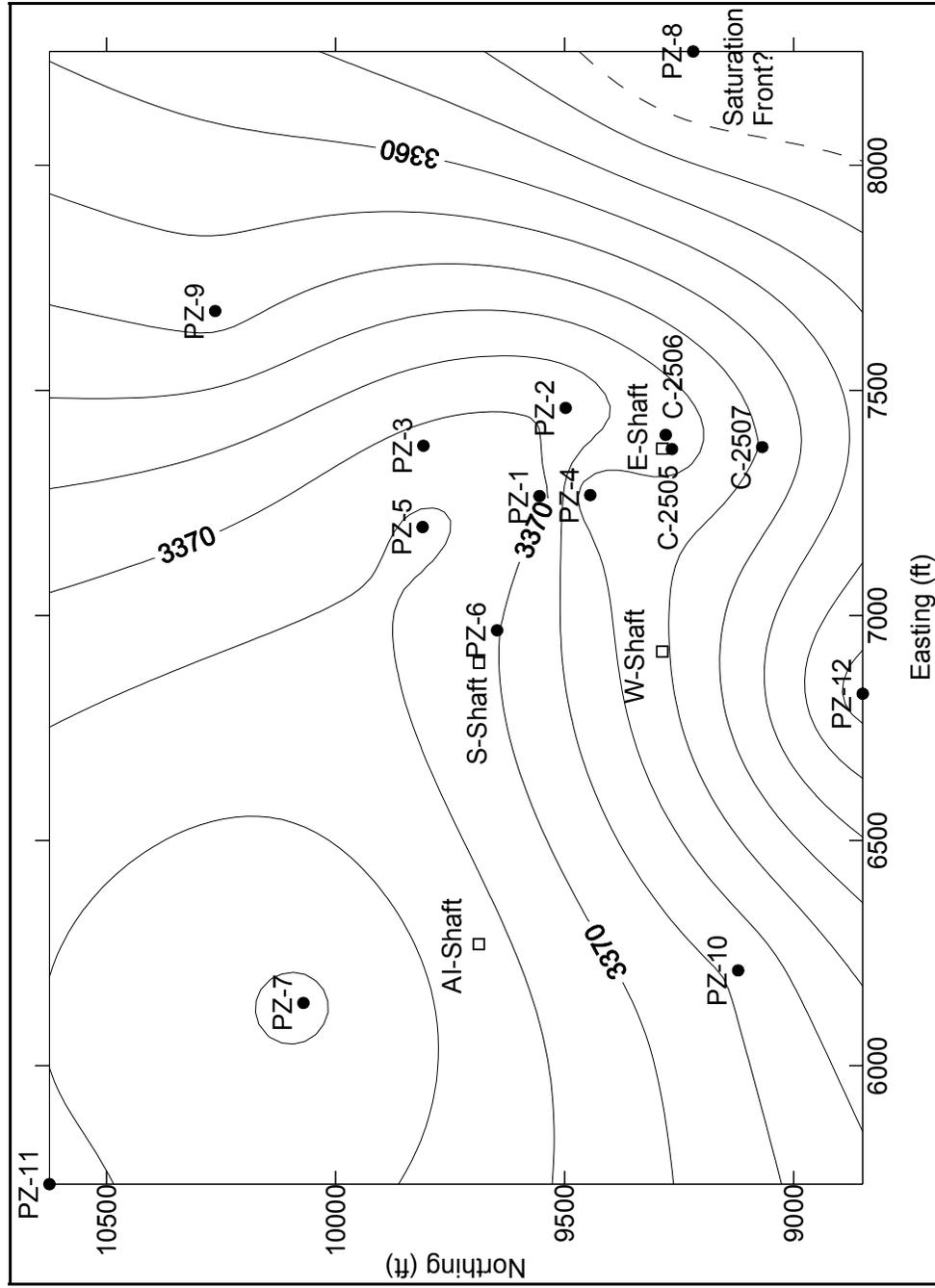


Figure 6.7 - Contour Plot of the Potentiometric Surface in the Santa Rosa Formation at the Dewey Lake Contract: December 2001

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Table 6.2 - Analytical Results for Groundwater Sampled from Well WQSP-1

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	51	52	50	52	mg/l	4	4	55.7
Bromide	33	30	26.8	25.8	mg/l	1	1	51.8
Chloride	37000	36000	35900	36100	mg/l	0.5	0.5	39105
Density	1.05	1.051	1.042	1.047	g/ml	N/A ^c	N/A	1.072
Fluoride	1.5	1.4	1.09	1.08	mg/l	0.2	0.1	4.36
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	2
Nitrate (as N)	<.10	<.10	<.10	<.10	mg/l	0.1	0.1	<10
Orthophosphate (as P)	<0.04	<0.04	<0.040	0.04	mg/l	0.04	0.04	0.1

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Table 6.2 - Analytical Results for Groundwater Sampled from Well WQSP-1

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
pH	7.1	7.1	7.31	7.33	SU ^d	N/A	N/A	6.89-7.65
Specific conductance	80000	81000	83800	83100	µmhos/cm	N/A	N/A	175000
Sulfate	4900	4800	4730	4720	mg/l	0.5	0.5	5757
Total dissolved solids	63000	63000	68300	65700	mg/l	10	10	80700
Total organic carbon	1.15	<1.0	<1.0	<1.0	mg/l	1	1	<5.0
Total organic halogen	9.7	11.4	1.6	2.9	mg/l	N/A	N/A	14.6
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<0.10
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	33.5
Antimony	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.33
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	<0.1
Barium	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<1.0
Beryllium	<0.0025	<0.0025	<0.003	<0.003	mg/l	0.003	0.003	<0.02
Boron	13.43	13.42	14.1	13.5	mg/l	0.005	0.05	19.3
Cadmium	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.2
Calcium	1854	1794	1828	1795	mg/l	0.5	0.2	2,087
Chromium	<0.01	<0.01	<0.01	<0.01	mg/l	0.01	0.01	<0.5
Cobalt	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.11
Copper	<0.0125	<0.0125	<0.013	<0.013	mg/l	0.0125	0.013	<1.0
Iron	<0.05	<0.05	0.08	<0.05	mg/l	0.05	0.05	1.32
Lead	0.0124	<0.010	0.013	0.01	mg/l	0.01	0.01	0.105
Lithium	0.719	0.693	0.88	0.841	mg/l	0.005	0.01	0.547
Magnesium	1255	1180	1262	1270	mg/l	0.5	0.2	1,247
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.490
Potassium	767	745	896	871	mg/l	0.5	0.2	799
Selenium	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	0.15
Silica	6.39	6	4.75	4.61	mg/l	0.05	0.05	17.9
Silver	<0.0125	<0.0125	<0.013	<0.013	mg/l	0.0125	0.013	<0.50
Sodium	19170	17460	18450	17430	mg/l	0.5	0.2	22,090
Thallium	<0.05	<0.05	<0.05	<0.050	mg/l	0.05	0.05	0.98
Tin	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.46
Vanadium	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.1
Zinc	<0.025	<0.025	<0.025	0.037	mg/l	0.025	0.025	<5.0

^a 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not Applicable

^d Standard Unit

^e Not reported by the laboratory

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Table 6.3 - Analytical Results for Groundwater Sampled from Well WQSP-2

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
<i>cis</i> -1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	28	50	46	48	mg/l	4	4	70.3
Bromide	42	38	55.8	60.8	mg/l	1	0.2	63.7
Chloride	35000	36000	34900	34800	mg/l	0.5	2	39670
Density	1.0479	1.0449	1.0496	1.0364	g/ml	N/A ^d	N/A	1.06
Fluoride	1.7	1.7	1.066	1.022	mg/l	0.2	0.1	20
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	2
Nitrate (as N)	<0.1	<0.1	<0.1	<0.1	mg/l	0.1	0.1	<10
Orthophosphate (as P)	<0.04	<0.04	<0.040	<0.04	mg/l	0.04	0.04	0.33

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Table 6.3 - Analytical Results for Groundwater Sampled from Well WQSP-2

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
pH	7.2	7.2	7.2	7.2	SU ^e	N/A	N/A	7.00-7.60
Specific conductance	79000	80000	85200	85000	µmhos/cm	N/A	N/A	124000
Sulfate	5200	5600	5160	5060	mg/l	0.5	2	6590
Total dissolved solids	62000	61000	62800	62800	mg/l	10	10	80500
Total organic carbon	<1.0	<1.0	2.91	<1.0	mg/l	1	1	7.97
Total organic halogen	6.5	2.7	2	3	mg/l	0.005	0.005	63.8
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	0.16
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	43
Antimony	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.50
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	<0.1
Barium	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<1.0
Beryllium	<0.0025	<0.0025	<0.0025	<0.0025	mg/l	0.003	0.003	<1.0
Boron	17.21	16.65	16.3	16	mg/l	0.005	0.05	19.4
Cadmium	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.5
Calcium	1651	1715	1689	1676	mg/l	0.5	0.2	1,827
Chromium	0.01	0.01	0.01	0.01	mg/l	0.01	0.01	<0.5
Cobalt	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.11
Copper	<0.0125	<0.0125	<0.0125	<0.0125	mg/l	0.0125	0.0125	<1.0
Iron	<0.50	<0.50	<0.05	<0.05	mg/l	0.5	0.05	1.32
Lead	<0.01	<0.01	<0.01	<0.01	mg/l	0.01	0.01	0.163
Lithium	0.727	0.681	0.92	0.913	mg/l	0.005	0.01	0.493
Magnesium	1199	1188	1175	1193	mg/l	0.5	0.2	1,310
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.490
Potassium	706	768	841	856	mg/l	0.5	0.2	845
Selenium	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	0.150
Silica	5.67	5.47	4.72	4.41	mg/l	0.05	0.5	24.0
Silver	<0.0125	<0.0125	<0.0125	<0.0125	mg/l	0.0125	0.0125	<0.50
Sodium	19790	21340	20910	21060	mg/l	0.5	0.2	21,900
Thallium	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	0.98
Tin	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.46
Vanadium	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.1
Zinc	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<5.0

^a 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not reported by the laboratory

^d Not Applicable

^e Standard Unit

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Table 6.4 - Analytical Results for Groundwater Sampled from Well WQSP-3

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
<i>cis</i> -1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	34	32	32	34	mg/l	4	4	54.5
Bromide	80	78	127	122	mg/l	1	0.2	137
Chloride	130000	130000	131000	129000	mg/l	0.5	2	149100
Density	1.131	1.132	1.152	1.146	g/ml	N/A ^d	N/A	1.17
Fluoride	0.71	0.69	0.938	0.92	mg/l	0.1	0.1	<10.0
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	2.18
Nitrate (as N)	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	12
Orthophosphate (as P)	<0.04	<0.04	0.118	0.0923	mg/l	0.04	0.04	0.41

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Table 6.4 - Analytical Results for Groundwater Sampled from Well WQSP-3

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
pH	6.6	6.6	6.77	6.79	SU ^e	N/A	N/A	6.60-7.20
Specific conductance	194000	205000	195000	197000	µmhos/cm	N/A	N/A	517000
Sulfate	7200	7200	7460	7190	mg/l	0.5	2	8015
Total dissolved solids	204000	210000	234000	215000	mg/l	10	10	261000
Total organic carbon	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	<5.0
Total organic halogen	10	5.3	5.8	6.2	mg/l	NR	0.005	55
Total phenols	<0.10	<0.10	0.153	0.162	mg/l	0.1	0.1	0.26
Total suspended solids	<1.0	<1.0	82	92	mg/l	1	1	107
Antimony	<0.013	<0.013	<0.125	<0.125	mg/l	0.013	0.125	<1.0
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	0.207
Barium	<0.02	<0.02	<0.50	<0.50	mg/l	0.02	0.5	<1.0
Beryllium	<0.01	<0.01	<0.0125	<0.0125	mg/l	0.01	0.0125	<0.1
Boron	44	51.4	78.8	59.5	mg/l	0.05	0.05	55.9
Cadmium	<0.01	<0.01	<0.05	<0.05	mg/l	0.01	0.05	<0.5
Calcium	1310	1300	1537	1430	mg/l	0.5	0.2	1,680
Chromium	<0.025	<0.025	<0.050	0.05	mg/l	0.025	0.05	<2.0
Cobalt	<0.013	<0.013	<0.125	<0.125	mg/l	0.013	0.125	<5.0
Copper	<0.050	<0.050	<0.0625	<0.0625	mg/l	0.05	0.0625	<1.0
Iron	<0.50	<0.50	<0.25	<0.25	mg/l	0.5	0.25	<1.0
Lead	<0.02	<0.02	<0.10	<0.10	mg/l	0.02	0.1	0.80
Lithium	0.527	0.492	1.28	1.28	mg/l	0.01	0.01	2.76
Magnesium	2120	2040	2455	2312	mg/l	0.5	0.2	2,625
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.05	<0.05	mg/l	0.025	0.05	<5.00
Potassium	2180	2190	3035	2862	mg/l	.50	0.2	3,438
Selenium	0.033	0.041	<0.250	<0.250	mg/l	0.013	0.25	<2.00
Silica	1.84	1.82	2	1.62	mg/l	0.5	0.5	7.20
Silver	<0.013	<0.013	<0.0625	<0.0625	mg/l	0.013	0.0625	0.31
Sodium	68300	71100	81600	74400	mg/l	0.5	0.2	140,400
Thallium	<0.013	<0.010	<0.100	<0.100	mg/l	0.013	0.1	5.800
Tin	<0.025	<0.025	<0.125	<0.125	mg/l	0.025	0.125	<5.00
Vanadium	<0.025	<0.025	<0.125	<0.125	mg/l	0.025	0.125	<5.00
Zinc	<0.050	<0.050	<0.125	<0.125	mg/l	0.05	0.125	2.70

^a 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not reported by the laboratory

^d Not Applicable

^e Standard Unit

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Table 6.5 - Analytical Results for Groundwater Sampled from Well WQSP-4

Parameter	Concentration							
	Round 12		Round 13		Units	Reporting Limit		
	Sample	Dup.	Sample	Dup.		Round 12	Round 13	95 th UTLV ^a
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
<i>cis</i> -1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	40	38	36	34	mg/l	4	4	47.1
Bromide	53.2	54.2	82	80	mg/l	0.1	0.2	<200
Chloride	54900	52100	55300	55000	mg/l	0.5	2	63960
Density	1.074	1.075	1.0764	1.0777	g/ml	N/A ^c	N/A	1.1
Fluoride	1.26	1.3	1.64	1.62	mg/l	0.1	0.1	2.73
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	<2.0
Nitrate (as N)	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<10
Orthophosphate (as P)	<0.04	<0.04	<0.04	<0.04	mg/l	0.04	0.04	0.54

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Table 6.5 - Analytical Results for Groundwater Sampled from Well WQSP-4

Parameter	Concentration							
	Round 12		Round 13		Units	Reporting Limit		
	Sample	Dup.	Sample	Dup.		Round 12	Round 13	95 th UTLV ^a
pH	7.3	7.31	7.1	7.1	SU ^d	N/A	N/A	6.80-7.61
Specific conductance	116000	124000	116000	121000	µmhos/cm	N/A	N/A	319800
Sulfate	6470	6380	6300	6130	mg/l	0.5	2	7927
Total dissolved solids	108000	109000	102000	104000	mg/l	10	10	123500
Total organic carbon	1.1	1.22	<1.0	<1.0	mg/l	1	1	<5.0
Total organic halogen	10	10	4	7.2	mg/l	NR ^e	NR	17
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	0.27
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	57
Antimony	<0.013	<0.013	<0.250	<0.250	mg/l	0.013	0.25	0.8
Arsenic	<0.05	<0.05	<0.10	<0.10	mg/l	0.05	0.1	<0.50
Barium	<0.02	<0.02	0.106	0.106	mg/l	0.02	0.02	<1.0
Beryllium	<0.010	<0.010	<0.025	<0.025	mg/l	0.01	0.01	0.25
Boron	34.7	34.7	39.3	36	mg/l	0.05	0.5	36.8
Cadmium	<0.010	<0.010	<0.050	<0.050	mg/l	0.01	0.05	<0.50
Calcium	1520	1650	1470	1505	mg/l	0.5	0.2	1,834
Chromium	<0.025	<0.025	0.011	0.012	mg/l	0.025	0.025	<2.0
Cobalt	<0.013	<0.013	<0.250	<0.250	mg/l	0.013	0.25	<0.50
Copper	<0.050	<0.050	<0.125	<0.125	mg/l	0.05	0.125	<0.50
Iron	0.056	<0.50	<0.50	<0.50	mg/l	0.5	0.5	<4.0
Lead	<0.02	<0.02	<0.10	<0.10	mg/l	0.02	0.02	0.525
Lithium	0.381	0.424	0.829	0.849	mg/l	0.01	0.01	1.380
Magnesium	1050	1060	1093	1134	mg/l	0.5	0.2	1,472
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.250	<0.250	mg/l	0.025	0.25	<5.00
Potassium	1020	1090	1221	1245	mg/l	0.5	0.2	1,648
Selenium	0.033	0.041	<0.500	<0.500	mg/l	0.013	0.5	2.009
Silica	2.96	3.28	3.58	3.51	mg/l	0.5	0.5	11.40
Silver	<0.013	<0.013	<0.125	<0.125	mg/l	0.013	0.125	0.519
Sodium	35000	34200	34100	33170	mg/l	0.5	0.2	38,790
Thallium	<0.013	<0.010	<0.500	<0.500	mg/l	0.01	0.5	1.00
Tin	<0.025	<0.025	<0.250	<0.250	mg/l	0.025	0.25	5.00
Vanadium	<0.025	<0.025	<0.250	<0.250	mg/l	0.025	0.25	<5.00
Zinc	<0.050	<0.050	<0.250	<0.250	mg/l	0.05	0.25	<5.00

^a 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not Applicable

^d Standard Unit

^e Not reported by the laboratory

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Table 6.6 - Analytical Results for Groundwater Sampled from Well WQSP-5

Parameter	Concentration				Units	Reporting Limit		95 th UTLV ^a
	Round 12		Round 13			Round 12	Round 13	
	Sample	Dup.	Sample	Dup.				
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	46	46	46	44	mg/l	4	4	56
Bromide	27.8	25.7	21.8	18.4	mg/l	1	0.2	59.4
Chloride	16100	15700	15600	14800	mg/l	0.5	2	18100
Density	1.027	1.023	1.0277	1.021	g/ml	N/A ^d	N/A	1.04
Fluoride	2.21	2	2.05	2.13	mg/l	0.1	0.1	3
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	<2.0
Nitrate (as N)	<0.1	<0.1	<0.10	<0.10	mg/l	0.1	0.1	<10
Orthophosphate (as P)	<0.04	<0.04	<0.04	<0.04	mg/l	0.04	0.04	<5.0

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Table 6.6 - Analytical Results for Groundwater Sampled from Well WQSP-5

Parameter	Concentration							
	Round 12		Round 13		Units	Reporting Limit		95 th UTLV ^a
	Sample	Dup.	Sample	Dup.		Round 12	Round 13	
pH	7.58	7.57	7.6	7.6	SU ^e	N/A	N/A	7.40-7.90
Specific conductance	44200	43800	35400	36600	µmhos/cm	N/A	N/A	67700
Sulfate	4890	4800	4690	4470	mg/l	0.5	2	6129
Total dissolved solids	32200	31300	31000	30800	mg/l	10	10	43950
Total organic carbon	1.97	<1.0	<1.0	<1.0	mg/l	1	1	<5.0
Total organic halogen	8.7	5.3	4.26	2.19	mg/l	0.005	0.005	8.37
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<0.10
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	<10.0
Antimony	<0.013	<0.013	<0.125	<0.125	mg/l	0.013	0.125	0.073
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/l	0.05	0.05	<0.50
Barium	<0.02	<0.02	<0.50	<0.50	mg/l	0.02	0.02	<1.0
Beryllium	<0.01	<0.01	<0.0125	<0.0125	mg/l	0.01	0.01	0.02
Boron	29	31.8	37.1	36.3	mg/l	0.05	0.05	40
Cadmium	<0.010	<0.010	<0.025	<0.025	mg/l	0.01	0.01	<0.050
Calcium	1011	1029	1090	1080	mg/l	5	0.2	1,303
Chromium	<0.025	<0.025	<0.050	<0.050	mg/l	0.025	0.025	<0.50
Cobalt	<0.013	<0.013	<0.125	<0.125	mg/l	0.013	0.125	<0.50
Copper	<0.05	<0.05	<0.0625	<0.0625	mg/l	0.05	0.05	<1.0
Iron	0.0684	0.0671	<0.250	0.49	mg/l	0.5	0.5	0.795
Lead	<0.02	<0.02	<0.05	<0.05	mg/l	0.02	0.05	<0.05
Lithium	0.376	0.368	0.603	0.602	mg/l	0.01	0.01	0.74
Magnesium	425	437	545	545	mg/l	5	0.2	547.0
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.125	<0.125	mg/l	0.025	0.125	<0.10
Potassium	474	505	452	454	mg/l	5	0.2	622.0
Selenium	0.033	0.041	<0.250	<0.250	mg/l	0.013	0.25	<0.10
Silica	4.23	4.11	4.26	4.36	mg/l	0.5	0.5	16.3
Silver	<0.013	<0.013	<0.0625	<0.0625	mg/l	0.013	0.0625	<0.50
Sodium	9756	9712	10600	10200	mg/l	5	0.2	11,190
Thallium	<0.013	<0.013	<0.250	<0.250	mg/l	0.01	0.25	0.209
Tin	<0.025	<0.025	<0.125	<0.125	mg/l	0.025	0.125	<0.10
Vanadium	<0.025	<0.025	<0.125	<0.125	mg/l	0.025	0.125	2.70
Zinc	<0.050	<0.050	<0.125	<0.125	mg/l	0.05	0.15	<5.00

^a 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not reported by the laboratory

^d Not Applicable

^e Standard Unit

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Table 6.7 - Analytical Results for Groundwater Sampled from Well WQSP-6

Parameter	Concentration							
	Round 12		Round 13		Units	Reporting		95 th UTLV ^a
	Sample	Dup.	Sample	Dup.		Round 12	Round 13	
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
<i>cis</i> -1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	42	42	46	44	mg/l	4	4	55.8
Bromide	6.04	5.22	6.36	6.51	mg/l	1	0.2	14.1
Chloride	5140	5170	4970	4820	mg/l	0.5	2	6200
Density	1.011	1.011	1.009	1.009	g/ml	N/A ^d	N/A	1.02
Fluoride	2.2	2.15	2.44	2.42	mg/l	0.1	0.1	4.85
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	<2.0
Nitrate (as N)	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	2	7.45
Orthophosphate (as P)	<0.04	<0.04	<0.04	<0.04	mg/l	0.04	0.04	0.34

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Table 6.7 - Analytical Results for Groundwater Sampled from Well WQSP-6

Parameter	Concentration							
	Round 12		Round 13		Units	Reporting		95 th UTLV ^a
	Sample	Dup.	Sample	Dup.		Round 12	Round 13	
pH	7.71	7.74	7.8	7.8	SU ^e	N/A	N/A	7.50-7.90
Specific conductance	20100	20400	16600	16500	µmhos/cm	N/A	N/A	27660
Sulfate	4600	4720	4500	4510	mg/l	0.5	2	5557
Total dissolved solids	16800	16300	16000	15600	mg/l	10	10	22500
Total organic carbon	1.57	<1.0	1.14	<1.0	mg/l	1	1	10.14
Total organic halogen	2.1	2.1	2.2	2.25	mg/l	NR	0.005	1.54
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<0.10
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	14.8
Antimony	<0.013	<0.013	<0.025	<0.025	mg/l	0.013	0.025	0.14
Arsenic	<0.05	<0.05	<0.01	<0.01	mg/l	0.05	0.01	<0.50
Barium	<0.020	<0.020	<0.100	<0.100	mg/l	0.02	0.1	<1.0
Beryllium	<0.010	<0.010	<0.0025	<0.025	mg/l	0.01	0.003	<0.020
Boron	11.1	13.9	20.3	17.6	mg/l	0.5	0.5	17.5
Cadmium	<0.010	<0.010	<0.005	<0.005	mg/l	0.01	0.01	<0.050
Calcium	663	687	672	688	mg/l	0.5	0.2	796
Chromium	<0.025	<0.025	<0.010	<0.010	mg/l	0.025	0.01	<0.50
Cobalt	<0.013	<0.013	<0.025	<0.025	mg/l	0.013	0.025	<0.50
Copper	<0.050	<0.050	<0.125	<0.125	mg/l	0.05	0.125	<1.0
Iron	0.0886	0.131	<0.050	<0.050	mg/l	0.05	0.05	3.105
Lead	0.0113	0.0132	<0.010	<0.010	mg/l	0.02	0.01	0.150
Lithium	0.99	1.08	0.369	0.369	mg/l	0.01	0.01	0.468
Magnesium	212	231	234	236	mg/l	0.5	0.2	255
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.50
Potassium	208	204	278	282	mg/l	0.5	0.2	270
Selenium	0.0188	0.019	<0.050	<0.050	mg/l	0.13	0.05	<0.10
Silica	4.58	5.8	4.15	4.16	mg/l	0.5	0.5	18.2
Silver	<0.013	<0.013	<0.0125	<0.0125	mg/l	0.013	0.013	<0.50
Sodium	4320	4330	4090	4230	mg/l	0.5	0.2	6,290
Thallium	0.013	<0.013	<0.050	<0.050	mg/l	0.013	0.05	0.560
Tin	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.10
Vanadium	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	<0.10
Zinc	<0.050	<0.050	0.025	<0.025	mg/l	0.05	0.025	<5.00

^a 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not reported by the laboratory

^d Not Applicable

^e Standard Unit

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Table 6.8 - Analytical Results for Groundwater Sampled from Well WQSP-6A

Parameter	Concentration							
	Round 12		Round 13		Units	Reporting		95 th UTLV ^a
	Sample	Dup.	Sample	Dup.		Round 12	Round 13	
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL ^b
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/l	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/l	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/l	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/l	1	1	<RL
<i>cis</i> -1,2-Dichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/l	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/l	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Toluene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/l	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/l	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/l	1	1	<RL
Xylene	<1	<1	<1	<1	µg/l	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/l	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/l	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/l	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/l	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/l	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/l	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/l	2	2	<RL
Alkalinity	104	106	102	102	mg/l	4	4	113
Bromide	1.23	1.23	1.14	<1.11	mg/l	1	0.2	14.5
Chloride	536	505	414	411	mg/l	0.5	2	1040
Density	1.005	1.005	1.005	1.005	g/ml	N/A ^c	N/A	1.01
Fluoride	1.91	1.91	1.39	1.44	mg/l	0.1	0.1	2.95
Iodide	<2.0	<2.0	<2.0	<2.0	mg/l	2	2	<2.0
Nitrate (as N)	6.37	6.37	3.67	3.82	mg/l	0.1	0.1	12.2
Orthophosphate (as P)	<0.04	<0.04	<0.04	<0.04	mg/l	0.04	0.04	0.11

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Table 6.8 - Analytical Results for Groundwater Sampled from Well WQSP-6A

pH	7.4	7.3	7.52	7.51	SU ^d	N/A	N/A	6.80-8.00
Specific conductance	4400	4370	4160	4050	µmhos/cm	N/A	N/A	5192
Sulfate	1900	1830	1900	1870	mg/l	0.5	2	2543
Total dissolved solids	3680	3670	4600	4550	mg/l	10	10	11000
Total organic carbon	1.28	<1.0	<1.0	<1.0	mg/l	1	1	15.45
Total organic halogen	0.029	0.041	0.039	0.039	mg/l	NR	0.005	0.19
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/l	0.1	0.1	<0.28
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/l	1	1	91
Antimony	<0.013	<0.013	<0.025	<0.025	mg/l	0.013	0.025	0.48
Arsenic	<0.050	<0.050	<0.010	<0.010	mg/l	0.05	0.01	<0.50
Barium	<0.020	<0.020	<0.100	<0.100	mg/l	0.02	0.1	<0.10
Beryllium	<0.010	<0.010	<0.0025	<0.0025	mg/l	0.01	0.003	<0.01
Boron	0.38	0.362	0.397	0.376	mg/l	0.05	0.05	<0.75
Cadmium	<0.010	<0.010	<0.005	<0.005	mg/l	0.01	0.005	<0.05
Calcium	570	540	622	620	mg/l	0.5	0.5	733
Chromium	<0.025	<0.025	<0.010	<0.010	mg/l	0.025	0.01	<0.50
Cobalt	<0.013	<0.013	<0.025	<0.025	mg/l	0.013	0.025	<0.50
Copper	<0.050	<0.050	<0.0125	<0.0125	mg/l	0.05	0.0125	<1.0
Iron	<0.500	<0.500	<0.050	<0.050	mg/l	0.5	0.05	<1.0
Lead	<0.020	0.013	<0.010	<0.010	mg/l	0.02	0.01	<0.05
Lithium	0.204	0.205	0.135	0.142	mg/l	0.01	0.01	<0.50
Magnesium	150	146	186	169	mg/l	0.5	5	188
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/l	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.284
Potassium	7.2	7.5	7.55	7.59	mg/l	0.5	0.5	10.1
Selenium	0.0385	0.0222	<0.050	<0.050	mg/l	0.013	0.05	0.220
Silica	10.6	11.2	10.2	9.65	mg/l	0.5	0.5	40.10
Silver	<0.013	<0.013	<0.0125	<0.0125	mg/l	0.013	0.0125	<0.50
Sodium	260	255	302	267	mg/l	0.5	0.5	369.0
Thallium	<0.013	<0.013	<0.050	<0.050	mg/l	0.013	0.05	0.058
Tin	<0.025	<0.025	<0.025	<0.025	mg/l	0.025	0.025	0.230
Vanadium	0.052	0.051	0.046	0.0465	mg/l	0.025	0.025	<0.50
Zinc	<0.050	<0.050	0.025	<0.025	mg/l	0.05	0.025	<5.00

^A 95th Upper Tolerance Limit Value, equivalent to 95% Confidence Limit

^b Reporting Limit

^c Not Applicable

^d Standard Unit

^e Not reported by the laboratory

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd AMSL
AEC-7	CUL	3657.25	1/9/01	07:23	619.94	0.98	618.96	188.66	3038.29	926.07	3061.25
AEC-7	CUL	3657.25	2/6/01	07:15	620.01	0.98	619.03	188.68	3038.22	926.05	3061.17
AEC-7	CUL	3657.25	3/6/01	14:18	619.90	0.98	618.92	188.65	3038.33	926.08	3061.29
AEC-7	CUL	3657.25	4/4/01	11:19	619.75	0.98	618.77	188.60	3038.48	926.13	3061.45
AEC-7	CUL	3657.25	5/8/01	07:37	620.01	0.98	619.03	188.68	3038.22	926.05	3061.17
AEC-7	CUL	3657.25	6/7/01	09:49	619.87	0.98	618.89	188.64	3038.36	926.09	3061.32
AEC-7	CUL	3657.25	7/10/01	08:30	619.97	0.98	618.99	188.67	3038.26	926.06	3061.21
AEC-7	CUL	3657.25	8/8/01	14:11	620.11	0.98	619.13	188.71	3038.12	926.02	3061.06
AEC-7	CUL	3657.25	9/7/01	13:35	619.73	0.98	618.75	188.60	3038.50	926.13	3061.48
AEC-7	CUL	3657.25	10/8/01	12:43	620.00	0.98	619.02	188.68	3038.23	926.05	3061.18
AEC-7	CUL	3657.25	11/13/01	12:53	619.94	0.98	618.96	188.66	3038.29	926.07	3061.25
AEC-7	CUL	3657.25	12/4/01	11:58	619.94	0.98	618.96	188.66	3038.29	926.07	3061.25
AEC-8	B/C	3537.10	1/9/01	07:52	510.58	0.00	510.58	155.62	3026.52	922.48	
AEC-8	B/C	3537.10	2/6/01	07:43	508.38	0.00	508.38	154.95	3028.72	923.15	
AEC-8	B/C	3537.10	3/6/01	14:48	506.92	0.00	506.92	154.51	3030.18	923.60	
AEC-8	B/C	3537.10	4/4/01	11:41	506.06	0.00	506.06	154.25	3031.04	923.86	
AEC-8	B/C	3537.10	5/8/01	08:02	504.13	0.00	504.13	153.66	3032.97	924.45	
AEC-8	B/C	3537.10	6/7/01	10:14	502.53	0.00	502.53	153.17	3034.57	924.94	
AEC-8	B/C	3537.10	7/10/01	08:55	500.82	0.00	500.82	152.65	3036.28	925.46	
AEC-8	B/C	3537.10	8/8/01	14:29	499.31	0.00	499.31	152.19	3037.79	925.92	
AEC-8	B/C	3537.10	9/7/01	13:50	497.69	0.00	497.69	151.70	3039.41	926.41	
AEC-8	B/C	3537.10	10/8/01	13:06	496.15	0.00	496.15	151.23	3040.95	926.88	
AEC-8	B/C	3537.10	11/12/01	11:12	494.44	0.00	494.44	150.71	3042.66	927.40	
AEC-8	B/C	3537.10	12/3/01	11:45	493.40	0.00	493.40	150.39	3043.70	927.72	
C-2737 (ANNULUS)	MAG	3399.30	4/5/01	10:49	257.83	0.00	257.83	78.59	3141.47	957.52	
C-2737 (ANNULUS)	MAG	3399.30	5/8/01	13:43	253.96	0.00	253.96	77.41	3145.34	958.70	
C-2737 (ANNULUS)	MAG	3399.30	6/6/01	06:57	253.44	0.00	253.44	77.25	3145.86	958.86	
C-2737 (ANNULUS)	MAG	3399.30	7/9/01	09:25	253.58	0.00	253.58	77.29	3145.72	958.82	
C-2737 (ANNULUS)	MAG	3399.30	8/7/01	13:13	253.77	0.00	253.77	77.35	3145.53	958.76	
C-2737 (ANNULUS)	MAG	3399.30	9/6/01	12:45	253.79	0.00	253.79	77.36	3145.51	958.75	
C-2737 (ANNULUS)	MAG	3399.30	10/10/01	07:55	254.00	0.00	254.00	77.42	3145.30	958.69	
C-2737 (ANNULUS)	MAG	3399.30	11/14/01	10:53	254.90	0.00	254.90	77.69	3144.40	958.41	
C-2737 (ANNULUS)	MAG	3399.30	12/5/01	10:15	254.34	0.00	254.34	77.52	3144.96	958.58	
C-2737 (PIP)	CUL	3399.30	4/5/01	10:43	386.07	0.75	385.32	117.45	3013.98	918.66	
C-2737 (PIP)	CUL	3399.30	5/8/01	13:39	376.04	0.75	375.29	114.39	3024.01	921.72	
C-2737 (PIP)	CUL	3399.30	6/6/01	06:51	385.94	0.75	385.19	117.41	3014.11	918.70	
C-2737 (PIP)	CUL	3399.30	7/9/01	09:14	385.82	0.75	385.07	117.37	3014.23	918.74	

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_AMSL_FT	WL_AMSL_M	Adj_Ft_Hd_amsl
C-2737 (PIP)	CUL	3399.30	8/7/01	13:08	385.75	0.75	385.00	117.35	3014.30	918.76	
C-2737 (PIP)	CUL	3399.30	9/6/01	12:40	385.42	0.75	384.67	117.25	3014.63	918.86	
C-2737 (PIP)	CUL	3399.30	10/10/01	07:48	385.43	0.75	384.68	117.25	3014.62	918.86	
C-2737 (PIP)	CUL	3399.30	11/14/01	10:49	385.55	0.75	384.80	117.29	3014.50	918.82	
C-2737 (PIP)	CUL	3399.30	12/5/01	10:11	385.78	0.75	385.03	117.36	3014.27	918.75	
CB-1	CUL	3328.38	1/10/01	12:49	84.76	0.69	84.07	25.62	3244.31	988.87	3256.31
CB-1	CUL	3328.38	2/5/01	13:05	83.66	0.69	82.97	25.29	3245.41	989.20	3257.44
CB-1	CUL	3328.38	4/5/01	08:36	77.98	0.69	77.29	23.56	3251.09	990.93	3263.30
CB-1	CUL	3328.38	5/9/01	10:26	73.15	0.69	72.46	22.09	3255.92	992.40	3268.28
CB-1	CUL	3328.38	7/11/01	10:50	76.21	0.69	75.52	23.02	3252.86	991.47	3265.12
CB-1	CUL	3328.38	8/7/01	09:15	72.55	0.69	71.86	21.90	3256.52	992.59	3268.90
CB-1	CUL	3328.38	10/9/01	12:31	62.84	0.69	62.15	18.94	3266.23	995.55	3278.91
CB-1	CUL	3328.38	11/12/01	10:11	57.79	0.69	57.10	17.40	3271.28	997.09	3284.11
CB-1	CUL	3328.38	3/7/01	11:51	81.88	0.69	81.19	24.75	3247.19	989.74	3259.28
CB-1	CUL	3328.38	6/6/01	12:17	75.63	0.69	74.94	22.84	3253.44	991.65	3265.72
CB-1	CUL	3328.38	9/5/01	14:45	68.11	0.69	67.42	20.55	3260.96	993.94	3273.47
CB-1	CUL	3328.38	12/3/01	10:19	54.79	0.69	54.10	16.49	3274.28	998.00	3287.21
CB-1 (PIP)	B/C	3328.38	1/10/01	12:45	314.36	0.76	313.60	95.59	3014.78	918.90	
CB-1 (PIP)	B/C	3328.38	2/5/01	12:53	314.46	0.76	313.70	95.62	3014.68	918.87	
CB-1 (PIP)	B/C	3328.38	3/7/01	11:47	314.42	0.76	313.66	95.60	3014.72	918.89	
CB-1 (PIP)	B/C	3328.38	4/5/01	08:28	314.29	0.76	313.53	95.56	3014.85	918.93	
CB-1 (PIP)	B/C	3328.38	5/9/01	10:29	314.43	0.76	313.67	95.61	3014.71	918.88	
CB-1 (PIP)	B/C	3328.38	6/6/01	12:14	314.37	0.76	313.61	95.59	3014.77	918.90	
CB-1 (PIP)	B/C	3328.38	7/11/01	10:40	314.00	0.76	313.24	95.48	3015.14	919.01	
CB-1 (PIP)	B/C	3328.38	8/7/01	09:08	314.50	0.76	313.74	95.63	3014.64	918.86	
CB-1 (PIP)	B/C	3328.38	9/5/01	14:40	314.48	0.76	313.72	95.62	3014.66	918.87	
CB-1 (PIP)	B/C	3328.38	10/9/01	12:28	314.40	0.76	313.64	95.60	3014.74	918.89	
CB-1 (PIP)	B/C	3328.38	11/12/01	10:03	314.58	0.76	313.82	95.65	3014.56	918.84	
CB-1 (PIP)	B/C	3328.38	12/3/01	10:14	314.48	0.76	313.72	95.62	3014.66	918.87	
DOE-1	CUL	3466.04	1/10/01	13:20	490.85	0.00	490.85	149.61	2975.19	906.84	3003.54
DOE-1	CUL	3466.04	2/5/01	13:31	490.79	0.00	490.79	149.59	2975.25	906.86	3003.61
DOE-1	CUL	3466.04	3/8/01	07:34	490.42	0.00	490.42	149.48	2975.62	906.97	3004.01
DOE-1	CUL	3466.04	4/5/01	09:05	490.12	0.00	490.12	149.39	2975.92	907.06	3004.33
DOE-1	CUL	3466.04	5/9/01	09:27	489.95	0.00	489.95	149.34	2976.09	907.11	3004.52
DOE-1	CUL	3466.04	6/6/01	10:25	489.79	0.00	489.79	149.29	2976.25	907.16	3004.69
DOE-1	CUL	3466.04	7/10/01	10:45	489.64	0.00	489.64	149.24	2976.40	907.21	3004.85
DOE-1	CUL	3466.04	8/7/01	07:18	489.40	0.00	489.40	149.17	2976.64	907.28	3005.11

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd AMSL
DOE-1	CUL	3466.04	9/7/01	13:15	489.43	0.00	489.43	149.18	2976.61	907.27	3005.08
DOE-1	CUL	3466.04	10/9/01	12:51	489.35	0.00	489.35	149.15	2976.69	907.30	3005.17
DOE-1	CUL	3466.04	11/13/01	14:30	489.39	0.00	489.39	149.17	2976.65	907.28	3005.12
DOE-1	CUL	3466.04	12/5/01	12:38	489.33	0.00	489.33	149.15	2976.71	907.30	3005.19
DOE-2	CUL	3419.09	1/8/01	14:00	378.24	0.00	378.24	115.29	3040.85	926.85	3053.63
DOE-2	CUL	3419.09	2/6/01	11:56	378.35	0.00	378.35	115.32	3040.74	926.82	3053.52
DOE-2	CUL	3419.09	3/6/01	12:48	378.31	0.00	378.31	115.31	3040.78	926.83	3053.56
DOE-2	MAG	3419.09	4/4/01	13:32	476.75	0.00	476.75	145.31	2942.34	896.83	
DOE-2	MAG	3419.09	5/8/01	09:34	371.51	0.00	371.51	113.24	3047.58	928.90	
DOE-2	MAG	3419.09	6/5/01	12:46	370.65	0.00	370.65	112.97	3048.44	929.16	
DOE-2	MAG	3419.09	7/9/01	07:40	369.85	0.00	369.85	112.73	3049.24	929.41	
DOE-2	MAG	3419.09	9/12/01	08:30	365.98	0.00	365.98	111.55	3053.11	930.59	
DOE-2	MAG	3419.09	10/23/01	09:44	362.54	0.00	362.54	110.50	3056.55	931.64	
DOE-2	MAG	3419.09	11/12/01	14:52	361.90	0.00	361.90	110.31	3057.19	931.83	
DOE-2	MAG	3419.09	12/3/01	12:14	360.97	0.00	360.97	110.02	3058.12	932.11	
ERDA-9	CUL	3410.10	1/9/01	13:05	403.46	0.65	402.81	122.78	3007.29	916.62	3022.68
ERDA-9	CUL	3410.10	2/5/01	10:07	404.10	0.65	403.45	122.97	3006.65	916.43	3022.00
ERDA-9	CUL	3410.10	3/7/01	14:24	403.47	0.65	402.82	122.78	3007.28	916.62	3022.66
ERDA-9	CUL	3410.10	4/5/01	13:15	403.00	0.65	402.35	122.64	3007.75	916.76	3023.16
ERDA-9	CUL	3410.10	5/8/01	13:25	402.86	0.65	402.21	122.59	3007.89	916.80	3023.30
ERDA-9	CUL	3410.10	6/6/01	06:42	402.47	0.65	401.82	122.47	3008.28	916.92	3023.71
ERDA-9	CUL	3410.10	7/11/01	07:35	402.30	0.65	401.65	122.42	3008.45	916.98	3023.89
ERDA-9	CUL	3410.10	8/7/01	13:48	402.16	0.65	401.51	122.38	3008.59	917.02	3024.04
ERDA-9	CUL	3410.10	9/6/01	13:45	401.96	0.65	401.31	122.32	3008.79	917.08	3024.25
ERDA-9	CUL	3410.10	10/10/01	08:04	401.91	0.65	401.26	122.30	3008.84	917.09	3024.30
ERDA-9	CUL	3410.10	11/14/01	10:40	402.05	0.65	401.40	122.35	3008.70	917.05	3024.15
ERDA-9	CUL	3410.10	12/5/01	10:22	402.15	0.65	401.50	122.38	3008.60	917.02	3024.05
H-01 (ANNULUS)	MAG	3399.84	1/9/01	13:18	168.27	0.00	168.27	51.29	3231.57	984.98	
H-01 (ANNULUS)	MAG	3399.84	2/5/01	08:51	169.95	0.00	169.95	51.90	3229.89	984.47	
H-01 (PIP)	CUL	3399.84	1/9/01	13:13	365.00	0.66	364.34	111.05	3035.50	925.22	3036.15
H-01 (PIP)	CUL	3399.84	2/5/01	08:40	365.17	0.66	364.51	111.10	3035.33	925.17	3035.98
H-02a	CUL	3378.09	3/8/01	10:06	341.03	0.00	341.03	103.95	3037.06	925.70	3040.58
H-02a	CUL	3378.09	6/6/01	10:10	340.75	0.00	340.75	103.86	3037.34	925.78	3040.86
H-02a	CUL	3378.09	9/6/01	12:15	340.50	0.00	340.50	103.78	3037.59	925.86	3041.12
H-02a	CUL	3378.09	12/5/01	13:42	340.32	0.00	340.32	103.73	3037.77	925.91	3041.30
H-02b1	MAG	3378.46	1/9/01	13:33	231.90	0.00	231.90	70.68	3146.56	959.07	
H-02b1	MAG	3378.46	2/6/01	13:45	231.98	0.00	231.98	70.71	3146.48	959.05	

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-02b1	MAG	3378.46	3/8/01	10:10	231.88	0.00	231.88	70.68	3146.58	959.08	
H-02b1	MAG	3378.46	4/5/01	14:43	231.74	0.00	231.74	70.63	3146.72	959.12	
H-02b1	MAG	3378.46	5/8/01	14:06	231.61	0.00	231.61	70.59	3146.85	959.16	
H-02b1	MAG	3378.46	6/6/01	09:56	231.51	0.00	231.51	70.56	3146.95	959.19	
H-02b1	MAG	3378.46	7/11/01	14:05	231.42	0.00	231.42	70.54	3147.04	959.22	
H-02b1	MAG	3378.46	8/7/01	11:57	231.34	0.00	231.34	70.51	3147.12	959.24	
H-02b1	MAG	3378.46	9/6/01	12:25	231.23	0.00	231.23	70.48	3147.23	959.28	
H-02b1	MAG	3378.46	10/10/01	07:28	231.23	0.00	231.23	70.48	3147.23	959.28	
H-02b1	MAG	3378.46	11/14/01	11:01	231.26	0.00	231.26	70.49	3147.20	959.27	
H-02b1	MAG	3378.46	12/5/01	13:34	231.27	0.00	231.27	70.49	3147.19	959.26	
H-02b2	CUL	3378.31	1/9/01	13:29	341.46	0.00	341.46	104.08	3036.85	925.63	3039.20
H-02b2	CUL	3378.31	2/6/01	13:52	341.40	0.00	341.40	104.06	3036.91	925.65	3039.26
H-02b2	CUL	3378.31	3/8/01	10:02	341.19	0.00	341.19	103.99	3037.12	925.71	3039.47
H-02b2	CUL	3378.31	4/5/01	14:45	341.15	0.00	341.15	103.98	3037.16	925.73	3039.51
H-02b2	CUL	3378.31	5/8/01	14:11	341.32	0.00	341.32	104.03	3036.99	925.67	3039.34
H-02b2	CUL	3378.31	6/6/01	10:05	341.03	0.00	341.03	103.95	3037.28	925.76	3039.63
H-02b2	CUL	3378.31	7/11/01	14:14	341.04	0.00	341.04	103.95	3037.27	925.76	3039.62
H-02b2	CUL	3378.31	8/7/01	12:51	341.01	0.00	341.01	103.94	3037.30	925.77	3039.65
H-02b2	CUL	3378.31	9/6/01	12:10	340.70	0.00	340.70	103.85	3037.61	925.86	3039.96
H-02b2	CUL	3378.31	10/10/01	07:33	340.69	0.00	340.69	103.84	3037.62	925.87	3039.97
H-02b2	CUL	3378.31	11/14/01	11:05	340.52	0.00	340.52	103.79	3037.79	925.92	3040.14
H-02b2	CUL	3378.31	12/5/01	13:38	340.71	0.00	340.71	103.85	3037.60	925.86	3039.95
H-02c	CUL	3378.41	3/8/01	09:56	341.39	0.00	341.39	104.06	3037.02	925.68	3049.88
H-02c	CUL	3378.41	6/6/01	09:50	341.00	0.00	341.00	103.94	3037.41	925.80	3050.29
H-02c	CUL	3378.41	9/6/01	12:04	340.77	0.00	340.77	103.87	3037.64	925.87	3050.53
H-02c	CUL	3378.41	12/5/01	13:29	339.70	0.00	339.70	103.54	3038.71	926.20	3051.65
H-03b1	MAG	3390.64	1/9/01	13:45	238.76	0.00	238.76	72.77	3151.88	960.69	
H-03b1	MAG	3390.64	2/6/01	14:04	238.69	0.00	238.69	72.75	3151.95	960.71	
H-03b1	MAG	3390.64	3/8/01	10:26	238.45	0.00	238.45	72.68	3152.19	960.79	
H-03b1	MAG	3390.64	4/5/01	13:45	239.38	0.00	239.38	72.96	3151.26	960.50	
H-03b1	MAG	3390.64	5/9/01	11:14	239.66	0.00	239.66	73.05	3150.98	960.42	
H-03b1	MAG	3390.64	6/6/01	07:10	239.47	0.00	239.47	72.99	3151.17	960.48	
H-03b1	MAG	3390.64	7/10/01	12:45	239.63	0.00	239.63	73.04	3151.01	960.43	
H-03b1	MAG	3390.64	8/7/01	13:24	239.76	0.00	239.76	73.08	3150.88	960.39	
H-03b1	MAG	3390.64	9/6/01	13:00	239.73	0.00	239.73	73.07	3150.91	960.40	
H-03b1	MAG	3390.64	10/10/01	08:17	239.87	0.00	239.87	73.11	3150.77	960.35	
H-03b1	MAG	3390.64	11/14/01	10:29	240.01	0.00	240.01	73.16	3150.63	960.31	

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-03b1	MAG	3390.64	12/5/01	10:32	240.09	0.00	240.09	73.18	3150.55	980.29	
H-03b2	CUL	3390.03	1/9/01	14:01	391.80	0.00	391.80	119.42	2998.23	913.86	3009.55
H-03b2	CUL	3390.03	2/6/01	14:20	391.68	0.00	391.68	119.38	2998.35	913.90	3009.67
H-03b2	CUL	3390.03	3/8/01	10:52	391.45	0.00	391.45	119.31	2998.58	913.97	3009.91
H-03b2	CUL	3390.03	4/5/01	13:56	391.36	0.00	391.36	119.29	2998.67	913.99	3010.01
H-03b2	CUL	3390.03	5/9/01	10:56	392.14	0.00	392.14	119.52	2997.89	913.76	3009.20
H-03b2	CUL	3390.03	6/6/01	07:36	391.40	0.00	391.40	119.30	2998.63	913.98	3009.97
H-03b2	CUL	3390.03	7/10/01	12:50	391.15	0.00	391.15	119.22	2998.88	914.06	3010.22
H-03b2	CUL	3390.03	8/7/01	13:33	391.15	0.00	391.15	119.22	2998.88	914.06	3010.22
H-03b2	CUL	3390.03	9/6/01	13:30	390.74	0.00	390.74	119.10	2999.29	914.18	3010.65
H-03b2	CUL	3390.03	10/10/01	08:34	390.79	0.00	390.79	119.11	2999.24	914.17	3010.60
H-03b2	CUL	3390.03	11/14/01	09:19	391.18	0.00	391.18	119.23	2998.85	914.05	3010.19
H-03b2	CUL	3390.03	12/5/01	10:54	391.09	0.00	391.09	119.20	2998.94	914.08	3010.29
H-03b3	CUL	3388.67	3/8/01	10:43	390.34	0.00	390.34	118.98	2998.33	913.89	3008.01
H-03b3	CUL	3388.67	6/6/01	07:30	389.85	0.00	389.85	118.83	2998.82	914.04	3008.52
H-03b3	CUL	3388.67	9/6/01	13:25	389.20	0.00	389.20	118.63	2999.47	914.24	3009.19
H-03b3	CUL	3388.67	12/5/01	10:47	389.67	0.00	389.67	118.77	2999.00	914.10	3008.70
H-03d/49 (PIP)	49ER	3390.01	1/9/01	13:50	302.52	2.22	300.30	91.53	3089.71	941.74	
H-03d/49 (PIP)	49ER	3390.01	2/6/01	14:07	302.37	2.22	300.15	91.49	3089.86	941.79	
H-03d/49 (PIP)	49ER	3390.01	3/8/01	10:31	302.05	2.22	299.83	91.39	3090.18	941.89	
H-03d/49 (PIP)	49ER	3390.01	4/5/01	13:48	301.81	2.22	299.59	91.32	3090.42	941.96	
H-03d/49 (PIP)	49ER	3390.01	5/9/01	11:03	301.50	2.22	299.28	91.22	3090.73	942.05	
H-03d/49 (PIP)	49ER	3390.01	6/6/01	07:19	301.34	2.22	299.12	91.17	3090.89	942.10	
H-03d/49 (PIP)	49ER	3390.01	7/10/01	12:35	301.23	2.22	299.01	91.14	3091.00	942.14	
H-03d/49 (PIP)	49ER	3390.01	8/7/01	13:29	301.26	2.22	299.04	91.15	3090.97	942.13	
H-03d/49 (PIP)	49ER	3390.01	9/6/01	13:05	301.00	2.22	298.78	91.07	3091.23	942.21	
H-03d/49 (PIP)	49ER	3390.01	10/10/01	08:22	300.84	2.22	298.62	91.02	3091.39	942.26	
H-03d/49 (PIP)	49ER	3390.01	11/14/01	10:23	300.62	2.22	298.40	90.95	3091.61	942.32	
H-03d/49 (PIP)	49ER	3390.01	12/5/01	10:37	300.59	2.22	298.37	90.94	3091.64	942.33	
H-03d/DL (PVC)	DL	3390.01	1/9/01	13:54	319.13	2.22	316.91	96.59	3073.10	936.68	
H-03d/DL (PVC)	DL	3390.01	2/6/01	14:13	319.14	2.22	316.92	96.60	3073.09	936.68	
H-03d/DL (PVC)	DL	3390.01	3/8/01	10:34	318.98	2.22	316.76	96.55	3073.25	936.73	
H-03d/DL (PVC)	DL	3390.01	4/5/01	13:52	318.91	2.22	316.69	96.53	3073.32	936.75	
H-03d/DL (PVC)	DL	3390.01	5/9/01	11:10	318.77	2.22	316.55	96.48	3073.46	936.79	
H-03d/DL (PVC)	DL	3390.01	6/6/01	07:24	318.70	2.22	316.48	96.46	3073.53	936.81	
H-03d/DL (PVC)	DL	3390.01	7/10/01	12:40	318.58	2.22	316.36	96.43	3073.65	936.85	
H-03d/DL (PVC)	DL	3390.01	8/7/01	13:38	318.53	2.22	316.31	96.41	3073.70	936.86	

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-03d/DL (PVC)	DL	3390.01	9/4/01	13:15	318.44	2.22	316.22	96.38	3073.79	936.89	
H-03d/DL (PVC)	DL	3390.01	10/10/01	08:27	318.37	2.22	316.15	96.36	3073.86	936.91	
H-03d/DL (PVC)	DL	3390.01	11/14/01	10:20	318.29	2.22	316.07	96.34	3073.94	936.94	
H-03d/DL (PVC)	DL	3390.01	12/5/01	10:41	318.27	2.22	316.05	96.33	3073.96	936.94	
H-04b	CUL	3333.35	1/9/01	14:16	332.85	0.00	332.85	101.45	3000.50	914.55	3004.07
H-04b	CUL	3333.35	2/7/01	12:00	332.60	0.00	332.60	101.38	3000.75	914.63	3004.33
H-04b	CUL	3333.35	3/8/01	09:23	332.40	0.00	332.40	101.32	3000.95	914.69	3004.53
H-04b	CUL	3333.35	4/5/01	14:19	332.29	0.00	332.29	101.28	3001.06	914.72	3004.64
H-04b	CUL	3333.35	5/9/01	07:47	332.25	0.00	332.25	101.27	3001.10	914.74	3004.69
H-04b	CUL	3333.35	6/6/01	09:26	331.97	0.00	331.97	101.18	3001.38	914.82	3004.97
H-04b	CUL	3333.35	7/11/01	08:54	332.19	0.00	332.19	101.25	3001.16	914.75	3004.75
H-04b	CUL	3333.35	8/7/01	10:39	332.36	0.00	332.36	101.30	3000.99	914.70	3004.57
H-04b	CUL	3333.35	9/6/01	14:12	332.24	0.00	332.24	101.27	3001.11	914.74	3004.70
H-04b	CUL	3333.35	10/10/01	09:04	332.31	0.00	332.31	101.29	3001.04	914.72	3004.62
H-04b	CUL	3333.35	11/14/01	10:03	332.18	0.00	332.18	101.25	3001.17	914.76	3004.76
H-04b	CUL	3333.35	12/5/01	13:13	332.28	0.00	332.28	101.28	3001.07	914.73	3004.66
H-04c	MAG	3334.04	1/9/01	14:24	190.06	0.00	190.06	57.93	3143.98	958.29	
H-04c	MAG	3334.04	2/7/01	12:12	190.00	0.00	190.00	57.91	3144.04	958.30	
H-04c	MAG	3334.04	3/8/01	09:27	189.88	0.00	189.88	57.88	3144.16	958.34	
H-04c	MAG	3334.04	4/5/01	14:22	189.74	0.00	189.74	57.83	3144.30	958.38	
H-04c	MAG	3334.04	5/9/01	07:52	189.86	0.00	189.86	57.87	3144.18	958.35	
H-04c	MAG	3334.04	6/6/01	09:33	189.72	0.00	189.72	57.83	3144.32	958.39	
H-04c	MAG	3334.04	7/11/01	09:02	189.85	0.00	189.85	57.87	3144.19	958.35	
H-04c	MAG	3334.04	8/7/01	10:52	189.85	0.00	189.85	57.87	3144.19	958.35	
H-04c	MAG	3334.04	9/6/01	14:05	189.71	0.00	189.71	57.82	3144.33	958.39	
H-04c	MAG	3334.04	10/10/01	08:51	189.76	0.00	189.76	57.84	3144.28	958.38	
H-04c	MAG	3334.04	11/14/01	10:00	189.82	0.00	189.82	57.86	3144.22	958.36	
H-04c	MAG	3334.04	12/5/01	13:09	189.71	0.00	189.71	57.82	3144.33	958.39	
H-05a	CUL	3506.24	3/7/01	08:50	475.09	0.00	475.09	144.81	3031.15	923.89	3071.09
H-05a	CUL	3506.24	6/7/01	10:47	475.05	0.00	475.05	144.80	3031.19	923.91	3071.13
H-05a	CUL	3506.24	9/10/01	07:00	475.23	0.00	475.23	144.85	3031.01	923.85	3070.93
H-05a	CUL	3506.24	12/4/01	11:18	474.94	0.00	474.94	144.76	3031.30	923.94	3071.25
H-05b	CUL	3506.04	1/9/01	08:16	477.67	0.00	477.67	145.59	3028.37	923.05	3073.24
H-05b	CUL	3506.04	2/6/01	08:00	477.71	0.00	477.71	145.61	3028.33	923.03	3073.20
H-05b	CUL	3506.04	3/7/01	08:44	477.59	0.00	477.59	145.57	3028.45	923.07	3073.33
H-05b	CUL	3506.04	4/4/01	11:58	477.40	0.00	477.40	145.51	3028.64	923.13	3073.54
H-05b	CUL	3506.04	5/8/01	10:29	477.62	0.00	477.62	145.58	3028.42	923.06	3073.30

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-05b	CUL	3506.04	6/7/01	10:35	477.50	0.00	477.50	145.54	3028.54	923.10	3073.43
H-05b	CUL	3506.04	7/10/01	09:11	477.56	0.00	477.56	145.56	3028.48	923.08	3073.37
H-05b	CUL	3506.04	8/8/01	14:46	477.60	0.00	477.60	145.57	3028.44	923.07	3073.32
H-05b	CUL	3506.04	9/10/01	06:50	477.62	0.00	477.62	145.58	3028.42	923.06	3073.30
H-05b	CUL	3506.04	10/10/01	12:06	477.49	0.00	477.49	145.54	3028.55	923.10	3073.44
H-05b	CUL	3506.04	11/13/01	13:23	477.55	0.00	477.55	145.56	3028.49	923.08	3073.38
H-05b	CUL	3506.04	12/4/01	11:11	477.47	0.00	477.47	145.53	3028.57	923.11	3073.47
H-05c	MAG	3506.04	1/9/01	08:22	349.08	0.00	349.08	106.40	3156.96	962.24	
H-05c	MAG	3506.04	2/6/01	08:07	349.00	0.00	349.00	106.38	3157.04	962.27	
H-05c	MAG	3506.04	3/7/01	08:49	348.95	0.00	348.95	106.36	3157.09	962.28	
H-05c	MAG	3506.04	4/4/01	12:07	348.71	0.00	348.71	106.29	3157.33	962.35	
H-05c	MAG	3506.04	5/8/01	10:35	348.92	0.00	348.92	106.35	3157.12	962.29	
H-05c	MAG	3506.04	6/7/01	10:55	348.65	0.00	348.65	106.27	3157.39	962.37	
H-05c	MAG	3506.04	7/10/01	09:20	348.83	0.00	348.83	106.32	3157.21	962.32	
H-05c	MAG	3506.04	8/8/01	15:00	348.84	0.00	348.84	106.33	3157.20	962.31	
H-05c	MAG	3506.04	9/10/01	07:05	348.89	0.00	348.89	106.34	3157.15	962.30	
H-05c	MAG	3506.04	10/10/01	12:14	348.75	0.00	348.75	106.30	3157.29	962.34	
H-05c	MAG	3506.04	11/13/01	13:31	348.85	0.00	348.85	106.33	3157.19	962.31	
H-05c	MAG	3506.04	12/4/01	11:27	348.75	0.00	348.75	106.30	3157.29	962.34	
H-06a	CUL	3348.11	3/6/01	10:42	295.54	0.00	295.54	90.08	3052.57	930.42	3064.76
H-06a	CUL	3348.11	6/5/01	11:39	295.16	0.00	295.16	89.96	3052.95	930.54	3065.16
H-06a	CUL	3348.11	9/4/01	07:19	295.10	0.00	295.10	89.95	3053.01	930.56	3065.22
H-06a	CUL	3348.11	12/4/01	14:10	294.97	0.00	294.97	89.91	3053.14	930.60	3065.35
H-06b	CUL	3348.25	1/9/01	09:54	296.45	0.00	296.45	90.36	3051.80	930.19	3063.95
H-06b	CUL	3348.25	2/6/01	09:08	296.32	0.00	296.32	90.32	3051.93	930.23	3064.08
H-06b	CUL	3348.25	3/6/01	10:51	296.33	0.00	296.33	90.32	3051.92	930.23	3064.07
H-06b	CUL	3348.25	4/4/01	14:23	296.04	0.00	296.04	90.23	3052.21	930.31	3064.38
H-06b	CUL	3348.25	5/8/01	11:51	296.25	0.00	296.25	90.30	3052.00	930.25	3064.16
H-06b	CUL	3348.25	6/5/01	11:45	295.97	0.00	295.97	90.21	3052.28	930.33	3064.45
H-06b	CUL	3348.25	7/9/01	08:50	295.94	0.00	295.94	90.20	3052.31	930.34	3064.48
H-06b	CUL	3348.25	8/7/01	14:18	295.99	0.00	295.99	90.22	3052.26	930.33	3064.43
H-06b	CUL	3348.25	9/4/01	07:34	295.88	0.00	295.88	90.18	3052.37	930.36	3064.54
H-06b	CUL	3348.25	10/10/01	11:25	295.83	0.00	295.83	90.17	3052.42	930.38	3064.59
H-06b	CUL	3348.25	11/14/01	07:19	295.62	0.00	295.62	90.10	3052.63	930.44	3064.81
H-06b	CUL	3348.25	12/5/01	14:05	295.75	0.00	295.75	90.14	3052.50	930.40	3064.68
H-06c	MAG	3348.52	1/9/01	09:48	284.09	0.00	284.09	86.59	3064.43	934.04	
H-06c	MAG	3348.52	2/6/01	09:00	283.98	0.00	283.98	86.56	3064.54	934.07	

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-06c	MAG	3348.52	3/6/01	10:46	283.98	0.00	283.98	86.56	3064.54	934.07	
H-06c	MAG	3348.52	4/4/01	14:15	283.77	0.00	283.77	86.49	3064.75	934.14	
H-06c	MAG	3348.52	5/8/01	11:45	284.02	0.00	284.02	86.57	3064.50	934.06	
H-06c	MAG	3348.52	6/5/01	11:34	283.71	0.00	283.71	86.47	3064.81	934.15	
H-06c	MAG	3348.52	7/9/01	08:45	283.83	0.00	283.83	86.51	3064.69	934.12	
H-06c	MAG	3348.52	8/7/01	14:11	283.85	0.00	283.85	86.52	3064.67	934.11	
H-06c	MAG	3348.52	9/4/01	07:26	283.76	0.00	283.76	86.49	3064.76	934.14	
H-06c	MAG	3348.52	10/10/01	11:19	283.69	0.00	283.69	86.47	3064.83	934.16	
H-06c	MAG	3348.52	11/14/01	07:25	283.60	0.00	283.60	86.44	3064.92	934.19	
H-06c	MAG	3348.52	12/5/01	13:59	283.68	0.00	283.68	86.47	3064.84	934.16	
H-07b1	CUL	3164.17	3/5/01	11:44	166.30	0.00	166.30	50.69	2997.87	913.75	2998.32
H-07b1	CUL	3164.17	6/4/01	11:44	165.99	0.00	165.99	50.59	2998.18	913.85	2998.63
H-07b1	CUL	3164.17	9/5/01	08:05	166.44	0.00	166.44	50.73	2997.73	913.71	2998.18
H-07b1	CUL	3164.17	12/3/01	08:33	166.48	0.00	166.48	50.74	2997.69	913.70	2998.14
H-07b2	CUL	3164.40	1/10/01	09:11	166.48	0.00	166.48	50.74	2997.92	913.77	2997.83
H-07b2	CUL	3164.40	2/7/01	08:16	166.38	0.00	166.38	50.71	2998.02	913.80	2997.93
H-07b2	CUL	3164.40	3/5/01	11:40	166.79	0.00	166.79	50.84	2997.61	913.67	2997.52
H-07b2	CUL	3164.40	4/3/01	12:34	166.40	0.00	166.40	50.72	2998.00	913.79	2997.91
H-07b2	CUL	3164.40	5/7/01	10:32	166.66	0.00	166.66	50.80	2997.74	913.71	2997.65
H-07b2	CUL	3164.40	6/4/01	11:40	166.36	0.00	166.36	50.71	2998.04	913.80	2997.95
H-07b2	CUL	3164.40	7/9/01	09:49	166.68	0.00	166.68	50.80	2997.72	913.71	2997.63
H-07b2	CUL	3164.40	8/6/01	11:28	166.84	0.00	166.84	50.85	2997.56	913.66	2997.47
H-07b2	CUL	3164.40	9/5/01	07:53	166.80	0.00	166.80	50.84	2997.60	913.67	2997.51
H-07b2	CUL	3164.40	10/8/01	10:21	166.80	0.00	166.80	50.84	2997.60	913.67	2997.51
H-07b2	CUL	3164.40	11/12/01	15:22	166.80	0.00	166.80	50.84	2997.60	913.67	2997.51
H-07b2	CUL	3164.40	12/3/01	08:24	166.86	0.00	166.86	50.86	2997.54	913.65	2997.45
H-08a	MAG	3432.99	1/10/01	09:45	405.95	0.00	405.95	123.73	3027.04	922.64	
H-08a	MAG	3432.99	2/7/01	08:53	406.05	0.00	406.05	123.76	3026.94	922.61	
H-08a	MAG	3432.99	3/5/01	11:06	405.90	0.00	405.90	123.72	3027.09	922.66	
H-08a	MAG	3432.99	4/3/01	13:35	405.88	0.00	405.88	123.71	3027.11	922.66	
H-08a	MAG	3432.99	5/7/01	11:01	405.88	0.00	405.88	123.71	3027.11	922.66	
H-08a	MAG	3432.99	6/7/01	08:48	405.89	0.00	405.89	123.72	3027.10	922.66	
H-08a	MAG	3432.99	7/10/01	13:15	405.96	0.00	405.96	123.74	3027.03	922.64	
H-08a	MAG	3432.99	8/6/01	12:25	405.99	0.00	405.99	123.75	3027.00	922.63	
H-08a	MAG	3432.99	9/5/01	08:35	406.04	0.00	406.04	123.76	3026.95	922.61	
H-08a	MAG	3432.99	10/9/01	07:46	406.11	0.00	406.11	123.78	3026.88	922.59	
H-08a	MAG	3432.99	11/13/01	09:55	406.15	0.00	406.15	123.79	3026.84	922.58	

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-08a	MAG	3432.99	12/4/01	08:20	406.16	0.00	406.16	123.80	3026.83	922.58	
H-08c	RUS/SAL	3432.90	1/10/01	09:50	453.79	0.00	453.79	138.32	2979.11	908.03	
H-08c	RUS/SAL	3432.90	2/7/01	09:00	453.88	0.00	453.88	138.34	2979.02	908.01	
H-08c	RUS/SAL	3432.90	3/5/01	11:11	453.73	0.00	453.73	138.30	2979.17	908.05	
H-08c	RUS/SAL	3432.90	4/3/01	13:45	453.79	0.00	453.79	138.32	2979.11	908.03	
H-08c	RUS/SAL	3432.90	5/7/01	11:06	453.65	0.00	453.65	138.27	2979.25	908.08	
H-08c	RUS/SAL	3432.90	6/7/01	09:05	453.62	0.00	453.62	138.26	2979.28	908.08	
H-08c	RUS/SAL	3432.90	7/10/01	13:25	453.60	0.00	453.60	138.26	2979.30	908.09	
H-08c	RUS/SAL	3432.90	8/6/01	12:33	453.61	0.00	453.61	138.26	2979.29	908.09	
H-08c	RUS/SAL	3432.90	9/5/01	08:45	453.65	0.00	453.65	138.27	2979.25	908.08	
H-08c	RUS/SAL	3432.90	10/9/01	08:00	453.55	0.00	453.55	138.24	2979.35	908.11	
H-08c	RUS/SAL	3432.90	11/13/01	10:01	453.67	0.00	453.67	138.28	2979.23	908.07	
H-08c	RUS/SAL	3432.90	12/4/01	08:28	453.68	0.00	453.68	138.28	2979.22	908.07	
H-09a	CUL	3406.68	3/5/01	10:42	415.35	0.54	414.81	126.43	2991.87	911.92	2992.12
H-09a	CUL	3406.68	6/6/01	14:38	414.73	0.54	414.19	126.25	2992.49	912.11	2992.74
H-09a	CUL	3406.68	9/5/01	09:55	416.08	0.54	415.54	126.66	2991.14	911.70	2991.39
H-09a	CUL	3406.68	12/4/01	07:57	414.23	0.00	414.23	126.26	2992.45	912.10	2992.70
H-09b	CUL	3406.86	1/10/01	10:11	415.96	0.00	415.96	126.78	2990.90	911.63	2991.15
H-09b	CUL	3406.86	2/7/01	09:23	415.05	0.00	415.05	126.51	2991.81	911.90	2992.06
H-09b	CUL	3406.86	3/5/01	10:28	414.67	0.00	414.67	126.39	2992.19	912.02	2992.44
H-09b	CUL	3406.86	4/3/01	14:10	413.91	0.00	413.91	126.16	2992.95	912.25	2993.20
H-09b	CUL	3406.86	5/7/01	13:25	413.87	0.00	413.87	126.15	2992.99	912.26	2993.24
H-09b	CUL	3406.86	6/6/01	14:26	414.04	0.00	414.04	126.20	2992.82	912.21	2993.07
H-09b	CUL	3406.86	7/10/01	13:45	415.47	0.00	415.47	126.64	2991.39	911.78	2991.64
H-09b	CUL	3406.86	8/6/01	13:11	415.75	0.00	415.75	126.72	2991.11	911.69	2991.36
H-09b	CUL	3406.86	9/5/01	09:45	415.39	0.00	415.39	126.61	2991.47	911.80	2991.72
H-09b	CUL	3406.86	10/9/01	08:35	414.83	0.00	414.83	126.44	2992.03	911.97	2992.28
H-09b	CUL	3406.86	11/13/01	10:27	416.27	0.00	416.27	126.88	2990.59	911.53	2990.84
H-09b	CUL	3406.86	12/4/01	07:49	415.55	0.00	415.55	126.66	2991.31	911.75	2991.56
H-09c	CUL	3407.30	3/5/01	10:36	415.57	0.00	415.57	126.67	2991.73	911.88	2991.98
H-09c	CUL	3407.30	6/6/01	14:15	414.96	0.00	414.96	126.48	2992.34	912.07	2992.59
H-09c	CUL	3407.30	9/5/01	09:35	416.30	0.00	416.30	126.89	2991.00	911.66	2991.25
H-09c	CUL	3407.30	12/4/01	07:36	414.92	0.00	414.92	126.47	2992.38	912.08	2992.63
H-10a	MAG	3688.67	1/10/01	10:42	528.39	0.00	528.39	161.05	3160.28	963.25	
H-10a	MAG	3688.67	2/7/01	10:00	528.41	0.00	528.41	161.06	3160.26	963.25	
H-10a	MAG	3688.67	3/7/01	10:02	528.08	0.00	528.08	160.96	3160.59	963.35	
H-10a	MAG	3688.67	4/4/01	09:04	527.92	0.00	527.92	160.91	3160.75	963.40	

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-10a	MAG	3688.67	5/7/01	14:15	527.85	0.00	527.85	160.89	3160.82	963.42	
H-10a	MAG	3688.67	6/6/01	13:30	527.49	0.00	527.49	160.78	3161.18	963.53	
H-10a	MAG	3688.67	7/11/01	13:15	526.91	0.00	526.91	160.60	3161.76	963.70	
H-10a	MAG	3688.67	8/6/01	14:18	526.63	0.00	526.63	160.52	3162.04	963.79	
H-10a	MAG	3688.67	9/5/01	12:20	526.54	0.00	526.54	160.49	3162.13	963.82	
H-10a	MAG	3688.67	10/9/01	09:56	526.51	0.00	526.51	160.48	3162.16	963.83	
H-10a	MAG	3688.67	11/13/01	11:10	526.59	0.00	526.59	160.50	3162.08	963.80	
H-10a	MAG	3688.67	12/4/01	09:24	526.49	0.00	526.49	160.47	3162.18	963.83	
H-10b	CUL	3689.47	1/10/01	10:53	694.60	0.00	694.60	211.71	2994.87	912.84	3026.99
H-10b	CUL	3689.47	2/7/01	10:12	694.57	0.00	694.57	211.70	2994.90	912.85	3027.02
H-10b	CUL	3689.47	3/7/01	10:08	694.64	0.00	694.64	211.73	2994.83	912.82	3026.95
H-10b	CUL	3689.47	4/4/01	09:20	694.49	0.00	694.49	211.68	2994.98	912.87	3027.10
H-10b	CUL	3689.47	5/7/01	14:22	694.44	0.00	694.44	211.67	2995.03	912.89	3027.16
H-10b	CUL	3689.47	6/6/01	13:37	694.07	0.00	694.07	211.55	2995.40	913.00	3027.54
H-10b	CUL	3689.47	7/11/01	13:25	694.22	0.00	694.22	211.60	2995.25	912.95	3027.39
H-10b	CUL	3689.47	8/6/01	13:56	694.30	0.00	694.30	211.62	2995.17	912.93	3027.30
H-10b	CUL	3689.47	9/5/01	12:30	694.46	0.00	694.46	211.67	2995.01	912.88	3027.13
H-10b	CUL	3689.47	10/9/01	10:09	694.60	0.00	694.60	211.71	2994.87	912.84	3026.99
H-10b	CUL	3689.47	11/13/01	11:18	694.80	0.00	694.80	211.78	2994.67	912.78	3026.78
H-10b	CUL	3689.47	12/4/01	09:33	694.77	0.00	694.77	211.77	2994.70	912.78	3026.81
H-11b1	CUL	3411.62	3/7/01	10:56	431.05	0.00	431.05	131.38	2980.57	908.48	3003.70
H-11b1	CUL	3411.62	6/6/01	10:43	430.42	0.00	430.42	131.19	2981.20	908.67	3004.38
H-11b1	CUL	3411.62	9/5/01	13:42	430.30	0.00	430.30	131.16	2981.32	908.71	3004.50
H-11b1	CUL	3411.62	12/3/01	10:38	430.39	0.00	430.39	131.18	2981.23	908.68	3004.41
H-11b2	CUL	3411.64	3/5/01	13:09	431.59	0.00	431.59	131.55	2980.05	908.32	3003.90
H-11b2	MAG	3411.64	6/6/01	10:55	284.24	0.00	284.24	86.64	3127.40	953.23	
H-11b2	MAG	3411.64	7/10/01	10:24	284.16	0.00	284.16	86.61	3127.48	953.26	
H-11b2	MAG	3411.64	9/11/01	09:20	284.30	0.00	284.30	86.65	3127.34	953.21	
H-11b2	MAG	3411.64	10/3/01	13:10	284.12	0.00	284.12	86.60	3127.52	953.27	
H-11b2	MAG	3411.64	11/12/01	10:10	284.16	0.00	284.16	86.61	3127.48	953.26	
H-11b2	MAG	3411.64	12/3/01	10:22	284.05	0.00	284.05	86.58	3127.59	953.29	
H-11b3	CUL	3412.42	3/7/01	11:01	432.21	0.00	432.21	131.74	2980.21	908.37	3005.07
H-11b3	CUL	3412.42	6/6/01	11:00	431.56	0.00	431.56	131.54	2980.86	908.57	3005.77
H-11b3	CUL	3412.42	9/5/01	13:50	431.73	0.00	431.73	131.59	2980.69	908.51	3005.59
H-11b3	CUL	3412.42	12/3/01	10:44	431.55	0.00	431.55	131.54	2980.87	908.57	3005.78
H-11b4	CUL	3410.89	1/10/01	13:03	427.12	0.00	427.12	130.19	2983.77	909.45	3003.82
H-11b4	CUL	3410.89	2/5/01	13:13	427.07	0.00	427.07	130.17	2983.82	909.47	3003.87

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-11b4	CUL	3410.89	3/7/01	10:51	426.91	0.00	426.91	130.12	2983.98	909.52	3004.04
H-11b4	CUL	3410.89	4/5/01	08:49	426.56	0.00	426.56	130.02	2984.33	909.62	3004.41
H-11b4	CUL	3410.89	5/9/01	10:42	426.46	0.00	426.46	129.99	2984.43	909.65	3004.52
H-11b4	CUL	3410.89	6/6/01	10:38	426.25	0.00	426.25	129.92	2984.64	909.72	3004.74
H-11b4	CUL	3410.89	7/10/01	10:15	426.22	0.00	426.22	129.91	2984.67	909.73	3004.78
H-11b4	CUL	3410.89	8/7/01	08:14	426.50	0.00	426.50	130.00	2984.39	909.64	3004.48
H-11b4	CUL	3410.89	9/5/01	13:40	426.42	0.00	426.42	129.97	2984.47	909.67	3004.56
H-11b4	CUL	3410.89	10/9/01	11:37	426.25	0.00	426.25	129.92	2984.64	909.72	3004.74
H-11b4	CUL	3410.89	11/12/01	10:22	426.41	0.00	426.41	129.97	2984.48	909.67	3004.57
H-11b4	CUL	3410.89	12/3/01	10:32	426.24	0.00	426.24	129.92	2984.65	909.72	3004.75
H-12	CUL	3427.19	1/10/01	11:32	458.05	0.00	458.05	139.61	2969.14	904.99	3006.35
H-12	CUL	3427.19	2/7/01	10:40	458.03	0.00	458.03	139.61	2969.16	905.00	3006.37
H-12	CUL	3427.19	3/7/01	09:26	458.02	0.00	458.02	139.60	2969.17	905.00	3006.38
H-12	CUL	3427.19	4/4/01	10:19	457.80	0.00	457.80	139.54	2969.39	905.07	3006.62
H-12	CUL	3427.19	5/7/01	15:03	457.81	0.00	457.81	139.54	2969.38	905.07	3006.61
H-12	CUL	3427.19	6/6/01	12:54	457.56	0.00	457.56	139.46	2969.63	905.14	3006.88
H-12	CUL	3427.19	7/10/01	09:45	457.63	0.00	457.63	139.49	2969.56	905.12	3006.81
H-12	CUL	3427.19	8/7/01	07:47	457.70	0.00	457.70	139.51	2969.49	905.10	3006.73
H-12	CUL	3427.19	9/5/01	13:05	456.64	0.00	456.64	139.18	2970.55	905.42	3007.89
H-12	CUL	3427.19	10/9/01	11:03	457.61	0.00	457.61	139.48	2969.58	905.13	3006.83
H-12	CUL	3427.19	11/13/01	13:46	457.64	0.00	457.64	139.49	2969.55	905.12	3006.80
H-12	CUL	3427.19	12/4/01	10:13	457.56	0.00	457.56	139.46	2969.63	905.14	3006.88
H-14	CUL	3347.11	1/10/01	14:31	337.58	0.00	337.58	102.89	3009.53	917.30	3012.41
H-14	CUL	3347.11	2/5/01	10:56	337.71	0.00	337.71	102.93	3009.40	917.27	3012.28
H-14	CUL	3347.11	3/8/01	08:25	337.48	0.00	337.48	102.86	3009.63	917.34	3012.51
H-14	MAG	3347.11	4/5/01	14:07	240.12	0.00	240.12	73.19	3106.99	947.01	
H-14	MAG	3347.11	5/9/01	08:13	312.04	0.00	312.04	95.11	3035.07	925.09	
H-14	MAG	3347.11	6/6/01	09:10	297.80	0.00	297.80	90.77	3049.31	929.43	
H-14	MAG	3347.11	7/11/01	08:37	281.79	0.00	281.79	85.89	3065.32	934.31	
H-14	MAG	3347.11	9/12/01	07:15	256.72	0.00	256.72	78.25	3090.39	941.95	
H-14	MAG	3347.11	10/3/01	13:00	251.11	0.00	251.11	76.54	3096.00	943.66	
H-14	MAG	3347.11	11/12/01	13:53	245.25	0.00	245.25	74.75	3101.86	945.45	
H-14	MAG	3347.11	12/3/01	12:29	244.64	0.00	244.64	74.57	3102.47	945.63	
H-15	CUL	3481.63	1/9/01	12:53	519.62	0.00	519.62	158.38	2962.01	902.82	3015.22
H-15	CUL	3481.63	2/5/01	10:20	519.73	0.00	519.73	158.41	2961.90	902.79	3015.10
H-15	CUL	3481.63	3/5/01	09:53	519.41	0.00	519.41	158.32	2962.22	902.88	3015.47
H-15	MAG	3481.63	4/6/01	07:50	382.94	0.00	382.94	116.72	3098.69	944.48	

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-15	MAG	3481.63	5/8/01	07:07	369.42	0.00	369.42	112.60	3112.21	948.60	
H-15	MAG	3481.63	6/7/01	11:21	369.04	0.00	369.04	112.48	3112.59	948.72	
H-15	MAG	3481.63	7/11/01	07:45	368.59	0.00	368.59	112.35	3113.04	948.85	
H-15	MAG	3481.63	9/12/01	06:45	368.77	0.00	368.77	112.40	3112.86	948.80	
H-15	MAG	3481.63	10/3/01	11:05	368.10	0.00	368.10	112.20	3113.53	949.00	
H-15	MAG	3481.63	11/12/01	13:20	368.68	0.00	368.68	112.37	3112.95	948.83	
H-15	MAG	3481.63	12/3/01	07:54	368.63	0.00	368.63	112.36	3113.00	948.84	
H-17	CUL	3385.31	1/10/01	12:14	424.46	0.00	424.46	129.38	2960.85	902.47	3009.89
H-17	CUL	3385.31	2/5/01	12:30	424.52	0.00	424.52	129.39	2960.79	902.45	3009.82
H-17	CUL	3385.31	3/7/01	11:19	424.19	0.00	424.19	129.29	2961.12	902.55	3010.21
H-17	CUL	3385.31	4/5/01	07:49	423.85	0.00	423.85	129.19	2961.46	902.65	3010.60
H-17	CUL	3385.31	5/9/01	09:55	423.79	0.00	423.79	129.17	2961.52	902.67	3010.67
H-17	CUL	3385.31	6/6/01	11:40	423.41	0.00	423.41	129.06	2961.90	902.79	3011.12
H-17	CUL	3385.31	7/11/01	09:44	423.41	0.00	423.41	129.06	2961.90	902.79	3011.12
H-17	CUL	3385.31	8/7/01	08:28	423.57	0.00	423.57	129.10	2961.74	902.74	3010.93
H-17	CUL	3385.31	9/5/01	13:58	423.54	0.00	423.54	129.09	2961.77	902.75	3010.96
H-17	CUL	3385.31	10/9/01	11:53	423.59	0.00	423.59	129.11	2961.72	902.73	3010.91
H-17	CUL	3385.31	11/13/01	14:16	423.44	0.00	423.44	129.06	2961.87	902.78	3011.08
H-17	CUL	3385.31	12/4/01	10:48	423.34	0.00	423.34	129.03	2961.97	902.81	3011.20
H-18	CUL	3414.21	1/9/01	09:32	354.55	0.00	354.55	108.07	3059.66	932.58	3074.93
H-18	CUL	3414.21	2/5/01	08:45	354.51	0.00	354.51	108.05	3059.70	932.60	3074.97
H-18	CUL	3414.21	3/6/01	11:10	354.60	0.00	354.60	108.08	3059.61	932.57	3074.88
H-18	MAG	3414.21	4/4/01	14:40	474.48	0.00	474.48	144.62	2939.73	896.03	
H-18	MAG	3414.21	5/8/01	11:30	335.62	0.00	335.62	102.30	3078.59	938.35	
H-18	MAG	3414.21	6/5/01	12:00	335.79	0.00	335.79	102.35	3078.42	938.30	
H-18	MAG	3414.21	7/9/01	08:29	336.09	0.00	336.09	102.44	3078.12	938.21	
H-18	MAG	3414.21	9/12/01	08:10	336.87	0.00	336.87	102.68	3077.34	937.97	
H-18	MAG	3414.21	10/3/01	09:10	336.85	0.00	336.85	102.67	3077.36	937.98	
H-18	MAG	3414.21	11/12/01	14:10	337.04	0.00	337.04	102.73	3077.17	937.92	
H-18	MAG	3414.21	12/3/01	12:29	336.96	0.00	336.96	102.71	3077.25	937.95	
H-19b0	CUL	3418.38	1/10/01	13:49	429.38	0.00	429.38	130.88	2989.00	911.05	3010.72
H-19b0	CUL	3418.38	2/6/01	14:45	429.35	0.00	429.35	130.87	2989.03	911.06	3010.75
H-19b0	CUL	3418.38	3/8/01	07:56	429.04	0.00	429.04	130.77	2989.34	911.15	3011.08
H-19b0	CUL	3418.38	4/5/01	09:16	428.98	0.00	428.98	130.75	2989.40	911.17	3011.14
H-19b0	CUL	3418.38	5/9/01	09:17	429.40	0.00	429.40	130.88	2988.98	911.04	3010.70
H-19b0	CUL	3418.38	6/6/01	08:20	428.90	0.00	428.90	130.73	2989.48	911.19	3011.23
H-19b0	CUL	3418.38	7/11/01	08:05	428.67	0.00	428.67	130.66	2989.71	911.26	3011.48

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
H-19b0	CUL	3418.38	8/7/01	10:06	428.64	0.00	428.64	130.65	2989.74	911.27	3011.51
H-19b0	CUL	3418.38	9/7/01	08:20	428.33	0.00	428.33	130.55	2990.05	911.37	3011.84
H-19b0	CUL	3418.38	10/9/01	13:17	428.30	0.00	428.30	130.55	2990.08	911.38	3011.87
H-19b0	CUL	3418.38	11/13/01	14:59	428.66	0.00	428.66	130.66	2989.72	911.27	3011.49
H-19b0	CUL	3418.38	12/5/01	11:40	428.65	0.00	428.65	130.65	2989.73	911.27	3011.50
H-19b2	CUL	3419.01	3/8/01	08:16	430.33	0.00	430.33	131.16	2988.68	910.95	3010.48
H-19b2	CUL	3419.01	6/6/01	08:06	430.23	0.00	430.23	131.13	2988.78	910.98	3010.59
H-19b2	CUL	3419.01	9/7/01	08:03	429.63	0.00	429.63	130.95	2989.38	911.16	3011.23
H-19b2	CUL	3419.01	12/5/01	11:22	429.93	0.00	429.93	131.04	2989.08	911.07	3010.91
H-19b3	CUL	3419.09	3/8/01	08:37	430.55	0.00	430.55	131.23	2988.54	910.91	3010.23
H-19b3	CUL	3419.09	6/6/01	08:26	430.38	0.00	430.38	131.18	2988.71	910.96	3010.41
H-19b3	CUL	3419.09	9/7/01	12:55	429.83	0.00	429.83	131.01	2989.26	911.13	3011.00
H-19b3	CUL	3419.09	12/5/01	12:00	430.14	0.00	430.14	131.11	2988.95	911.03	3010.67
H-19b4	CUL	3419.03	3/8/01	08:21	429.78	0.00	429.78	131.00	2989.25	911.12	3010.84
H-19b4	CUL	3419.03	6/6/01	08:34	429.40	0.00	429.40	130.88	2989.63	911.24	3011.24
H-19b4	CUL	3419.03	9/7/01	08:26	429.08	0.00	429.08	130.78	2989.95	911.34	3011.58
H-19b4	CUL	3419.03	12/5/01	11:49	429.49	0.00	429.49	130.91	2989.54	911.21	3011.15
H-19b5	CUL	3418.63	3/8/01	08:11	429.94	0.00	429.94	131.05	2988.69	910.95	3010.18
H-19b5	CUL	3418.63	6/6/01	08:10	429.75	0.00	429.75	130.99	2988.88	911.01	3010.38
H-19b5	CUL	3418.63	9/7/01	08:15	429.24	0.00	429.24	130.83	2989.39	911.17	3010.93
H-19b5	CUL	3418.63	12/5/01	11:33	429.51	0.00	429.51	130.91	2989.12	911.08	3010.64
H-19b6	CUL	3419.07	3/8/01	08:28	430.43	0.00	430.43	131.20	2988.64	910.94	3010.27
H-19b6	CUL	3419.07	6/6/01	08:39	430.29	0.00	430.29	131.15	2988.78	910.98	3010.42
H-19b6	CUL	3419.07	9/7/01	13:02	429.71	0.00	429.71	130.98	2989.36	911.16	3011.04
H-19b6	CUL	3419.07	12/5/01	12:06	430.04	0.00	430.04	131.08	2989.03	911.06	3010.69
H-19b7	CUL	3418.99	3/8/01	08:06	430.57	0.00	430.57	131.24	2988.42	910.87	3010.08
H-19b7	CUL	3418.99	6/6/01	08:03	430.42	0.00	430.42	131.19	2988.57	910.92	3010.24
H-19b7	CUL	3418.99	9/7/01	08:05	429.89	0.00	429.89	131.03	2989.10	911.08	3010.80
H-19b7	CUL	3418.99	12/5/01	11:28	430.18	0.00	430.18	131.12	2988.81	910.99	3010.50
P-15	CUL	3311.38	1/8/01	12:14	295.55	0.00	295.55	90.08	3015.83	919.22	3016.61
P-15	CUL	3311.38	2/5/01	10:42	295.80	0.00	295.80	90.16	3015.58	919.15	3016.36
P-15	CUL	3311.38	3/8/01	09:42	295.35	0.00	295.35	90.02	3016.03	919.29	3016.81
P-15	CUL	3311.38	4/5/01	14:32	295.56	0.00	295.56	90.09	3015.82	919.22	3016.60
P-15	CUL	3311.38	5/8/01	14:24	295.79	0.00	295.79	90.16	3015.59	919.15	3016.37
P-15	CUL	3311.38	6/4/01	12:10	295.45	0.00	295.45	90.05	3015.93	919.26	3016.71
P-15	CUL	3311.38	7/11/01	09:20	295.69	0.00	295.69	90.13	3015.69	919.18	3016.47
P-15	CUL	3311.38	8/7/01	12:34	295.77	0.00	295.77	90.15	3015.61	919.16	3016.39

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
P-15	CUL	3311.38	9/5/01	11:20	295.78	0.00	295.78	90.15	3015.60	919.15	3016.38
P-15	CUL	3311.38	10/8/01	10:43	295.78	0.00	295.78	90.15	3015.60	919.15	3016.38
P-15	CUL	3311.38	11/12/01	08:57	295.90	0.00	295.90	90.19	3015.48	919.12	3016.26
P-15	CUL	3311.38	12/5/01	09:40	295.78	0.00	295.78	90.15	3015.60	919.15	3016.38
P-17	CUL	3337.24	1/10/01	12:29	355.06	0.54	354.52	108.06	2982.72	909.13	2996.85
P-17	CUL	3337.24	2/5/01	12:25	355.18	0.54	354.64	108.09	2982.60	909.10	2996.73
P-17	CUL	3337.24	3/7/01	11:36	354.94	0.54	354.40	108.02	2982.84	909.17	2996.98
P-17	CUL	3337.24	4/5/01	07:11	354.68	0.54	354.14	107.94	2983.10	909.25	2997.26
P-17	CUL	3337.24	5/9/01	10:09	354.61	0.54	354.07	107.92	2983.17	909.27	2997.33
P-17	CUL	3337.24	6/6/01	11:55	354.32	0.54	353.78	107.83	2983.46	909.36	2997.64
P-17	CUL	3337.24	7/11/01	10:05	354.31	0.54	353.77	107.83	2983.47	909.36	2997.65
P-17	CUL	3337.24	8/7/01	08:46	354.48	0.54	353.94	107.88	2983.30	909.31	2997.47
P-17	CUL	3337.24	9/5/01	14:15	354.54	0.54	354.00	107.90	2983.24	909.29	2997.41
P-17	CUL	3337.24	10/9/01	12:10	354.47	0.54	353.93	107.88	2983.31	909.31	2997.48
P-17	CUL	3337.24	11/12/01	09:40	354.53	0.54	353.99	107.90	2983.25	909.29	2997.42
P-17	CUL	3337.24	12/3/01	09:43	354.43	0.54	353.89	107.87	2983.35	909.33	2997.53
P-18	CUL	3478.42	1/10/01	11:51	316.48	0.68	315.80	96.26	3162.62	963.97	3234.14
P-18	CUL	3478.42	2/7/01	11:15	316.37	0.68	315.69	96.22	3162.73	964.00	3234.27
P-18	CUL	3478.42	3/7/01	09:11	316.17	0.68	315.49	96.16	3162.93	964.06	3234.49
P-18	CUL	3478.42	4/4/01	10:55	316.02	0.68	315.34	96.12	3163.08	964.11	3234.66
P-18	CUL	3478.42	5/7/01	15:24	315.86	0.68	315.18	96.07	3163.24	964.16	3234.84
P-18	CUL	3478.42	6/6/01	12:32	315.72	0.68	315.04	96.02	3163.38	964.20	3234.99
P-18	CUL	3478.42	7/10/01	10:03	315.60	0.68	314.92	95.99	3163.50	964.23	3235.13
P-18	CUL	3478.42	8/7/01	07:32	315.52	0.68	314.84	95.96	3163.58	964.26	3235.22
P-18	CUL	3478.42	9/5/01	13:25	315.38	0.68	314.70	95.92	3163.72	964.30	3235.37
P-18	CUL	3478.42	10/9/01	11:22	315.28	0.68	314.60	95.89	3163.82	964.33	3235.48
P-18	CUL	3478.42	11/13/01	14:02	315.15	0.68	314.47	95.85	3163.95	964.37	3235.63
P-18	CUL	3478.42	12/4/01	10:30	315.05	0.68	314.37	95.82	3164.05	964.40	3235.74
WIPP-12	CUL	3472.06	1/9/01	10:39	440.47	0.00	440.47	134.26	3031.59	924.03	3088.34
WIPP-12	CUL	3472.06	2/5/01	09:35	440.53	0.00	440.53	134.27	3031.53	924.01	3088.27
WIPP-12	CUL	3472.06	3/7/01	14:02	440.37	0.00	440.37	134.22	3031.69	924.06	3088.45
WIPP-12	CUL	3472.06	4/5/01	12:30	440.22	0.00	440.22	134.18	3031.84	924.10	3088.61
WIPP-12	CUL	3472.06	5/8/01	13:02	440.30	0.00	440.30	134.20	3031.76	924.08	3088.52
WIPP-12	CUL	3472.06	6/5/01	13:45	439.97	0.00	439.97	134.10	3032.09	924.18	3088.89
WIPP-12	CUL	3472.06	7/11/01	06:45	440.05	0.00	440.05	134.13	3032.01	924.16	3088.80
WIPP-12	CUL	3472.06	8/8/01	13:28	440.08	0.00	440.08	134.14	3031.98	924.15	3088.77
WIPP-12	CUL	3472.06	9/6/01	06:55	440.13	0.00	440.13	134.15	3031.93	924.13	3088.71

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
WIPP-12	CUL	3472.06	10/10/01	13:12	440.09	0.00	440.09	134.14	3031.97	924.14	3088.75
WIPP-12	CUL	3472.06	11/14/01	08:49	440.13	0.00	440.13	134.15	3031.93	924.13	3088.71
WIPP-12	CUL	3472.06	12/5/01	14:53	439.91	0.00	439.91	134.08	3032.15	924.20	3088.95
WIPP-13	CUL	3405.71	1/8/01	14:11	348.85	0.64	348.21	106.13	3057.50	931.93	3088.07
WIPP-13	CUL	3405.71	2/5/01	14:09	348.81	0.64	348.17	106.12	3057.54	931.94	3088.12
WIPP-13	CUL	3405.71	3/6/01	12:36	348.89	0.64	348.25	106.15	3057.46	931.91	3088.03
WIPP-13	CUL	3405.71	4/4/01	13:55	348.38	0.00	348.38	106.19	3057.33	931.87	3087.90
WIPP-13	CUL	3405.71	5/7/01	09:52	348.28	0.00	348.28	106.16	3057.43	931.90	3088.00
WIPP-13	CUL	3405.71	6/5/01	13:00	348.09	0.00	348.09	106.10	3057.62	931.96	3088.20
WIPP-13	CUL	3405.71	7/9/01	07:55	348.23	0.00	348.23	106.14	3057.48	931.92	3088.05
WIPP-13	CUL	3405.71	8/8/01	10:54	348.40	0.00	348.40	106.19	3057.31	931.87	3087.88
WIPP-13	CUL	3405.71	9/4/01	12:51	348.67	0.00	348.67	106.27	3057.04	931.79	3087.60
WIPP-13	CUL	3405.71	10/10/01	10:30	348.52	0.00	348.52	106.23	3057.19	931.83	3087.76
WIPP-13	CUL	3405.71	11/14/01	08:13	348.45	0.00	348.45	106.21	3057.26	931.85	3087.83
WIPP-13	CUL	3405.71	12/5/01	15:12	348.63	0.00	348.63	106.26	3057.08	931.80	3087.64
WIPP-18	CUL	3458.76	1/9/01	10:58	425.11	0.00	425.11	129.57	3033.65	924.66	3071.12
WIPP-18	CUL	3458.76	2/5/01	09:45	425.23	0.00	425.23	129.61	3033.53	924.62	3070.99
WIPP-18	CUL	3458.76	3/5/01	09:29	425.07	0.00	425.07	129.56	3033.69	924.67	3071.17
WIPP-18	MAG	3458.76	4/5/01	12:37	522.65	0.00	522.65	159.30	2936.11	894.93	
WIPP-18	MAG	3458.76	5/8/01	12:43	319.19	0.00	319.19	97.29	3139.57	956.94	
WIPP-18	MAG	3458.76	6/5/01	13:54	318.08	0.00	318.08	96.95	3140.68	957.28	
WIPP-18	MAG	3458.76	7/11/01	06:50	318.61	0.00	318.61	97.11	3140.15	957.12	
WIPP-18	MAG	3458.76	9/12/01	10:22:05	326.62	0.00	326.62	99.55	3132.14	954.68	
WIPP-18	MAG	3458.76	10/3/01	10:22:05	332.88	0.00	332.88	101.46	3125.88	952.77	
WIPP-18	MAG	3458.76	11/12/01	10:22:05	342.33	0.00	342.33	104.34	3116.43	949.89	
WIPP-18	MAG	3458.76	12/3/01	10:22:05	345.90	0.00	345.90	105.43	3112.86	948.80	
WIPP-19	CUL	3435.14	1/9/01	11:05	396.15	0.00	396.15	120.75	3038.99	926.28	3076.70
WIPP-19	CUL	3435.14	2/5/01	09:53	396.32	0.00	396.32	120.80	3038.82	926.23	3076.51
WIPP-19	CUL	3435.14	3/7/01	13:54	396.16	0.00	396.16	120.75	3038.98	926.28	3076.69
WIPP-19	CUL	3435.14	4/5/01	12:50	396.01	0.00	396.01	120.70	3039.13	926.33	3076.85
WIPP-19	CUL	3435.14	5/8/01	12:30	396.10	0.00	396.10	120.73	3039.04	926.30	3076.75
WIPP-19	CUL	3435.14	6/5/01	14:04	395.69	0.00	395.69	120.61	3039.45	926.42	3077.21
WIPP-19	CUL	3435.14	7/11/01	07:00	395.58	0.00	395.58	120.57	3039.56	926.46	3077.33
WIPP-19	CUL	3435.14	8/8/01	13:37	395.51	0.00	395.51	120.55	3039.63	926.48	3077.40
WIPP-19	CUL	3435.14	9/6/01	07:10	395.40	0.00	395.40	120.52	3039.74	926.51	3077.53
WIPP-19	CUL	3435.14	10/10/01	13:24	395.30	0.00	395.30	120.49	3039.84	926.54	3077.64
WIPP-19	CUL	3435.14	11/14/01	08:55	395.18	0.00	395.18	120.45	3039.96	926.58	3077.77

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
WIPP-19	CUL	3435.14	12/5/01	14:58	395.31	0.00	395.31	120.49	3039.83	926.54	3077.62
WIPP-21	CUL	3418.96	1/9/01	12:39	404.03	0.00	404.03	123.15	3014.93	918.95	3038.99
WIPP-21	CUL	3418.96	2/5/01	10:00	404.53	0.00	404.53	123.30	3014.43	918.80	3038.46
WIPP-21	CUL	3418.96	3/7/01	13:39	404.08	0.00	404.08	123.16	3014.88	918.94	3038.94
WIPP-21	CUL	3418.96	4/5/01	13:03	403.64	0.00	403.64	123.03	3015.32	919.07	3039.41
WIPP-21	CUL	3418.96	5/8/01	12:11	403.54	0.00	403.54	123.00	3015.42	919.10	3039.52
WIPP-21	CUL	3418.96	6/5/01	14:26	403.03	0.00	403.03	122.84	3015.93	919.26	3040.07
WIPP-21	CUL	3418.96	7/11/01	07:25	402.91	0.00	402.91	122.81	3016.05	919.29	3040.19
WIPP-21	CUL	3418.96	8/8/01	13:50	402.80	0.00	402.80	122.77	3016.16	919.33	3040.31
WIPP-21	CUL	3418.96	9/6/01	07:45	402.69	0.00	402.69	122.74	3016.27	919.36	3040.43
WIPP-21	CUL	3418.96	10/10/01	13:51	402.60	0.00	402.60	122.71	3016.36	919.39	3040.53
WIPP-21	CUL	3418.96	11/14/01	09:08	402.65	0.00	402.65	122.73	3016.31	919.37	3040.47
WIPP-21	CUL	3418.96	12/5/01	15:02	402.86	0.00	402.86	122.79	3016.10	919.31	3040.25
WIPP-22	CUL	3428.12	1/9/01	12:29	398.99	0.00	398.99	121.61	3029.13	923.28	3060.11
WIPP-22	CUL	3428.12	2/5/01	09:56	399.28	0.00	399.28	121.70	3028.84	923.19	3059.80
WIPP-22	CUL	3428.12	3/7/01	13:43	399.04	0.00	399.04	121.63	3029.08	923.26	3060.06
WIPP-22	CUL	3428.12	4/5/01	12:58	398.80	0.00	398.80	121.55	3029.32	923.34	3060.32
WIPP-22	CUL	3428.12	5/8/01	12:22	398.80	0.00	398.80	121.55	3029.32	923.34	3060.32
WIPP-22	CUL	3428.12	6/5/01	14:15	398.35	0.00	398.35	121.42	3029.77	923.47	3060.81
WIPP-22	CUL	3428.12	7/11/01	07:09	398.27	0.00	398.27	121.39	3029.85	923.50	3060.90
WIPP-22	CUL	3428.12	8/8/01	13:43	398.20	0.00	398.20	121.37	3029.92	923.52	3060.97
WIPP-22	CUL	3428.12	9/6/01	07:34	398.07	0.00	398.07	121.33	3030.05	923.56	3061.11
WIPP-22	CUL	3428.12	10/10/01	13:36	397.96	0.00	397.96	121.30	3030.16	923.59	3061.23
WIPP-22	CUL	3428.12	11/14/01	09:01	397.90	0.00	397.90	121.28	3030.22	923.61	3061.30
WIPP-22	CUL	3428.12	12/5/01	15:07	398.00	0.00	398.00	121.31	3030.12	923.58	3061.19
WIPP-25 (ANNULUS)	MAG	3214.39	1/8/01	12:59	165.62	0.00	165.62	50.48	3048.77	929.27	
WIPP-25 (ANNULUS)	MAG	3214.39	2/5/01	09:46	165.69	0.00	165.69	50.50	3048.70	929.24	
WIPP-25 (ANNULUS)	MAG	3214.39	3/6/01	10:12	164.79	0.00	164.79	50.23	3049.60	929.52	
WIPP-25 (ANNULUS)	MAG	3214.39	4/3/01	11:33	164.37	0.00	164.37	50.10	3050.02	929.65	
WIPP-25 (ANNULUS)	MAG	3214.39	5/7/01	08:56	164.11	0.00	164.11	50.02	3050.28	929.73	
WIPP-25 (ANNULUS)	MAG	3214.39	6/5/01	11:00	163.87	0.00	163.87	49.95	3050.52	929.80	
WIPP-25 (ANNULUS)	MAG	3214.39	7/9/01	14:15	163.70	0.00	163.70	49.90	3050.69	929.85	
WIPP-25 (ANNULUS)	MAG	3214.39	8/8/01	09:21	163.60	0.00	163.60	49.87	3050.79	929.88	
WIPP-25 (ANNULUS)	MAG	3214.39	9/4/01	11:45	163.54	0.00	163.54	49.85	3050.85	929.90	
WIPP-25 (ANNULUS)	MAG	3214.39	10/8/01	09:04	163.62	0.00	163.62	49.87	3050.77	929.87	
WIPP-25 (ANNULUS)	MAG	3214.39	11/13/01	08:13	163.84	0.00	163.84	49.94	3050.55	929.81	
WIPP-25 (ANNULUS)	MAG	3214.39	12/4/01	14:00	163.85	0.00	163.85	49.94	3050.54	929.80	

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Fr_Hd_amsl
WIPP-25 (PIP)	CUL	3214.39	1/8/01	12:55	156.75	0.42	156.33	47.65	3058.06	932.10	3055.01
WIPP-25 (PIP)	CUL	3214.39	2/5/01	09:37	156.18	0.42	155.76	47.48	3058.63	932.27	3055.57
WIPP-25 (PIP)	CUL	3214.39	3/6/01	10:09	155.85	0.42	155.43	47.38	3058.96	932.37	3055.90
WIPP-25 (PIP)	CUL	3214.39	4/3/01	11:30	155.44	0.42	155.02	47.25	3059.37	932.50	3056.31
WIPP-25 (PIP)	CUL	3214.39	5/7/01	08:53	155.35	0.42	154.93	47.22	3059.46	932.52	3056.40
WIPP-25 (PIP)	CUL	3214.39	6/5/01	10:55	155.21	0.42	154.79	47.18	3059.60	932.57	3056.53
WIPP-25 (PIP)	CUL	3214.39	7/9/01	14:10	154.96	0.42	154.54	47.10	3059.85	932.64	3056.78
WIPP-25 (PIP)	CUL	3214.39	8/8/01	09:16	154.90	0.42	154.48	47.09	3059.91	932.66	3056.84
WIPP-25 (PIP)	CUL	3214.39	9/4/01	11:40	154.95	0.42	154.53	47.10	3059.86	932.65	3056.79
WIPP-25 (PIP)	CUL	3214.39	10/8/01	09:02	154.79	0.42	154.37	47.05	3060.02	932.69	3056.95
WIPP-25 (PIP)	CUL	3214.39	11/13/01	08:10	154.70	0.42	154.28	47.02	3060.11	932.72	3057.04
WIPP-25 (PIP)	CUL	3214.39	12/4/01	13:53	154.38	0.42	153.96	46.93	3060.43	932.82	3057.36
WIPP-26	CUL	3153.20	1/8/01	10:52	131.45	0.00	131.45	40.07	3021.75	921.03	3021.89
WIPP-26	CUL	3153.20	2/7/01	07:43	131.37	0.00	131.37	40.04	3021.83	921.05	3021.97
WIPP-26	CUL	3153.20	3/6/01	09:35	131.56	0.00	131.56	40.10	3021.64	921.00	3021.77
WIPP-26	CUL	3153.20	4/3/01	12:08	131.15	0.00	131.15	39.97	3022.05	921.12	3022.19
WIPP-26	CUL	3153.20	5/7/01	09:39	131.25	0.00	131.25	40.01	3021.95	921.09	3022.09
WIPP-26	CUL	3153.20	6/4/01	11:11	132.00	0.00	132.00	40.23	3021.20	920.86	3021.33
WIPP-26	CUL	3153.20	7/9/01	10:20	131.41	0.00	131.41	40.05	3021.79	921.04	3021.93
WIPP-26	CUL	3153.20	8/6/01	11:06	131.80	0.00	131.80	40.17	3021.40	920.92	3021.53
WIPP-26	CUL	3153.20	9/5/01	07:15	132.63	0.00	132.63	40.43	3020.57	920.67	3020.70
WIPP-26	CUL	3153.20	10/8/01	09:39	131.79	0.00	131.79	40.17	3021.41	920.93	3021.54
WIPP-26	CUL	3153.20	11/13/01	08:48	131.06	0.00	131.06	39.95	3022.14	921.15	3022.28
WIPP-26	CUL	3153.20	12/5/01	09:02	131.80	0.00	131.80	40.17	3021.40	920.92	3021.53
WIPP-27 (PIP)	CUL	3178.98	1/8/01	09:44	98.26	0.42	97.84	29.82	3081.14	939.13	3087.20
WIPP-27 (PIP)	CUL	3178.98	2/6/01	10:28	98.38	0.42	97.96	29.86	3081.02	939.09	3087.08
WIPP-27 (PIP)	CUL	3178.98	3/6/01	07:36	98.53	0.42	98.11	29.90	3080.87	939.05	3086.92
WIPP-27 (PIP)	CUL	3178.98	4/3/01	10:25	98.57	0.42	98.15	29.92	3080.83	939.04	3086.88
WIPP-27 (PIP)	CUL	3178.98	5/7/01	07:49	98.75	0.42	98.33	29.97	3080.65	938.98	3086.70
WIPP-27 (PIP)	CUL	3178.98	6/4/01	09:05	98.60	0.42	98.18	29.93	3080.80	939.03	3086.85
WIPP-27 (PIP)	CUL	3178.98	7/9/01	13:25	98.96	0.42	98.54	30.03	3080.44	938.92	3086.48
WIPP-27 (PIP)	CUL	3178.98	8/6/01	10:02	99.27	0.42	98.85	30.13	3080.13	938.82	3086.16
WIPP-27 (PIP)	CUL	3178.98	9/4/01	10:35	99.23	0.42	98.81	30.12	3080.17	938.84	3086.20
WIPP-27 (PIP)	CUL	3178.98	10/8/01	08:05	98.59	0.42	98.17	29.92	3080.81	939.03	3086.86
WIPP-27 (PIP)	CUL	3178.98	11/13/01	07:27	97.95	0.42	97.53	29.73	3081.45	939.23	3087.52
WIPP-27 (PIP)	CUL	3178.98	12/4/01	13:19	97.30	0.42	96.88	29.53	3082.10	939.42	3088.19
WIPP-29	CUL	2978.26	1/8/01	10:29	11.09	0.00	11.09	3.38	2967.17	904.39	2970.36

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Fr_Hd_amsl
WIPP-29	CUL	2978.26	2/7/01	07:20	11.00	0.00	11.00	3.35	2967.26	904.42	2970.46
WIPP-29	CUL	2978.26	3/6/01	09:11	11.03	0.00	11.03	3.36	2967.23	904.41	2970.43
WIPP-29	CUL	2978.26	4/4/01	07:02	11.15	0.00	11.15	3.40	2967.11	904.38	2970.28
WIPP-29	CUL	2978.26	5/7/01	10:05	11.20	0.00	11.20	3.41	2967.06	904.36	2970.23
WIPP-29	CUL	2978.26	6/4/01	10:47	11.35	0.00	11.35	3.46	2966.91	904.31	2970.05
WIPP-29	CUL	2978.26	7/9/01	10:45	11.66	0.00	11.66	3.55	2966.60	904.22	2969.68
WIPP-29	CUL	2978.26	8/6/01	10:42	11.25	0.00	11.25	3.43	2967.01	904.34	2970.17
WIPP-29	CUL	2978.26	9/4/01	09:45	11.40	0.00	11.40	3.47	2966.86	904.30	2969.99
WIPP-29	CUL	2978.26	10/8/01	07:09	11.33	0.00	11.33	3.45	2966.93	904.32	2970.07
WIPP-29	CUL	2978.26	11/13/01	09:19	11.51	0.00	11.51	3.51	2966.75	904.27	2969.86
WIPP-29	CUL	2978.26	12/4/01	14:36	11.20	0.00	11.20	3.41	2967.06	904.36	2970.23
WIPP-30 (ANNULUS)	MAG	3429.05	1/8/01	13:39	335.84	2.08	333.76	101.73	3095.29	943.44	
WIPP-30 (ANNULUS)	MAG	3429.05	2/6/01	11:35	333.44	2.08	331.36	101.00	3097.69	944.18	
WIPP-30 (ANNULUS)	MAG	3429.05	3/6/01	13:35	331.70	2.08	329.62	100.47	3099.43	944.71	
WIPP-30 (ANNULUS)	MAG	3429.05	4/4/01	13:00	330.80	2.08	328.72	100.19	3100.33	944.98	
WIPP-30 (ANNULUS)	MAG	3429.05	5/8/01	08:48	329.03	2.08	326.95	99.65	3102.10	945.52	
WIPP-30 (ANNULUS)	MAG	3429.05	6/5/01	09:26	326.86	2.08	324.78	98.99	3104.27	946.18	
WIPP-30 (ANNULUS)	MAG	3429.05	7/10/01	08:05	324.85	2.08	322.77	98.38	3106.28	946.79	
WIPP-30 (ANNULUS)	MAG	3429.05	8/8/01	10:36	321.90	0.00	321.90	98.12	3107.15	947.06	
WIPP-30 (ANNULUS)	MAG	3429.05	9/4/01	12:25	321.55	0.00	321.55	98.01	3107.50	947.17	
WIPP-30 (ANNULUS)	MAG	3429.05	10/10/01	10:00	320.65	0.00	320.65	97.73	3108.40	947.44	
WIPP-30 (ANNULUS)	MAG	3429.05	11/12/01	11:46	319.91	0.00	319.91	97.51	3109.14	947.67	
WIPP-30 (ANNULUS)	MAG	3429.05	12/3/01	11:56	318.37	0.00	318.37	97.04	3110.68	948.14	
WIPP-30 (PIP)	CUL	3429.05	1/8/01	13:31	369.15	2.08	367.07	111.88	3061.98	933.29	3068.89
WIPP-30 (PIP)	CUL	3429.05	2/6/01	11:30	368.15	2.08	366.07	111.58	3062.98	933.60	3069.92
WIPP-30 (PIP)	CUL	3429.05	3/6/01	13:24	367.20	2.08	365.12	111.29	3063.93	933.89	3070.89
WIPP-30 (PIP)	CUL	3429.05	4/4/01	12:50	366.19	2.08	364.11	110.98	3064.94	934.19	3071.93
WIPP-30 (PIP)	CUL	3429.05	5/8/01	08:54	365.41	2.08	363.33	110.74	3065.72	934.43	3072.73
WIPP-30 (PIP)	CUL	3429.05	6/5/01	09:28	364.54	2.08	362.46	110.48	3066.59	934.70	3073.62
WIPP-30 (PIP)	CUL	3429.05	7/10/01	08:00	364.37	2.08	362.29	110.43	3066.76	934.75	3073.79
WIPP-30 (PIP)	CUL	3429.05	8/8/01	10:19	363.13	0.70	362.43	110.47	3066.62	934.71	3073.65
WIPP-30 (PIP)	CUL	3429.05	9/4/01	12:30	362.63	0.70	361.93	110.32	3067.12	934.86	3074.16
WIPP-30 (PIP)	CUL	3429.05	10/10/01	09:52	362.34	0.70	361.64	110.23	3067.41	934.95	3074.46
WIPP-30 (PIP)	CUL	3429.05	11/12/01	11:40	362.18	0.70	361.48	110.18	3067.57	935.00	3074.62
WIPP-30 (PIP)	CUL	3429.05	12/3/01	11:52	361.90	0.70	361.20	110.09	3067.85	935.08	3074.91
WQSP-1	CUL	3419.20	1/9/01	09:21	366.36	0.16	366.20	111.62	3063.00	930.55	3069.65
WQSP-1	CUL	3419.20	2/6/01	08:37	366.27	0.16	366.11	111.59	3063.09	930.58	3069.75

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Fr_Hd_amsl
WGSP-1	CUL	3419.20	3/6/01	11:20	366.26	0.16	366.10	11.59	3053.10	930.58	3089.76
WGSP-1	CUL	3419.20	4/5/01	11:14	366.27	0.16	366.11	11.59	3053.09	930.58	3089.75
WGSP-1	CUL	3419.20	5/8/01	11:19	365.95	0.16	365.79	11.49	3053.41	930.68	3070.08
WGSP-1	CUL	3419.20	6/5/01	12:10	365.68	0.16	365.52	11.41	3053.68	930.76	3070.36
WGSP-1	CUL	3419.20	7/9/01	08:20	365.71	0.16	365.55	11.42	3053.65	930.75	3070.33
WGSP-1	CUL	3419.20	8/7/01	14:36	365.88	0.16	365.72	11.47	3053.48	930.70	3070.15
WGSP-1	CUL	3419.20	9/4/01	06:35	365.52	0.16	365.66	11.45	3053.54	930.72	3070.22
WGSP-1	CUL	3419.20	10/10/01	10:42	365.78	0.16	365.62	11.44	3053.58	930.73	3070.26
WGSP-1	CUL	3419.20	11/14/01	06:53	365.55	0.16	365.39	11.37	3053.81	930.80	3070.50
WGSP-1	CUL	3419.20	12/5/01	14:22	365.75	0.16	365.59	11.43	3053.61	930.74	3070.29
WGSP-2	CUL	3463.90	1/9/01	08:48	404.59	0.16	404.43	123.27	3059.47	932.53	3079.21
WGSP-2	CUL	3463.90	2/6/01	08:24	404.33	0.16	404.17	123.19	3059.73	932.61	3079.49
WGSP-2	CUL	3463.90	3/7/01	08:26	404.09	0.16	403.93	123.12	3059.97	932.68	3079.74
WGSP-2	CUL	3463.90	4/4/01	12:26	405.38	0.16	405.22	123.51	3058.68	932.29	3078.39
WGSP-2	CUL	3463.90	5/8/01	10:10	405.14	0.16	404.98	123.44	3058.92	932.36	3078.64
WGSP-2	CUL	3463.90	6/5/01	13:12	404.37	0.16	404.21	123.20	3059.69	932.59	3079.44
WGSP-2	CUL	3463.90	7/9/01	08:06	404.16	0.16	404.00	123.14	3059.90	932.66	3079.66
WGSP-2	CUL	3463.90	8/8/01	11:10	404.06	0.16	403.90	123.11	3060.00	932.69	3079.77
WGSP-2	CUL	3463.90	9/6/01	10:45	403.90	0.16	403.74	123.06	3060.16	932.74	3079.94
WGSP-2	CUL	3463.90	10/10/01	11:49	405.05	0.16	404.89	123.41	3059.01	932.39	3078.73
WGSP-2	CUL	3463.90	11/14/01	08:24	404.64	0.16	404.48	123.29	3059.42	932.51	3079.16
WGSP-2	CUL	3463.90	12/5/01	14:35	404.61	0.16	404.45	123.28	3059.45	932.52	3079.19
WGSP-3	CUL	3480.30	1/9/01	10:28	470.11	0.16	469.95	143.24	3010.35	917.55	3067.27
WGSP-3	CUL	3480.30	2/5/01	09:10	469.68	0.16	469.52	143.11	3010.78	917.69	3067.76
WGSP-3	CUL	3480.30	3/7/01	14:11	469.08	0.16	468.92	142.93	3011.38	917.87	3068.45
WGSP-3	CUL	3480.30	4/5/01	11:37	473.11	0.16	472.95	144.16	3007.35	916.64	3063.83
WGSP-3	CUL	3480.30	5/8/01	13:11	469.94	0.16	469.78	143.19	3010.52	917.61	3067.46
WGSP-3	CUL	3480.30	6/5/01	13:31	469.16	0.16	469.00	142.95	3011.30	917.84	3068.36
WGSP-3	CUL	3480.30	7/11/01	06:35	468.88	0.16	468.72	142.87	3011.58	917.93	3068.68
WGSP-3	CUL	3480.30	8/8/01	13:16	468.63	0.16	468.47	142.79	3011.83	918.01	3068.96
WGSP-3	CUL	3480.30	9/6/01	06:45	468.40	0.16	468.24	142.72	3012.06	918.08	3069.23
WGSP-3	CUL	3480.30	10/10/01	12:56	472.87	0.16	472.71	144.08	3007.59	916.71	3064.11
WGSP-3	CUL	3480.30	11/14/01	08:40	469.28	0.16	469.12	142.99	3011.18	917.81	3068.22
WGSP-3	CUL	3480.30	12/5/01	14:45	469.04	0.16	468.88	142.91	3011.42	917.88	3068.49
WGSP-4	CUL	3433.00	1/10/01	13:39	446.73	0.16	446.57	136.11	2986.43	910.26	3011.49
WGSP-4	CUL	3433.00	2/6/01	14:35	447.66	0.16	447.50	136.40	2985.50	909.98	3010.49
WGSP-4	CUL	3433.00	3/8/01	07:49	446.42	0.16	446.26	136.02	2986.74	910.36	3011.82

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
WGSP-4	CUL	3433.00	4/5/01	09:36	446.43	0.16	446.27	136.02	2986.73	910.36	3011.81
WGSP-4	CUL	3433.00	5/9/01	09:07	446.71	0.16	446.55	136.11	2986.45	910.27	3011.51
WGSP-4	CUL	3433.00	6/6/01	07:45	446.24	0.16	446.08	135.97	2986.92	910.41	3011.83
WGSP-4	CUL	3433.00	7/11/01	07:55	446.03	0.16	445.87	135.90	2987.13	910.48	3012.05
WGSP-4	CUL	3433.00	8/7/01	09:55	446.00	0.16	445.84	135.89	2987.16	910.49	3012.09
WGSP-4	CUL	3433.00	9/7/01	07:45	445.71	0.16	445.55	135.80	2987.45	910.57	3012.40
WGSP-4	CUL	3433.00	10/9/01	13:06	445.68	0.16	445.52	135.79	2987.48	910.58	3012.43
WGSP-4	CUL	3433.00	11/13/01	14:42	445.95	0.16	445.79	135.88	2987.21	910.50	3012.14
WGSP-4	CUL	3433.00	12/5/01	12:15	445.99	0.16	445.83	135.89	2987.17	910.49	3012.10
WGSP-5	CUL	3384.40	1/10/01	13:58	382.59	0.16	382.43	116.56	3001.97	915.00	3009.00
WGSP-5	CUL	3384.40	2/7/01	11:30	382.47	0.16	382.31	116.53	3002.09	915.04	3009.13
WGSP-5	CUL	3384.40	3/8/01	08:57	382.20	0.16	382.04	116.45	3002.36	915.12	3009.40
WGSP-5	CUL	3384.40	4/5/01	09:59	382.19	0.16	382.03	116.44	3002.37	915.12	3009.41
WGSP-5	CUL	3384.40	5/9/01	08:56	383.37	0.16	383.21	116.80	3001.19	914.76	3008.20
WGSP-5	CUL	3384.40	6/6/01	08:45	383.31	0.16	383.15	116.78	3001.25	914.78	3008.27
WGSP-5	CUL	3384.40	7/11/01	08:15	382.04	0.16	381.88	116.40	3002.52	915.17	3009.57
WGSP-5	CUL	3384.40	8/7/01	10:14	381.95	0.16	381.79	116.37	3002.61	915.20	3009.66
WGSP-5	CUL	3384.40	9/7/01	12:45	381.54	0.16	381.38	116.24	3003.02	915.32	3010.08
WGSP-5	CUL	3384.40	10/9/01	13:26	381.52	0.16	381.36	116.24	3003.04	915.33	3010.10
WGSP-5	CUL	3384.40	11/14/01	09:26	382.16	0.16	382.00	116.43	3002.40	915.13	3009.44
WGSP-5	CUL	3384.40	12/5/01	12:48	381.97	0.16	381.81	116.38	3002.59	915.19	3009.64
WGSP-6	CUL	3363.80	1/10/01	14:11	348.70	0.16	348.54	106.23	3015.26	919.05	3018.98
WGSP-6	CUL	3363.80	2/7/01	11:43	348.45	0.16	348.29	106.16	3015.51	919.13	3019.23
WGSP-6	CUL	3363.80	3/8/01	09:01	348.22	0.16	348.06	106.09	3015.74	919.20	3019.47
WGSP-6	CUL	3363.80	4/5/01	10:16	348.14	0.16	347.98	106.06	3015.82	919.22	3019.55
WGSP-6	CUL	3363.80	5/9/01	08:30	348.23	0.16	348.07	106.09	3015.73	919.19	3019.46
WGSP-6	CUL	3363.80	6/6/01	09:00	349.16	0.16	349.00	106.38	3014.80	918.91	3018.51
WGSP-6	CUL	3363.80	7/11/01	08:30	348.36	0.16	348.20	106.13	3015.60	919.15	3019.32
WGSP-6	CUL	3363.80	8/7/01	10:25	348.20	0.16	348.04	106.08	3015.76	919.20	3019.49
WGSP-6	CUL	3363.80	9/7/01	12:30	347.74	0.16	347.58	105.94	3016.22	919.34	3019.95
WGSP-6	CUL	3363.80	10/10/01	09:17	347.74	0.16	347.58	105.94	3016.22	919.34	3019.95
WGSP-6	CUL	3363.80	11/14/01	09:36	350.62	0.16	350.46	106.82	3013.34	918.47	3017.03
WGSP-6	CUL	3363.80	12/5/01	12:55	348.45	0.16	348.29	106.16	3015.51	919.13	3019.23
WGSP-6a	DL	3364.70	1/10/01	14:20	166.35	0.25	166.10	50.63	3198.60	974.93	
WGSP-6a	DL	3364.70	2/7/01	11:50	166.32	0.25	166.07	50.62	3198.63	974.94	
WGSP-6a	DL	3364.70	3/8/01	09:10	166.38	0.25	166.13	50.64	3198.57	974.92	
WGSP-6a	DL	3364.70	4/5/01	10:24	166.61	0.25	166.36	50.71	3198.34	974.85	

* AMSL - above mean sea level

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Table 6.9 - Groundwater Level Measurement Results for 2001

WELL_NO	ZONE	TOC_AMSL*	DATE	TIME	TP_FT_TOC	ADJ_FT	WL_FT	WL_METERS	WL_MSL_FT	WL_MSL_M	Adj_Ft_Hd_amsl
WQSP-6a	DL	3364.70	5/9/01	08:25	166.71	0.25	166.46	50.74	3198.24	974.82	
WQSP-6a	DL	3364.70	6/4/01	06:42	166.44	0.25	166.19	50.65	3198.51	974.91	
WQSP-6a	DL	3364.70	7/11/01	08:35	166.62	0.25	166.37	50.71	3198.33	974.85	
WQSP-6a	DL	3364.70	8/7/01	10:31	166.79	0.25	166.54	50.76	3198.16	974.80	
WQSP-6a	DL	3364.70	9/7/01	12:35	166.50	0.25	166.25	50.67	3198.45	974.89	
WQSP-6a	DL	3364.70	10/10/01	09:26	166.64	0.25	166.39	50.72	3198.31	974.84	
WQSP-6a	DL	3364.70	11/12/01	05:00	166.69	0.25	166.44	50.73	3198.26	974.83	
WQSP-6a	DL	3364.70	12/5/01	13:01	166.84	0.25	166.59	50.78	3198.11	974.78	

* AMSL - above mean sea level

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Table 6.10 - Analytical Results for Shallow Groundwater Program

Parameter	Units	C-2505	C-2506	C-2507	Dup.	C-2811	PZ-1
Ammonium	mg/l	0.097	0.0967	<0.0042	0.0075	<0.0042	0.0699
Arsenic	mg/l	<0.003	<0.003	0.0015	0.0017	0.0014	<0.003
Barium	mg/l	0.103	0.0914	0.0377	0.0386	0.0934	0.125
Boron	mg/l	0.17	0.12	0.27	0.25	0.17	0.079
Bromide	mg/l	9.9	9.5	5.3	5.6	2.8	19.2
Cadmium	mg/l	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.001
Calcium	mg/l	943	1250	418	431	283	4250
Chloride	mg/l	6230	9240	1300	1330	956	33100
Chromium	mg/l	0.0141	0.0099	0.0491	0.0535	0.0017	0.0108
Iron	mg/l	<0.008	<0.008	<0.0008	<0.0008	<0.0008	<0.008
Lead	mg/l	0.0048	<0.001	0.00012	<0.0001	<0.0001	<0.001
Magnesium	mg/l	646	820	337	331	207	2310
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0016
Nitrate	mg/l	23.2	23.2	26	25.7	27.9	4.9
Nitrite	mg/l	0.0165	<0.0082	0.0139	0.0156	0.0147	<0.0082
pH		7.28	7.2	7.61	7.42	7.56	6.94
Potassium	mg/l	11.3	14.5	6.5	6.5	4.6	32
Selenium	mg/l	0.112	0.0447	0.075	0.0698	0.0243	0.0753
Silicon	mg/l	22.7	22.3	25	25	22.3	19.4
Silver	mg/l	<0.001	<0.001	<0.0001	0.00012	<0.0001	<0.001
Sodium	mg/l	2030	3230	328	329	163	12700
Specific Gravity	mg/g	1.01	1.01	1	1	1	1.04
Sulfate	mg/l	1290	1300	940	970	379	1610
Total Dissolved Solids	mg/l	13000	18000	4170	4180	2630	62200
Total Inorganic Carbon	mg/l			75.1	75.8	49.5	
Total Organic Carbon	mg/l			3	2.9	1.4	
Total Suspended Solids	mg/l	<20	<20	<20	<20	<20	<20
Zinc	mg/l	<0.05	<0.05	0.0438	0.0386	0.0357	<0.05
Parameter	Units	PZ-2	PZ-3	PZ-4	Dup.	PZ-5	PZ-6
Ammonium	mg/l	0.129	0.101	0.112	0.123	0.0578	0.0345
Arsenic	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Barium	mg/l	0.0588	0.0816	0.149	0.151	0.0977	0.0931
Boron	mg/l	0.13	0.16	0.15	0.15	0.1	0.11
Bromide	mg/l	7.6	7.5	12.1	7.1	23.1	16.6
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	mg/l	997	1230	2110	2110	3070	2240
Chloride	mg/l	9160	23500	32900	34200	37500	36200
Chromium	mg/l	0.0115	0.0119	0.0134	0.0129	0.0117	0.0156
Iron	mg/l	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Lead	mg/l	<0.001	<0.001	<0.001	<0.001	0.0018	0.0048
Magnesium	mg/l	626	839	1090	1090	1760	1330
Mercury	mg/l	<0.0002	<0.0002	0.0017	0.0016	0.0014	0.00021
Nitrate	mg/l	6.79	16.3	17.2	17.1	14.4	25.2
Nitrite	mg/l	0.0169	<0.0082	0.0147	0.0145	0.0177	0.0153
pH		7.3	7.23	7.22	7.33	7.04	6.94
Potassium	mg/l	13.7	95	39.8	39.6	68.8	170
Selenium	mg/l	0.102	0.102	0.0431	0.0429	0.069	0.0607
Silicon	mg/l	20.4	18.3	20.5	20.4	18.7	20.3
Silver	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	2.4
Sodium	mg/l	3880	11800	16000	16000	16200	17700
Specific Gravity	mg/g	1.01	1.03	1.04	1.04	1.05	1.04
Sulfate	mg/l	1660	1660	1300	1290	1510	2040
Total Dissolved Solids	mg/l	18000	41800	58600	59400	65200	65700
Total Inorganic Carbon	mg/l						
Total Organic Carbon	mg/l						

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Table 6.10 - Analytical Results for Shallow Groundwater Program

Total Suspended Solids	mg/l	<20	<20	<20	<20	<20	<20
Zinc	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Parameter	Units	PZ-7	PZ-9	PZ-10	PZ-11	PZ-12	Dup.
Ammonium	mg/l	0.0466	0.267	<0.0042	0.142	0.124	0.154
Arsenic	mg/l	<0.003	<0.003	0.0014	<0.003	<0.003	<0.003
Barium	mg/l	0.0598	0.185	0.0479	0.246	0.116	0.115
Boron	mg/l	0.064	0.17	0.28	0.062	0.21	0.2
Bromide	mg/l	18	57.1	2.2	21.4	5.6	4.9
Cadmium	mg/l	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001
Calcium	mg/l	3340	3550	254	3980	868	867
Chloride	mg/l	38900	72400	468	56700	6530	6560
Chromium	mg/l	0.0126	0.0181	0.00083	0.0112	0.0114	0.0121
Iron	mg/l	<0.008	49.2	<0.0008	<0.008	<0.008	<0.008
Lead	mg/l	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001
Magnesium	mg/l	2010	3550	177	2950	613	608
Mercury	mg/l	0.0016	0.00079	<0.0002	0.0022	<0.0002	<0.0002
Nitrate	mg/l	20.2	14.4	18.3	28.2	29.5	30.8
Nitrite	mg/l	0.0209	<0.0082	0.0089	<0.0082	0.0083	0.0082
pH		6.75	5.99	7.45	6.62	7.28	7.19
Potassium	mg/l	61	499	4.2	62.9	24.7	24.5
Selenium	mg/l	0.0916	0.0516	0.031	0.0289	0.0378	0.0367
Silicon	mg/l	20	10.6	22.3	12.5	20.2	20.2
Silver	mg/l	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001
Sodium	mg/l	17000	36100	188	24300	2290	2290
Specific Gravity	mg/g	1.05	1.09	1.01	1.07	1.05	1.06
Sulfate	mg/l	2180	3470	730	2380	829	843
Total Dissolved Solids	mg/l	70200	134000	2320	99000	12900	12800
Total Inorganic Carbon	mg/l			93.1			
Total Organic Carbon	mg/l			2.5			
Total Suspended Solids	mg/l	<20	71	39	59	<20	<20
Zinc	mg/l	<0.05	<0.05	0.0409	<0.05	<0.05	<0.05

CHAPTER 7 - RADIOLOGICAL DOSE ASSESSMENT

It is the policy of DOE ". . . to conduct its operations in an environmentally safe and sound manner. Protection of the environment and the public are responsibilities of paramount importance and concern to DOE" (DOE Order 5400.1). "It is also a DOE objective that potential exposures to members of the public be as far below the limits as is reasonably achievable. . ." (DOE Order 5400.5).

Chapter 4 of this report summarized the amount of radioactivity in air emissions and other media sampled in the WIPP environment in 2001. It is the purpose of this chapter to summarize the air emission levels in regard to the potential dose from WIPP operations.

Specifically, this chapter summarizes:

- Regulatory requirements on emissions of radionuclides, effective dose equivalents, and use of CAP88-PC computer model;
- The national average dose from naturally occurring sources of radiation;
- The estimated dose from air emissions from WIPP;
- The total potential dose from WIPP operations; and
- Potential doses to nonhuman biota from radioactivity measured near WIPP.

7.1 Introduction and Dose Limits

Title 40 CFR Part 61, Subpart H-National Emission Standards for Emissions of Radionuclides Other than Radon From Department of Energy Facilities, Section 61.92 Standard state "Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/year."

Compliance with the above regulatory compliance is determine by measuring effluent flow rate, monitoring, extracting, collecting, and measuring radionuclides, and calculating the effective dose equivalent (EDE). The EDE is the weighted sum of the doses to the individual organs of the body. The dose to each organ is weighted according to the risk that dose represents. These organ doses are then added together, and that total is the effective dose equivalent. In this manner, the risk from different sources of radiation can be controlled by a single standard.

To calculate the EDE to members of the public, require the use of CAP88-PC or other EPA approved computer models and procedures. The WIPP Effluent Monitoring Program generally uses CAP88-PC. CAP88-PC is a set of computer programs, datasets and associated utility programs for estimation of dose and risk from radionuclide air emissions. CAP88-PC uses a Gaussian Plume dispersion model, which

predicts air concentrations, deposition rates, concentrations in food, and intake rates for people. CAP88-PC estimates dose and risk to individuals and populations from multiple pathways. Dose and risk is calculated for ingestion, inhalation, ground level air immersion and ground surface irradiation exposure pathways.

Environmental radiation protection standards for the management and disposal of TRU wastes set limits on the total annual radiation dose to members of the public at 0.25 mSv (25 mrem) to the whole body and 0.75 mSv (75 mrem) to any critical organ (40 CFR §191.03). National standards for emissions of radionuclides from DOE facilities state that the maximum annual dose to any member of the public from air emissions must be no greater than 0.1 mSv (10 mrem) (40 CFR §61.92). The SDWA (40 CFR §141.16) states that average annual concentrations of beta- and gamma-emitting human-made radionuclides in drinking water shall not result in an annual dose greater than 0.04 mSv (4 mrem). It is important to note that all of these dose limits are set for radionuclides released to the environment from DOE operations. They do not include, but are limits in addition to, doses from natural background radiation or from medical procedures.

7.2 Background Radiation

Radiation is a naturally-occurring phenomenon that has been in the environment since the beginning of time. There are several sources of natural radiation: cosmic and cosmogenic radiation (from outer space and the earth's atmosphere), terrestrial radiation (from the earth's crust), and internal radiation (naturally-occurring radiation in our bodies, such as ⁴⁰K). The most common sources of terrestrial radiation are uranium, thorium, and their decay products. Potassium-40 is another source of terrestrial radiation. While not a major radiation source, ⁴⁰K may be enhanced in the southeastern New Mexico environment due to local potash mining. Radon gas, a decay product of uranium, is the most widely known naturally-occurring terrestrial radionuclide. In addition to natural radioactivity, small amounts of radioactivity from above-ground nuclear weapons tests that occurred from 1945 through 1980 and the 1986 Chernobyl nuclear accident are also present in the environment. Together, these sources of radiation are called "background" radiation. Every human is constantly exposed to background radiation. Exposure to radioactivity from weapons testing fallout is quite small compared to natural radioactivity and continually gets smaller as radionuclides decay.

Naturally occurring radiation in our environment can deliver both internal and external doses. Internal dose is received as a result of the intake of radionuclides. The major routes of intake of radionuclides for members of the public are ingestion and inhalation. Ingestion includes the intake of the radionuclides from eating and drinking contaminated food or drink. Inhalation includes the intake of radionuclides through breathing dust particles containing radioactive materials or radon gas. External dose can occur from submersion in contaminated air or deposition of contaminants on surfaces. The average annual dose received by a member of the public from naturally-occurring radionuclides is about 3 mSv (300 mrem) (Table 7.1).

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Table 7.1 - Annual Estimated Average Radiation Dose Received by a Member of the Population of the United States from Naturally Occurring Radiation Sources (adapted from NCRP, 1987)

Source	Average Annual Effective Dose Equivalent	
	(mSv)	(mrem)
Inhaled (Radon and Decay Products)	2	200
Internal Radionuclides	0.39	39
Terrestrial Radiation	0.28	28
Cosmic Radiation	0.27	27
Cosmogenic Radioactivity	0.01	1
Rounded Total from Natural Sources	3	300

7.3 Dose from Air Emissions

The NESHAP issued by the EPA set limits for radionuclide emissions to air (40 CFR Part 61). Compliance procedures for DOE facilities (40 CFR §61.93[a]) require the use of CAP88-PC or AIRDOS-PC computer models, or an equivalent, to calculate dose to members of the public. For the determination of the radiation dose received by members of the public, WIPP used the computer model CAP88-PC, version 2.0. Source term input for the program was determined by radiochemical analyses of periodic air samples taken from the effluent Stations A, B, and C (see Section 4.1). Air samples were analyzed for ²⁴¹Am, ²³⁹⁺²⁴⁰Pu, and ²³⁸Pu because they constitute over 98 percent of the dose potential from contact-handled waste. Measured activity values greater than the MDC were used as a part of the source term for the air emission pathway and, for measured results less than the MDC, the MDC value was used as part of the source term (see Table 4.1). CAP88-PC dose calculations are based on the assumption that exposed persons remain at home during the entire year and all vegetables, milk, and meat consumed are home produced. Thus, this dose calculation is a maximum potential dose which encompasses dose from inhalation, submersion, deposition, and ingestion of air emitted radionuclides.

For 2001, the CAP88-PC model predicted the highest dose to someone residing near WIPP to be at the Smith Ranch approximately 8 km (5 mi) northwest of WIPP. Results showed the whole body dose potentially received by someone residing at this location to be about 4.96×10^{-8} mSv (4.96×10^{-6} mrem) per year.

7.4 Total Potential Dose from WIPP Operations

The radiation dose received by members of the public as a result of the management and storage of TRU radioactive wastes at any disposal facility operated by the DOE is regulated under 40 CFR Part 191, Subpart A. Specific standards state that the combined annual dose to any member of the public in the general environment shall not exceed 0.25 mSv (25 mrem) to the whole body and 0.75 mSv (75 mrem) to any critical

organ. Section 7.3 discussed the potential dose received from radionuclides released to the air from WIPP. The following sections discuss the potential dose through other pathways and the total potential dose a member of the public may have received from WIPP operations during 2001.

7.4.1 Potential Dose from Water Ingestion Pathway

The potential dose to individuals from the ingestion of WIPP-related radionuclides transported in water is estimated to be nonexistent for several reasons. Drinking water for communities near WIPP comes from groundwater sources which are not expected to be affected by potential WIPP contaminants (based on current radionuclide transport scenarios summarized in the WIPP Safety Analysis Report (DOE/WIPP 95-2065)). The only credible pathway for contaminants from WIPP to accessible groundwater is through the Culebra member of the Rustler Formation and the Dewey Lake Formation (DOE/CAO 96-2184). Water from the Culebra is naturally not potable due to high levels of TDS. Water from the Dewey Lake Formation is suitable for livestock consumption having TDS values below 10,000 mg/l. Groundwater and surface water samples collected around WIPP during 2001 did not contain radionuclide concentrations discernable from those in samples collected prior to WIPP receiving waste.

7.4.2 Potential Dose from Wild Game Ingestion

Game animals sampled during 2000 were mule deer, quail, rabbit, and fish. The only radionuclides detected were not different from background levels measured prior to commencement of waste shipments to WIPP. Therefore, no dose from WIPP-related radionuclides is estimated to have been received by any individual from this pathway during 2001.

7.4.3 Total Potential Dose from All Pathways

The only pathway for which a dose could be estimated was that of air emissions. Air emissions from WIPP were not above background ambient air levels. Estimated concentrations of radionuclides in air emissions accounted for the calculable dose from WIPP operations during 2001. The effective dose equivalent potentially received by the maximally exposed individual residing 8 km (5 mi) northwest of WIPP was calculated to be 4.96×10^{-8} mSv (4.96×10^{-6} mrem) per year whole body. This value is in compliance with the requirements of 0.1 mSv (10 mrem) per year as specified in 40 CFR §61.92.

In compliance with 40 CFR Part 191, Subpart A, the receptor selected resides year-round at the WIPP fence line located 350 meters in the NW sector. The dose to this receptor is estimated to be 8.99×10^{-7} mSv (8.99×10^{-5} mrem) per year whole body and 1.56×10^{-5} mSv (1.56×10^{-3} mrem) per year to the critical organ. These values are in compliance with the requirements of 0.25 mSv (25 mrem) and 0.75 mSv (75mrem) per year to the critical organ as specified in 40 CFR §191.03(b).

7.5 Dose to Nonhuman Biota

DOE Order 5400.5 lists the environmental radiation protection requirements that WIPP must meet to protect aquatic animals. In addition, dose limits below which no deleterious effects on populations of aquatic and terrestrial organisms have been observed have been discussed by the National Council on Radiation Protection and Measurements (NCRP-109) and the International Atomic Energy Agency (IAEA Technical Report Series No. 332). Those dose limits are:

- Aquatic animals - 10 mGy/d (1 rad/d)
- Terrestrial plants - 10 mGy/d (1 rad/d)
- Terrestrial animals - 1 mGy/d (0.1 rad/d)

The DOE has considered proposing these dose standards for aquatic and terrestrial biota under proposed rule 10 CFR Part 834, "Radiation protection of the public and the environment" but has delayed until guidance for demonstrating compliance was developed. The DOE-STD-XXXX-YR, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, was developed to meet this need. Although the proposed rule has not been implemented, the DOE requires reporting of radiation doses to non-human biota in the Annual Site Environmental Report using the Interim Technical Standard.

The Interim Technical Standard uses a multi-phase approach, including an initial screening phase with conservative assumptions. Software is provided with the Interim Technical Standard to conduct the screening evaluation. In the initial screen, Biota Concentration Guides (BCG) are derived using very conservative assumptions for a variety of generic organisms. Maximum concentrations of radionuclides detected in soil, sediment, and water during environmental monitoring are divided by the BCGs and the results are summed for each organism (DOE-STD-XXXX-YR). If the sum of these fractions is less than 1, the site is deemed to have passed the screen and no further action is required. This screening evaluation is intended to provide a very conservative evaluation of whether the site is in compliance with the recommended limits.

This guidance was used to screen radionuclide concentrations observed around WIPP during 2001 using the maximum radionuclide concentrations listed in Table 7.2. The sum of fractions was less than one for all media, demonstrating compliance with the proposed rule. Radiation in the environment surrounding WIPP does not have a deleterious effect on populations of plants and animals.

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Table 7.2 - General Screening Results for Potential Radiation Dose to Nonhuman Biota from Radionuclide Concentrations in Surface Water (Bq/l), Sediment (Bq/g), and Soil (Bq/g) near the WIPP Site. Maximum detected concentrations were compared with BCG^a values to assess potential dose to biota. As long as the sum of the ratios between observed maximum concentrations and the associated BCG is below 1.0, no adverse effects on plant or animal populations are expected (DOE-STD-XXXX-YR).

Medium	Radionuclide	Maximum Observed Concentration	BCG	Concentration/BCG
Aquatic System Evaluation				
Sediment (Bq/g)	⁶⁰ Co	6.85×10 ⁻⁴	5.00×10 ¹	1.37×10 ⁻⁵
	¹³⁷ Cs	4.59×10 ⁻²	1.00×10 ²	4.59×10 ⁻⁴
	²³⁴ U	4.96×10 ⁻²	2.00×10 ²	2.48×10 ⁻⁴
	²³⁵ U	2.12×10 ⁻³	1.00×10 ²	2.12×10 ⁻⁵
	²³⁸ U	3.35×10 ⁻²	9.00×10 ¹	3.72×10 ⁻⁴
	²⁴¹ Am	7.10×10 ⁻⁴	2.00×10 ²	3.55×10 ⁻⁶
Water ^b (Bq/l)	⁶⁰ Co	4.66×10 ⁻¹	1.00×10 ²	4.66×10 ⁻³
	¹³⁷ Cs	3.23×10 ⁻¹	2.00×10 ⁰	1.62×10 ⁻¹
	²³⁴ U	2.18×10 ⁻¹	7.00×10 ⁰	3.11×10 ⁻²
	²³⁵ U	6.51×10 ⁻³	8.00×10 ⁰	8.14×10 ⁻³
	²³⁸ U	1.08×10 ⁻¹	8.00×10 ⁰	1.35×10 ⁻²
	²⁴¹ Am	6.51×10 ⁻⁴	2.00×10 ¹	3.26×10 ⁻⁵
			Sum of Fractions	2.21×10 ⁻¹
Terrestrial System Evaluation				
Soil (Bq/g)	⁶⁰ Co	3.66×10 ⁻⁴	3.00×10 ¹	1.22×10 ⁻⁵
	¹³⁷ Cs	1.65×10 ⁻²	8.00×10 ⁻¹	2.06×10 ⁻²
	²³⁴ U	2.09×10 ⁻²	2.00×10 ²	1.05×10 ⁻⁴
	²³⁵ U	2.32×10 ⁻³	1.00×10 ²	2.32×10 ⁻⁵
	²³⁸ U	2.27×10 ⁻²	6.00×10 ¹	3.78×10 ⁻⁴
	²⁴¹ Am	4.18×10 ⁻⁴	1.00×10 ²	4.18×10 ⁻⁶
Water (Bq/l)	⁶⁰ Co	4.66×10 ⁻¹	4.00×10 ⁴	1.17×10 ⁻⁵
	¹³⁷ Cs	3.23×10 ⁻¹	2.00×10 ⁴	1.62×10 ⁻⁵
	²³⁴ U	2.18×10 ⁻¹	1.00×10 ⁴	2.18×10 ⁻⁵
	²³⁵ U	6.51×10 ⁻³	2.00×10 ⁴	3.26×10 ⁻⁷
	²³⁸ U	1.08×10 ⁻¹	2.00×10 ⁴	5.40×10 ⁻⁶
	²⁴¹ Am	6.51×10 ⁻⁴	7.00×10 ³	9.30×10 ⁻⁸
		Sum of Fractions	2.12×10 ⁻²	

^a The radionuclide concentration in the medium that would produce a radiation dose in the organism equal to the dose limit under the conservative assumptions in the model.

^b Sediment and water samples were assumed to be co-located.

CHAPTER 8 - QUALITY ASSURANCE

The fundamental objective of a QA program is to ensure high-quality measurements are produced and reported from the analytical laboratory. The defensibility of data generated by laboratories must be based on sound scientific principles, method evaluations, and data verification and validation. WIPP Laboratories, Wastren, in Grand Junction, Colorado; Air Toxics, Ltd., in Folsom, California; and Trace Analysis, in Lubbock, Texas, were the contract laboratories that performed the radiological and nonradiological analyses for WIPP environmental samples.

All laboratories were required to have documented QA programs, standard procedures to perform the work, and to participate in some intercomparison programs with the National Institute of Standards and Technology Radiochemistry Intercomparison Program (NRIP), the Environmental Monitoring Laboratory of the DOE Environmental Measurements Laboratory Quality Assurance Program (QAP), the Environmental Resource Associates® (ERA) interlaboratory assessment, and/or any other reputable intercomparison program.

The contract laboratories used one or more of these accepted protocols in their QA program.

- American Society of Mechanical Engineers NQA-1-1994, *Quality Assurance Program Requirements for Nuclear Facilities*.
- Title 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."
- EPA/600 14-83-004, QAMS-005/80, *Interim Guidelines and Specification for Preparing Quality Assurance Project Plans*.
- NRC Regulatory Guide 4.15, Rev. 1, Quality Assurance for Radiological Monitoring Program-Effluent Streams and the Environment.
- HPS N13.30 ANSI, *Performance Criteria for Radiobioassay*.
- Proposed ANSI/ASQC-E4, *Quality Assurance Program Requirements for Environmental Programs*.

The WIPP Environmental Monitoring Section performed assessments and audits to ensure the quality of the systems, processes, and deliverables were maintained or improved. Along with these regulatory requirements, the Environmental Monitoring Section also implements DOE Order 414.1A, *Quality Assurance*. The parameters for performance evaluations are completeness, reproducibility, accuracy, comparability, and representativeness.

8.1 Completeness

The completeness parameter was calculated as the ratio of the number of valid results to the total number of samples collected and analyzed. The gross alpha/beta analyses were 96 percent complete for 2001. Samples for air particulates were 95.6 percent complete. Samples and measurements for all other media (groundwater, surface water, soil, sediment, and animal and plant tissues) were 100 percent complete. The data quality objective established for the environmental program is 98 percent complete. The Environmental Monitoring Program exceeded the objective in 2001 for environmental samples.

8.2 Reproducibility

The reproducibility of the measurements was validated through analyses of duplicate samples. A low-volume air sampler was rotated in each quarter from location to location, and sampled along with routine samples. The results of these duplicate comparisons are shown in Tables 8.1, 8.2, 8.3, and 8.4 for the four quarters of 2001. The duplicate samples for other matrices were collected at the same time, same place, and under similar conditions as routine samples. These samples were analyzed in the same analytical batch and/or sample delivery group using similar methods for radiochemical separation and counting as the original samples.

Reproducibility is partially influenced by statistical counting uncertainty, so variances were expected between samples with very low activities (environmental levels). As a part of data validation all radiochemical duplicate samples are evaluated for the RER and on analytical chemistry the relative percent difference (RPD).

Where:

$$RER = \frac{|(\text{Mean Activity})_{\text{ori}} - (\text{Mean Activity})_{\text{dup}}|}{\sqrt{(2 \times SD)_{\text{ori}}^2 + (2 \times SD)_{\text{dup}}^2}}$$

(Mean Activity) _{ori}	=	Mean Activity of Original Sample
(Mean Activity) _{dup}	=	Mean Activity of Duplicate Sample
SD	=	Standard Deviation of Original and Duplicate Samples

Relative error ratio results equal to or less than one are acceptable and considered to demonstrate reproducibility. A gross alpha result for the week of January 10, 2001, RER is greater than one, 1.03 (Table 8.1).

$$RPD = \left[\frac{S - D}{S + D} \right] * 100$$

2

Where:

S = Sample concentration

D = Duplicate sample concentration

An acceptable range for RPD is < 25 percent for the analytical methods. The duplicate results, RER, and RPD for all required analysis passed the required criteria. WIPP's requirement is to reanalyze the batch of samples associated with the duplicate that failed to meet criteria.

8.3 Accuracy and Comparability

The accuracy of the analyses were assured/controlled by using NIST-traceable standards for instrument calibration. Internal QC is performed by using NIST-traceable spiked laboratory control samples. Samples having analysis recoveries outside the range of 50 to 120 percent were reanalyzed. Intercomparisons were performed with the DOE Environmental Measurements Laboratory (EML), NRIP, and ERA to ensure the reliability of radiochemical separation methods and counting instruments. Accuracy, expressed as percent bias, was calculated by:

$$\% \text{ BIAS} = \left[\frac{A_m - A_k}{A_k} \right] * 100$$

Where:

% BIAS	=	Percent Bias
A_m	=	Measured Sample Activity
A_k	=	Known Sample Activity

The DOE EML QAP, NRIP, and ERA prepare QC samples containing various alpha-, beta-, and gamma-emitting nuclides in water, soil, air filter, vegetation, synthetic urine, and tissue media and distributes them to numerous laboratories. The programs are an interlaboratory comparison in that results from the participants are compared with the experimentally determined results of QAP, NRIP, and ERA. Also, the administering programs EML, NIST, and ERA assess the results as acceptable or not within a range of bias from the EML, NIST, and ERA known result.

Wastren Laboratory participated in the QAP and ERA programs and WIPP Laboratories participated in the QAP and NRIP programs. The results for Wastren Laboratory are provided in Tables 8.5, 8.6, 8.7, and 8.8 for QAP air, soil, vegetation, and water, respectively. Table 8.9 displays the results for ERA water. Table 8.10 contains the NRIP results for WIPP Laboratories and Tables 8.11, 8.12, 8.13, and 8.14 contain the results for the QAP air, soil, vegetation, and water, respectively. WIPP Laboratories percent bias was acceptable for all radionuclides and all media with two exceptions. Strontium-90 in vegetation during the June intercomparison (QAP 54) and ⁹⁰Sr in air during the December intercomparison (QAP 55). The percent bias exceeded the acceptable level for the vegetation sample (QAP 54) for ⁹⁰Sr in June; however,

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according to QAP's evaluation, the result is acceptable with a warning. WIPP Laboratories did not analyze the Environmental Monitoring vegetation samples during the June time frame and the laboratory did have acceptable results in the next intercomparison round. The stable carrier addition, as prescribed by the strontium method, was not added correctly during the chemical process for the air filter QAP 55 sample. The weight of the carrier was not recorded properly; therefore, the activity of the sample was calculated with an incorrect weight. In the December intercomparison (QAP 55), the amount of stable strontium carrier added to the air filter sample was recorded incorrectly. This caused an error in the activity calculation that resulted in the reported number being not acceptable.

Wastren Laboratory's percent bias in evaluating soil was acceptable for all radionuclides and all media except for ^{212}Bi in soil during the June intercomparison (QAP 54). The percent bias exceeds the acceptable level of -25 percent; however, the result is acceptable with warning by QAP's evaluation. WIPP does not require the analysis of ^{212}Bi in any media.

DOE EML QAP participant's analytical performance is evaluated based on the historical analytical capabilities for individual analyte/matrix pairs. The criteria for acceptable performance has been chosen to be between the 15th and 85th percentile of the cumulative normalized distribution, which can be viewed as the 70 percent of all historic measurements. The acceptable with warning criteria is between the 5th and 15th percentile and between the 85th and 95th percentile. In other words, the middle 90 percent of all reported values are acceptable, while the outer 5th through 15th (10 percent) and 85th through 95th (10 percent) percentiles are in the warning area. The not acceptable criteria is established at less than the 5th percentile and greater than the 95th percentile, that is, the outer 10 percent of historical data.

The ERA ^{226}Ra also failed to meet the acceptable percent bias due to a calculation problem at the laboratory. Wastren Laboratory assumed equilibrium with ^{224}Ra in the calculation spreadsheet which caused the ^{226}Ra result to be understated. This problem has been corrected by issuing a nonconformance internally, which instructs analysts to not make an assumption of equilibrium on intercomparison samples. The ERA acceptance criteria for ^{226}Ra was 3.44 to 5.86 pCi/l and the reported result was 3.21 pCi/l.

Air Toxics, Ltd., participated in the ERA, for 49 VOCs in non-potable water. Results were 96 percent satisfactory (Table 8.15). Two volatiles results: bromodichloromethane and bromoform have a performance evaluation of "Check for Error" which indicates that the result is above the warning limit, but within the acceptance limit.

Trace Analysis, Inc., participated in several ERA interlaboratory assessments. For the ERA (July 19, 2001) run of WP-76 response performance standards (Table 8.16), 11 of 193 (5.7 percent) parameters were not acceptable. Subsequently, blind samples were analyzed for all analytes missed. When reevaluated, all were acceptable.

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The cyanide analysis failed to meet the acceptance criteria due to a problem with the extraction process in the laboratory. The instrument calibration verification passed the QC requirements. The laboratory control sample, however, had low recovery, indicating a loss of cyanide during the extraction process. The corrective action was to retrain the analyst extracting the cyanide samples. The laboratory QA officer also submitted a blind sample to verify the effectiveness of the corrective action. The blind sample had a 99 percent recovery.

The total organic carbon did not meet the acceptance criteria because of deteriorated standards. The standards used had not expired; however, when a new curve was analyzed with new standards, the sample was within acceptable range.

The thallium result in the metals analysis was also not acceptable. The instrument was adjusted to read at a more sensitive range. The blind sample submitted for analysis passed with the adjusted instrument line.

The polychlorinated biphenyl (PCB) Aroclor 1260 in water failed to meet acceptance criteria because of the analyst not following the procedure properly. The analyst has been retrained and blind samples submitted passed acceptance criteria.

Four compounds were out of the acceptable range in the semivolatile analysis. Anthracene and benzo(a)anthracene were misidentified on the instrument raw printout. The laboratory implemented a step in reviewing instrument printouts by a second person to avoid misidentifying peaks. Chrysene and di-n-octylphthalate were missed due to a bad stock standard which has been corrected by replacing the standard and running a new curve. Blind samples for the semi-volatile analysis also passed for the compounds missed.

The ERA UST-34 (Table 8.17) and QuiK™ Response (Table 8.18) both had excellent results; all compounds were within acceptable range.

Wastren Laboratory, participated in several methods within the ERA assessment, WP-74, May 17, 2001. Results were 99 percent satisfactory (Table 8.19). Of the volatile analysis, trichloroethylene was not acceptable due to a reporting problem. The laboratory discovered that the raw data did not match the reported result. To correct the problem internally, the laboratory QA officer now performs a final review prior to reporting results. Bromide and orthophosphate as P also did not pass the acceptable criteria. The laboratory investigated all obvious possibilities such as dilution error, calculation error, calibration problems and was not able to resolve the problem until the ion chromatograph was replaced. The samples were analyzed on the new instrument and the results fell within the acceptable range.

8.4 Representativeness

The primary objective of environmental monitoring has been to protect the health and safety of the population surrounding the WIPP facility. The quality objective of representativeness was based on potential radiation exposure of the population through

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inhalation and ingestion. Samples of ambient air, surface water, sediment, groundwater, and biota were collected from areas representative of potential pathways for intake.

The samples were collected using generally accepted methodologies for environmental sampling and approved procedures, ensuring they were representative of the media sampled. These samples were analyzed for natural radioactivity, fallout radioactivity from nuclear weapons tests, and other anthropogenic radionuclides. The reported concentrations at various locations were representative of the baseline information for radionuclides of interest at the WIPP facility.

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**Table 8.1 - Comparison of Duplicate Air Monitoring Results
(First Quarter of 2001) from WIPP Laboratories Data from WIPP East (WEE) Sampling Location**

Week Beginning	Gross Alpha (Bq/m ³)				Gross Beta (Bq/m ³)					
	Sample	2 x TPU ^a	Duplicate	2 x TPU	RER ^b	Sample	2 x TPU	Duplicate	2 x TPU	RER
01/03	4.19×10 ⁻⁵	2.29×10 ⁻⁵	4.74×10 ⁻⁵	2.23×10 ⁻⁵	0.17	1.12×10 ⁻³	1.49×10 ⁻⁴	1.23×10 ⁻³	1.55×10 ⁻⁴	0.51
01/10	2.94×10 ⁻⁵	1.85×10 ⁻⁵	6.17×10 ⁻⁵	2.55×10 ⁻⁵	1.03	7.95×10 ⁻⁴	1.10×10 ⁻⁴	7.78×10 ⁻⁴	1.07×10 ⁻⁴	0.11
01/17	6.18×10 ⁻⁵	2.62×10 ⁻⁵	3.07×10 ⁻⁵	1.86×10 ⁻⁵	0.97	1.21×10 ⁻³	1.53×10 ⁻⁴	1.21×10 ⁻³	1.52×10 ⁻⁴	0.00
01/24	3.22×10 ⁻⁵	1.93×10 ⁻⁵	5.77×10 ⁻⁵	2.54×10 ⁻⁵	0.80	7.73×10 ⁻⁴	1.08×10 ⁻⁴	8.34×10 ⁻⁴	1.15×10 ⁻⁴	0.39
01/31	9.76×10 ⁻⁵	3.28×10 ⁻⁵	1.07×10 ⁻⁵	3.52×10 ⁻⁵	0.20	1.31×10 ⁻³	1.64×10 ⁻⁴	1.32×10 ⁻³	1.66×10 ⁻⁴	0.04
02/07	4.93×10 ⁻⁵	2.36×10 ⁻⁵	4.19×10 ⁻⁵	2.13×10 ⁻⁵	0.23	8.69×10 ⁻⁴	1.20×10 ⁻⁴	9.19×10 ⁻⁴	1.24×10 ⁻⁴	0.29
02/14	4.59×10 ⁻⁵	2.28×10 ⁻⁵	4.08×10 ⁻⁵	2.15×10 ⁻⁵	0.16	1.30×10 ⁻³	1.64×10 ⁻⁴	1.17×10 ⁻³	1.50×10 ⁻⁴	0.58
02/21	4.27×10 ⁻⁵	2.19×10 ⁻⁵	3.75×10 ⁻⁵	2.13×10 ⁻⁵	0.17	7.20×10 ⁻⁴	1.03×10 ⁻⁴	7.49×10 ⁻⁴	1.08×10 ⁻⁴	0.19
02/28	5.57×10 ⁻⁵	2.37×10 ⁻⁵	5.63×10 ⁻⁵	2.39×10 ⁻⁵	0.02	9.12×10 ⁻⁴	1.21×10 ⁻⁴	8.63×10 ⁻⁴	1.16×10 ⁻⁴	0.29
03/07	2.99×10 ⁻⁵	1.81×10 ⁻⁵	1.67×10 ⁻⁵	1.37×10 ⁻⁵	0.58	5.54×10 ⁻⁴	8.61×10 ⁻⁵	5.77×10 ⁻⁴	8.80×10 ⁻⁵	0.19
03/14	4.69×10 ⁻⁵	2.19×10 ⁻⁵	5.14×10 ⁻⁵	2.40×10 ⁻⁵	0.14	6.84×10 ⁻⁴	9.86×10 ⁻⁵	7.17×10 ⁻⁴	1.05×10 ⁻⁴	0.23
03/21	3.56×10 ⁻⁵	2.08×10 ⁻⁵	3.95×10 ⁻⁵	2.13×10 ⁻⁵	0.13	7.69×10 ⁻⁴	1.10×10 ⁻⁴	6.97×10 ⁻⁴	1.02×10 ⁻⁴	0.48
03/28	4.73×10 ⁻⁵	2.27×10 ⁻⁵	6.21×10 ⁻⁵	2.59×10 ⁻⁵	0.43	8.39×10 ⁻⁴	1.15×10 ⁻⁴	8.67×10 ⁻⁴	1.18×10 ⁻⁴	0.17

^a Total propagated uncertainty

^b Relative error ratio

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**Table 8.2 - Comparison of Duplicate Air Monitoring Results
(Second Quarter of 2001) from WIPP Laboratories Data from WIPP South (WSS) Sampling Location**

Week Beginning	Gross Alpha (Bq/m ³)				Gross Beta (Bq/m ³)				RER	
	Sample	2 x TPU ^a	Duplicate	2 x TPU	Sample	2 x TPU	Duplicate	2 x TPU		
04/04	8.69×10 ⁻⁵	3.15×10 ⁻⁵	7.63×10 ⁻⁵	2.94×10 ⁻⁵	0.25	7.40×10 ⁻⁴	7.01×10 ⁻⁴	1.06×10 ⁻⁴	1.02×10 ⁻⁴	0.27
04/11	5.36×10 ⁻⁵	2.38×10 ⁻⁵	5.64×10 ⁻⁵	2.50×10 ⁻⁵	0.08	8.57×10 ⁻⁴	9.49×10 ⁻⁴	1.16×10 ⁻⁴	1.27×10 ⁻⁴	0.53
04/18	7.32×10 ⁻⁵	2.87×10 ⁻⁵	7.40×10 ⁻⁵	2.90×10 ⁻⁵	0.02	7.83×10 ⁻⁴	7.68×10 ⁻⁴	1.10×10 ⁻⁴	1.09×10 ⁻⁴	0.10
04/25	7.80×10 ⁻⁵	2.96×10 ⁻⁵	5.83×10 ⁻⁵	2.57×10 ⁻⁵	0.50	1.06×10 ⁻³	9.50×10 ⁻⁴	1.39×10 ⁻⁴	1.27×10 ⁻⁴	0.58
05/02	7.54×10 ⁻⁵	2.92×10 ⁻⁵	6.39×10 ⁻⁵	2.66×10 ⁻⁵	0.29	7.88×10 ⁻⁴	7.35×10 ⁻⁴	1.12×10 ⁻⁴	1.06×10 ⁻⁴	0.34
05/09	6.05×10 ⁻⁵	2.62×10 ⁻⁵	5.82×10 ⁻⁵	2.52×10 ⁻⁵	0.06	7.86×10 ⁻⁴	9.11×10 ⁻⁴	1.12×10 ⁻⁴	1.24×10 ⁻⁴	0.75
05/16	4.32×10 ⁻⁵	2.18×10 ⁻⁵	3.80×10 ⁻⁵	2.04×10 ⁻⁵	0.17	6.44×10 ⁻⁴	6.32×10 ⁻⁴	9.62×10 ⁻⁵	9.51×10 ⁻⁵	0.09
05/23	5.91×10 ⁻⁵	2.75×10 ⁻⁵	6.81×10 ⁻⁵	2.89×10 ⁻⁵	0.23	8.98×10 ⁻⁴	8.15×10 ⁻⁴	1.23×10 ⁻⁴	1.13×10 ⁻⁴	0.50
05/30	8.27×10 ⁻⁵	3.15×10 ⁻⁵	6.98×10 ⁻⁵	2.91×10 ⁻⁵	0.30	8.72×10 ⁻⁴	8.65×10 ⁻⁴	1.19×10 ⁻⁴	1.18×10 ⁻⁴	0.04
06/06	6.82×10 ⁻⁵	2.87×10 ⁻⁵	7.27×10 ⁻⁵	2.94×10 ⁻⁵	0.11	8.90×10 ⁻⁴	7.55×10 ⁻⁴	1.23×10 ⁻⁴	1.09×10 ⁻⁴	0.82
06/13	5.27×10 ⁻⁵	2.43×10 ⁻⁵	5.83×10 ⁻⁵	2.56×10 ⁻⁵	0.16	6.68×10 ⁻⁴	6.37×10 ⁻⁴	9.81×10 ⁻⁵	9.50×10 ⁻⁵	0.23
06/20	9.79×10 ⁻⁵	3.39×10 ⁻⁵	9.08×10 ⁻⁵	3.18×10 ⁻⁵	0.15	8.56×10 ⁻⁴	9.21×10 ⁻⁴	1.20×10 ⁻⁴	1.25×10 ⁻⁴	0.38
06/27	7.38×10 ⁻⁵	3.04×10 ⁻⁵	7.27×10 ⁻⁵	3.06×10 ⁻⁵	0.03	7.49×10 ⁻⁴	7.75×10 ⁻⁴	1.11×10 ⁻⁴	1.15×10 ⁻⁴	0.16

^a Total propagated uncertainty

^b Relative error ratio

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**Table 8.3 - Comparison of Duplicate Air Monitoring Results
(Third Quarter of 2001) from WIPP Laboratories Data from Mills Ranch (MLR) Sampling Location**

Week Beginning	Gross Alpha (Bq/m ³)				Gross Beta (Bq/m ³)					
	Sample	2 x TPU ^a	Duplicate	2 x TPU	RER ^b	Sample	2 x TPU	Duplicate	2 x TPU	RER
07/04	2.50×10 ⁻⁵	1.63×10 ⁻⁵	4.17×10 ⁻⁵	2.08×10 ⁻⁵	0.63	6.34×10 ⁻⁴	9.07×10 ⁻⁵	6.82×10 ⁻⁴	9.61×10 ⁻⁵	0.36
07/11	6.25×10 ⁻⁵	2.73×10 ⁻⁵	5.70×10 ⁻⁵	2.61×10 ⁻⁵	0.15	8.97×10 ⁻⁴	1.23×10 ⁻⁴	9.08×10 ⁻⁴	1.24×10 ⁻⁴	0.06
07/18	NR ^c	NR	6.90×10 ⁻⁵	2.79×10 ⁻⁵	N/A ^d	NR	NR	7.06×10 ⁻⁴	1.03×10 ⁻⁴	N/A
07/25	5.34×10 ⁻⁵	2.46×10 ⁻⁵	3.39×10 ⁻⁵	1.95×10 ⁻⁵	0.62	6.60×10 ⁻⁴	9.83×10 ⁻⁵	7.24×10 ⁻⁴	1.04×10 ⁻⁴	0.45
08/01	3.96×10 ⁻⁵	2.11×10 ⁻⁵	2.36×10 ⁻⁵	1.65×10 ⁻⁵	0.60	6.86×10 ⁻⁴	1.01×10 ⁻⁴	8.08×10 ⁻⁴	1.13×10 ⁻⁴	0.80
08/08	7.59×10 ⁻⁵	2.96×10 ⁻⁵	9.41×10 ⁻⁵	3.25×10 ⁻⁵	0.41	7.82×10 ⁻⁴	1.10×10 ⁻⁴	7.73×10 ⁻⁴	1.08×10 ⁻⁴	0.06
08/15	8.28×10 ⁻⁵	3.07×10 ⁻⁵	4.44×10 ⁻⁵	2.28×10 ⁻⁵	1.00	8.34×10 ⁻⁴	1.15×10 ⁻⁴	8.22×10 ⁻⁴	1.14×10 ⁻⁴	0.07
08/22	3.28×10 ⁻⁵	2.17×10 ⁻⁵	2.75×10 ⁻⁵	2.04×10 ⁻⁵	0.18	6.88×10 ⁻⁴	1.03×10 ⁻⁴	7.00×10 ⁻⁴	1.04×10 ⁻⁴	0.08
08/29	4.36×10 ⁻⁵	2.27×10 ⁻⁵	5.57×10 ⁻⁵	2.53×10 ⁻⁵	0.36	6.04×10 ⁻⁴	9.04×10 ⁻⁵	6.85×10 ⁻⁴	9.87×10 ⁻⁵	0.61
09/05	4.70×10 ⁻⁵	2.53×10 ⁻⁵	5.23×10 ⁻⁵	2.64×10 ⁻⁵	0.14	7.25×10 ⁻⁴	1.07×10 ⁻⁴	7.80×10 ⁻⁴	1.12×10 ⁻⁴	0.36
09/12	2.50×10 ⁻⁵	1.79×10 ⁻⁵	3.74×10 ⁻⁵	2.11×10 ⁻⁵	0.45	7.50×10 ⁻⁴	1.06×10 ⁻⁴	8.31×10 ⁻⁴	1.14×10 ⁻⁴	0.52
09/19	5.99×10 ⁻⁵	2.59×10 ⁻⁵	3.65×10 ⁻⁵	1.84×10 ⁻⁵	0.74	8.80×10 ⁻⁴	1.22×10 ⁻⁴	7.23×10 ⁻⁴	1.01×10 ⁻⁴	0.99
09/26	5.92×10 ⁻⁵	2.56×10 ⁻⁵	6.35×10 ⁻⁵	2.64×10 ⁻⁵	0.12	1.25×10 ⁻³	1.60×10 ⁻⁴	1.42×10 ⁻³	1.76×10 ⁻⁴	0.71

^a Total propagated uncertainty

^b Relative error ratio

^c Not Reported

^d Not Applicable since sample or duplicate value is not reported.

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**Table 8.4 - Comparison of Duplicate Air Monitoring Results
(Fourth Quarter of 2001) from WIPP Laboratories Data from Smith Ranch (SMR) Sampling Location**

Week Beginning	Gross Alpha (Bq/m ³)				Gross Beta (Bq/m ³)					
	Sample	2 x TPU ^a	Duplicate	2 x TPU	RER ^b	Sample	2 x TPU	Duplicate	2 x TPU	RER
10/03	4.23×10 ⁻⁵	2.21×10 ⁻⁵	2.52×10 ⁻⁵	1.70×10 ⁻⁵	0.61	1.02×10 ⁻³	1.37×10 ⁻⁴	1.17×10 ⁻³	1.51×10 ⁻⁴	0.74
10/10	7.41×10 ⁻⁵	3.05×10 ⁻⁵	NR ^c	NR	N/A ^d	8.20×10 ⁻⁴	1.16×10 ⁻⁴	NR	NR	N/A
10/17	3.66×10 ⁻⁵	2.18×10 ⁻⁵	5.75×10 ⁻⁵	2.71×10 ⁻⁵	0.60	1.39×10 ⁻³	1.73×10 ⁻⁴	1.19×10 ⁻³	1.53×10 ⁻⁴	0.87
10/24	1.08×10 ⁻⁴	3.63×10 ⁻⁵	1.18×10 ⁻⁴	3.87×10 ⁻⁵	0.19	1.19×10 ⁻³	1.53×10 ⁻⁴	1.12×10 ⁻³	1.47×10 ⁻⁴	0.33
10/31	NR	NR	1.22×10 ⁻⁴	3.86×10 ⁻⁵	N/A	NR	NR	8.51×10 ⁻⁴	1.18×10 ⁻⁴	N/A
11/07	NR	NR	1.63×10 ⁻⁴	4.59×10 ⁻⁵	N/A	NR	NR	1.75×10 ⁻³	2.11×10 ⁻⁴	N/A
11/14	NR	NR	4.18×10 ⁻⁵	2.33×10 ⁻⁵	N/A	NR	NR	7.64×10 ⁻⁴	1.12×10 ⁻⁴	N/A
11/21	NR	NR	8.81×10 ⁻⁵	3.01×10 ⁻⁵	N/A	NR	NR	8.12×10 ⁻⁴	1.09×10 ⁻⁴	N/A
11/28	9.20×10 ⁻⁵	3.23×10 ⁻⁵	1.25×10 ⁻⁴	3.89×10 ⁻⁵	0.65	9.38×10 ⁻⁴	1.25×10 ⁻⁴	1.00×10 ⁻³	1.33×10 ⁻⁴	0.35
12/05	4.27×10 ⁻⁵	1.98×10 ⁻⁵	6.04×10 ⁻⁵	2.41×10 ⁻⁵	0.57	6.89×10 ⁻⁴	9.55×10 ⁻⁵	7.34×10 ⁻⁴	1.01×10 ⁻⁴	0.32
12/12	7.72×10 ⁻⁵	3.07×10 ⁻⁵	1.19×10 ⁻⁴	4.08×10 ⁻⁵	0.82	1.13×10 ⁻³	1.50×10 ⁻⁴	1.08×10 ⁻³	1.49×10 ⁻⁴	0.24
12/19	4.28×10 ⁻⁵	2.16×10 ⁻⁵	4.10×10 ⁻⁵	2.13×10 ⁻⁵	0.06	1.09×10 ⁻³	1.41×10 ⁻⁴	1.04×10 ⁻³	1.36×10 ⁻⁴	0.26
12/26	6.77×10 ⁻⁵	2.68×10 ⁻⁵	9.63×10 ⁻⁵	3.30×10 ⁻⁵	0.67	1.16×10 ⁻³	1.49×10 ⁻⁴	1.20×10 ⁻³	1.54×10 ⁻⁴	0.19

^a Total propagated uncertainty

^b Relative error ratio

^c Not Reported

^d Not Applicable since sample or duplicate value is not reported.

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**Table 8.5 - Environmental Measurements Laboratory Assessments for Wastren, 2001
MATRIX: Air Filter (Bq/Filter)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		% Bias	Reported		EML		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
²⁴¹ Am	0.49	0.02	0.486	0.016	0.82	0.094	0.005	0.088	0.01	6.82
⁶⁰ Co	21	2	19.44	0.5	8.02	19	2	17.5	0.47	8.57
¹³⁷ Cs	9.8	2	8.76	0.34	11.87	18	2	17.1	0.58	5.26
Gross α	3.57	0.34	3.97	0.3	-10.08	5.54	0.67	5.362	0.536	3.32
Gross β	2.51	0.29	2.58	0.15	-2.71	11.98	1.34	12.77	1.277	-6.19
⁵⁴ Mn	7.4	1	6.52	0.28	13.5	88	14	81.15	4.76	8.44
²³⁸ Pu	0.21	0.008	0.215	0.009	-2.32	0.069	0.004	0.071	0	-2.82
²³⁹ Pu	0.14	0.006	0.136	0.012	2.94	0.23	0.009	0.2291	0.017	0.39
⁹⁰ Sr	7.34	0.39	7.1	0.22	3.38	3.31	0.19	3.481	0.233	-4.91
²³⁴ U	0.043	0.004	0.046	0.002	-6.52	0.099	0.005	0.1082	0.01	-8.5
²³⁸ U	0.046	0.004	0.046	0.002	0	0.104	0.005	0.1093	0.01	-4.85
TOT U(μg)	3.6	N/A ^d	3.7	0.16	-2.7	8.1	N/A	8.844	0.581	-8.41

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

^d Not Applicable

**Table 8.6 - Environmental Measurements Laboratory Assessments for Wastren, 2001
MATRIX: Soil (Bq/kg)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		% Bias	Reported		EML		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
²²⁸ Ac	42.4	10	42.7	1.7	-0.7	56.3	8	59.57	2.09	-5.49
²⁴¹ Am	14.53	0.76	14.8	0.51	-1.82	4.98	0.31	4.432	0.312	12.36
²¹² Bi	25.4	20	42	4.1	-39.52 ^d	54.2	18	62.0667	5.152	-12.67
¹³⁷ Cs	1624	162	1740	90	-6.67	542	70	612.33	30.62	-11.48
⁴⁰ K	462	56	468	25	-1.28	617	206	623.33	33.04	-1.02
²¹² Pb	45.8	16	41.5	2.2	10.36	59.7	11	58.33	3.13	2.35
²¹⁴ Pb	29.5	10	34.3	1.6	-13.99	41.9	6	39.67	1.72	5.62
²³⁹ Pu	24.83	1.11	25.6	0.34	-3.01	9.32	0.49	8.948	0.323	4.16
⁹⁰ Sr	66.6	5.1	69	5.7	-3.48	29.1	2.4	30.596	1.065	-4.89
²³⁴ Th	59.3	24	46.6	3.5	27.25	N/A ^e	N/A	N/A	N/A	N/A
²³⁴ U	40.46	2.41	43.6	1.8	-7.2	87	4.81	92.23	1.3	-5.67
²³⁸ U	42.27	2.46	46.1	1.3	-8.31	92.87	5.08	98.33	3.2	-5.55
TOTU(μg)	3.6	N/A	3.73	0.02	-3.48	8	N/A	7.948	0.125	0.65

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

^d Not Acceptable

^e Not Applicable

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**Table 8.7 - Environmental Measurements Laboratory Assessments for Wastren, 2001
MATRIX: Vegetation (Bq/kg)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		%	Reported		EML		%
	Value	Error	Value	Error		Value	Error	Value	Error	
²⁴¹ Am	6.19	0.34	6.17	0.32	0.32	7.62	0.4	6.915	0.419	10.2
²⁴⁴ Cm	3.65	0.24	3.69	0.29	-1.08	4.27	0.26	4.308	1.021	-0.88
⁶⁰ Co	32.4	6	30.4	1.2	6.58	37.4	4	35.3	1.436	5.95
¹³⁷ Cs	835	168	842	42	-0.83	993	130	1030	51.8	-3.59
⁴⁰ K	691	166	603	32	14.59	1200	400	898.67	48.23	33.53
²³⁹ Pu	9.18	0.48	9.58	1.3	-4.18	11.54	0.48	11.022	0.43	4.7
⁹⁰ Sr	1224	65	1330	70	-7.97	1541	84	1612.8	48.6	-4.45

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

**Table 8.8 - Environmental Measurements Laboratory Assessments for Wastren, 2001
MATRIX: Water (Bq/l)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		%	Reported		EML		%
	Value	Error	Value	Error		Value	Error	Value	Error	
²⁴¹ Am	1.62	0.07	1.67	0.08	-2.99	0.77	0.04	0.7597	0.04	1.36
⁶⁰ Co	104	8	98.2	3.6	5.91	218	20	209	7.59	4.31
¹³⁷ Cs	77	14	73	3.7	5.48	44	5	45.133	2.467	-2.51
Gross α	1918	165	1900	190	0.95	1224	118	1150	115	6.43
Gross β	1272	140	1297	100	-1.93	8005	731	7970	800	0.44
³ H	86.1	8.4	79.3	2	8.58	214	17	207	2.69	3.38
²³⁸ Pu	1.58	0.07	1.58	0.09	0	1.13	0.05	1.0882	0.058	3.84
²³⁹ Pu	1.65	0.07	1.64	0.09	0.61	1.78	0.07	1.628	0.114	9.33
⁹⁰ Sr	4.08	0.26	4.4	0.2	-7.27	3.82	0.25	3.729	0.364	2.44
²³⁴ U	0.95	0.05	1.04	0.05	-8.65	1.15	0.07	1.166	0.062	-1.37
²³⁸ U	0.97	0.05	1.04	0.04	-6.73	1.12	0.07	1.169	0.056	4.19
TOTU(μg)	0.078	N/A ^d	0.08	0.003	-2.5	0.091	N/A	0.0944	0	-3.6

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

^d Not Applicable

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**Table 8.9 - Environmental Resource Associates® for Wastren, 2001
MATRIX: Water (pCi/l)**

RN ^b	37007					37129				
	Reported		ERA ^a		% Bias	Reported		ERA		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
U(NAT)	19.8	N/A ^c	20.4	3	-2.94	N/A	N/A	N/A	N/A	N/A
²²⁶ Ra	3.21	0.122	4.65	0.698	-30.97 ^d	N/A	N/A	N/A	N/A	N/A
²²⁸ Ra	13.4	0.458	14.4	3.6	-6.94	N/A	N/A	N/A	N/A	N/A
Gross α	N/A	N/A	N/A	N/A	N/A	16.3	1.42	17.8	5	-8.42
Gross β	N/A	N/A	N/A	N/A	N/A	45.1	0.833	53	10	-14.9

^a Environmental Resource Associates®

^b Radionuclide

^c Not Applicable

^d Not Acceptable

Table 8.10 - NRIP for WIPP Laboratories, 2001

RN ^b	Synthetic Urine (mBq/g)					Soil (Bq/g)				
	Reported		NIST ^a		% Bias	Reported		NIST		% Bias
	Value	% 1 σ Error	Value	% 1 σ Error		Value	% 1 σ Error	Value	% 1 σ Error	
²⁴¹ Am	0.0608	19.24	0.061	0.32	-0.3	0.6364	21.4	0.715	0.32	-10.9
²³⁸ Pu	0.0584	17.59	0.0623	0.55	-6.3	0.7465	14.4	0.73	0.55	2.3
²³⁹ Pu	0.0582	17.58	0.0609	0.38	-4.4	0.7701	14.7	0.713	0.39	8
⁹⁰ Sr	0.0573	10.81	0.0637	0.37	-10	0.6191	3.5	0.747	0.37	-17.1
²³⁸ U	0.0597	18.34	0.06	0.03	-0.5	0.7665	30.2	0.703	0.3	9.1

^a National Institute of Standards and Technology

^b Radionuclide

**Table 8.11 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2001
MATRIX: Air Filter (Bq/Filter)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		% Bias	Reported		EML		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
²⁴¹ Am	0.462	0.096	0.486	0.016	-4.94	0.099	0.016	0.088	0.01	12.5
⁶⁰ Co	19.13	2.57	19.44	0.5	-1.59	17.433	2.373	17.5	0.47	-0.38
¹³⁷ Cs	8.377	1.167	8.76	0.34	-4.37	17.4	2.423	17.1	0.58	1.75
Gross α	3.26	0.332	3.97	0.3	-17.88	5.14	0.519	5.362	0.536	-4.14
Gross β	2.523	0.256	2.58	0.15	-2.21	11	1.097	12.77	1.277	-13.86
⁵⁴ Mn	6.593	0.948	6.52	0.28	1.12	84.733	11.5	81.15	4.76	4.42
²³⁸ Pu	0.2	0.042	0.215	0.009	-6.98	0.065	0.013	0.071	0	-8.45
²³⁹ Pu	0.129	0.028	0.136	0.012	-5.15	0.232	0.038	0.2291	0.017	1.26
⁹⁰ Sr	5.41	0.298	7.1	0.22	-23.8	1.86	0.141	3.481	0.233	-46.57 ^d
Bq U	0.105	0.016	0.093	0	12.9	0.21	0.023	0.2225	0.014	-5.62

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

^d Not Acceptable

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**Table 8.12 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2001
MATRIX: Soil (Bq/Filter)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		% Bias	Reported		EML		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
²²⁸ Ac	37.667	6.623	42.7	1.7	-11.79	53.033	8.547	59.57	2.09	-10.97
²⁴¹ Am	17.05	2.549	14.8	0.51	15.2	5.523	1.103	4.432	0.312	24.62
²¹² Bi	47.6	11.5	42	4.1	13.33	56.633	12.267	62.0667	5.152	-8.75
²¹⁴ Bi	27	4.713	32.6	1.4	-17.18	32.633	4.967	36.9	1.53	-11.56
Bq U	83.41	8.247	91.8	2.3	-9.14	205.75	21.145	194.23	3.76	5.93
¹³⁷ Cs	1633.3	205.67	1740	90	-6.13	576.667	72.733	612.33	30.62	-5.82
⁴⁰ K	531.67	71.67	468	25	13.6	716.333	94.967	623.33	33.04	14.92
²¹² Pb	51.33	7.607	41.5	2.2	23.69	71.9	10.15	58.33	3.13	23.26
²¹⁴ Pb	34.667	5.837	34.3	1.6	1.07	42.533	6.127	39.67	1.72	7.22
²³⁹ Pu	30.057	4.631	25.6	0.67	17.41	10.62	2.037	8.948	0.323	18.68
⁹⁰ Sr	61.64	7.363	69	5.7	-10.67	28.733	3.66	30.596	1.065	-6.09

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

**Table 8.13 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2001
MATRIX: Vegetation (Bq/kg)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		% Bias	Reported		EML		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
²⁴¹ Am	6.283	1.14	6.17	0.32	1.83	8.21	1.63	6.915	0.419	18.73
²⁴⁴ Cm	3.82	0.769	3.69	0.29	3.52	NR ^d	NR	4.308	1.021	N/A ^e
⁶⁰ Co	29.967	3.97	30.4	1.2	-1.42	33.967	4.48	35.3	1.436	-3.78
¹³⁷ Cs	761	95.8	842	42	-9.62	899	113	1030	51.8	-12.72
⁴⁰ K	661	88.167	603	32	9.62	973.667	128	898.67	48.23	8.34
²³⁹ Pu	9.27	1.437	9.58	1.3	-3.24	11.27	1.65	11.022	0.43	2.25
⁹⁰ Sr	877.333	70.367	1330	70	-34.04 ^f	1601.67	126.667	1612.8	48.6	-0.69

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

^d Not Reported

^e Not Applicable

^f Not Acceptable according to the percent bias acceptable limits, but acceptable with warning according to EML

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**Table 8.14 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2001
MATRIX: Water (Bq/l)**

RN ^c	QAP ^a 54 June 2001					QAP 55 December 2001				
	Reported		EML ^b		% Bias	Reported		EML		% Bias
	Value	Error	Value	Error		Value	Error	Value	Error	
²⁴¹ Am	1.66	0.277	1.67	0.08	-0.599	0.742	0.163	0.7597	0.04	-2.33
Bq U	1.947	0.223	2.12	0.09	-8.16	2.227	0.241	2.372	0.118	-6.11
⁶⁰ Co	102.667	13.633	98.2	3.6	4.55	211.333	28.3	209	7.59	1.12
¹³⁷ Cs	75.03	10.167	73	3.7	2.78	45.533	6.343	45.133	2.467	0.89
²³⁸ Pu	1.507	0.298	1.58	0.09	-4.62	1.031	0.168	1.0882	0.058	-5.26
²³⁹ Pu	1.597	0.315	1.64	0.09	-2.62	1.653	0.258	1.628	0.114	1.54
⁹⁰ Sr	4.105	0.289	4.4	0.2	-6.7	4.22	0.338	3.729	0.364	13.17

^a Quality Assurance Program

^b Environmental Measurements Laboratory

^c Radionuclide

**Table 8.15 - Environmental Resource Associates® Assessment of Air Toxics, Ltd., WP-75,
June 14, 2001, for Volatile Organic Compounds**

Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Acetone	µg/l	< 10.00	0	NR ^a	Acceptable
Acetonitrile	µg/l	< 10.00	0	NR	Acceptable
Acrylonitrile	µg/l	< 2.00	0	NR	Acceptable
Acrolein	µg/l	< 10.00	0	NR	Acceptable
Benzene	µg/l	59.1	51.7	37.3 - 66.5	Acceptable
Bromodichloromethane	µg/l	43.4	34.6	24.4 - 45.1	Check for Error ^b
Bromoform	µg/l	49.4	37.4	24.0 - 51.3	Check for Error
Bromomethane	µg/l	< 2.00	0	NR	Acceptable
2-Butanone (MEK)	µg/l	< 10.0	0	NR	Acceptable
Carbon disulfide	µg/l	< 2.00	0	NR	Acceptable
Carbon tetrachloride	µg/l	59.3	55.4	34.2 - 78.1	Acceptable
Chlorobenzene	µg/l	36.5	31.7	22.7 - 40.3	Acceptable
Chlorodibromomethane	µg/l	61.6	51.4	34.0 - 68.3	Acceptable
Chloroethane	µg/l	< 2.00	0	NR	Acceptable
2-Chloroethylvinylether	µg/l	< 10.0	0	NR	Acceptable
Chloroform	µg/l	26.9	23.3	16.4 - 30.1	Acceptable
Chloromethane	µg/l	< 2.00	0	NR	Acceptable
DBCP	µg/l	< 10.0	0	NR	Acceptable
1,2-Dibromoethane (EDB)	µg/l	< 2.00	0	NR	Acceptable
Dibromomethane	µg/l	< 2.00	0	NR	Acceptable
1,2-Dichlorobenzene	µg/l	21.3	18.4	12.7 - 23.8	Acceptable
1,3-Dichlorobenzene	µg/l	43.2	38.5	27.1 - 48.1	Acceptable
1,4-Dichlorobenzene	µg/l	14.1	11.6	7.81 - 15.5	Acceptable
Dichlorodifluoromethane	µg/l	< 2.00	0	NR	Acceptable
1,1-Dichloroethane	µg/l	< 2.00	0	NR	Acceptable
1,2-Dichloroethane	µg/l	47.4	39.9	27.6 - 53.3	Acceptable
1,1-Dichloroethylene	µg/l	69.8	64.4	35.2 - 98.5	Acceptable
cis-1,2-Dichloroethylene	µg/l	< 2.00	0	NR	Acceptable

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**Table 8.15 - Environmental Resource Associates® Assessment of Air Toxics, Ltd., WP-75,
June 14, 2001, for Volatile Organic Compounds**

Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
trans-1,2-Dichloroethylene	µg/l	32.1	28.6	16.5 - 40.6	Acceptable
1,2-Dichloropropane	µg/l	16	14.3	10.8 - 17.7	Acceptable
cis-1,3-Dichloropropylene	µg/l	< 2.00	0	NR	Acceptable
trans-1,3-Dichloropropylene	µg/l	< 2.00	0	NR	Acceptable
Ethylbenzene	µg/l	29.1	24.3	16.4 - 31.6	Acceptable
2-Hexanone	µg/l	< 10.0	0	NR	Acceptable
Methylene chloride	µg/l	12.7	12.2	7.75 - 17.6	Acceptable
4-Methyl-2-pentanone (MIBK)	µg/l	< 10.0	0	NR	Acceptable
Styrene	µg/l	< 2.00	0	NR	Acceptable
1,1,1,2-Tetrachloroethane	µg/l	< 2.00	0	NR	Acceptable
1,1,2,2-Tetrachloroethane	µg/l	109	84.7	49.6 - 118	Acceptable
Tetrachloroethylene	µg/l	44.8	41.7	27.6 - 53.5	Acceptable
Toluene	µg/l	18.5	16.1	11.3 - 20.6	Acceptable
1,1,1-Trichloroethane	µg/l	28.7	26.2	17.1 - 34.5	Acceptable
1,1,2-Trichloroethane	µg/l	47.8	39.3	27.2 - 50.9	Acceptable
Trichloroethylene	µg/l	54.9	50.9	33.0 - 65.8	Acceptable
Trichlorofluoromethane	µg/l	49.8	44	11.6 - 75.5	Acceptable
1,2,3-Trichloropropane	µg/l	< 2.00	0	NR	Acceptable
Vinyl acetate	µg/l	< 10.0	0	NR	Acceptable
Vinyl chloride	µg/l	< 2.00	0	NR	Acceptable
Xylenes, total	µg/l	147	127	72.7 - 171	Acceptable

^a Not Reported

^b Check for Error indicates result is above the warning limit, but within the acceptance limit.

**Table 8.16 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., WP-76,
July 19, 2001**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
pH	S.U.	5.91	5.9	5.77 - 6.04	Acceptable
Cyanide	mg/l	0.333	0.556	0.384 - 0.717	Not Acceptable
Phenolics, total	mg/l	0.182	0.175	0.0886 - 0.261	Acceptable
Grease & Oil (Gravimetric)	mg/l	20.8	21	12.3 - 25.9	Acceptable
Total Residual Chlorine	mg/l	3.58	3.44	2.83 - 4.05	Acceptable
Mercury	µg/l	3.73	4.27	3.11 - 5.42	Acceptable
Hexavalent Chromium	µg/l	191	187	152 - 215	Acceptable
Minerals					
Total solids at 105°C	mg/l	224	255	217 - 291	Acceptable
Total Dissolved Solids	mg/l	225	240	178 - 302	Acceptable
Conductivity at 25°C	µmhos	336	338	312 - 364	Acceptable
Alkalinity as CaCO ₃	mg/l	60	56.9	50.7 - 63.4	Acceptable
Chloride	mg/l	51.4	54.7	48.9 - 60.1	Acceptable
Fluoride	mg/l	2.7	2.95	2.57 - 3.29	Acceptable
Potassium	mg/l	15.1	15.1	12.9 - 17.4	Acceptable
Sodium	mg/l	49.4	61.6	55.6 - 67.7	Not Acceptable

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**Table 8.16 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., WP-76,
July 19, 2001**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Sulfate	mg/l	10.1	11.1	8.03 - 13.9	Acceptable
<u>Hardness</u>					
Total suspended solids	mg/l	41	45	33.7 - 48.2	Acceptable
Calcium	mg/l	27.1	27.2	24.1 - 31.0	Acceptable
Magnesium	mg/l	21.5	20.9	18.3 - 23.4	Acceptable
Calcium hardness as CaCO ₃	mg/l	NR ^a	67.9	48.8 - 90.5	
Total hardness as CaCO ₃	mg/l	156	154	140 - 169	Acceptable
<u>Demand</u>					
BOD	mg/l	108	107	54.3 - 161	Acceptable
CBOD	mg/l	67	92.4	41.5 - 143	Acceptable
COD	mg/l	185	174	134 - 198	Acceptable
TOC	mg/l	84.8	68.7	57.4 - 79.0	Not Acceptable
<u>Nutrients</u>					
Ammonia as N	mg/l	3.53	3.78	2.87 - 4.67	Acceptable
Nitrate as N	mg/l	11.8	11.9	9.42 - 14.1	Acceptable
Ortho-phosphate as P	mg/l	1.24	1.27	1.07 - 1.48	Acceptable
Total phosphorus as P	mg/l	1.51	1.43	1.08 - 1.71	Acceptable
Total kjeldahl nitrogen as N	mg/l	17.9	23.7	17.4 - 29.2	Check for Error ^b
<u>Trace Metals</u>					
Aluminum	µg/l	1240	1190	1020 - 1360	Acceptable
Antimony	µg/l	804	733	518 - 880	Acceptable
Arsenic	µg/l	693	621	521 - 727	Acceptable
Barium	µg/l	2080	2070	1760 - 2340	Acceptable
Beryllium	µg/l	46	47	38.6 - 53.3	Acceptable
Boron	µg/l	630	724	517 - 931	Acceptable
Cadmium	µg/l	628	658	562 - 747	Acceptable
Chromium	µg/l	287	286	248 - 325	Acceptable
Cobalt	µg/l	530	519	456 - 582	Acceptable
Copper	µg/l	660	652	592 - 716	Acceptable
Iron	µg/l	2890	2930	2600 - 3300	Acceptable
Lead	µg/l	1450	1450	1270 - 1620	Acceptable
Manganese	µg/l	2740	2690	2420 - 2990	Acceptable
Molybdenum	µg/l	270	279	238 - 320	Acceptable
Nickel	µg/l	1000	988	894 - 1100	Acceptable
Selenium	µg/l	1210	1210	963 - 1400	Acceptable
Silver	µg/l	214	213	182 - 244	Acceptable
Strontium	µg/l	NR	161	137 - 185	NR
Thallium	µg/l	101	191	152 - 224	Not Acceptable
Vanadium	µg/l	1860	1850	1670 - 2030	Acceptable
Zinc	µg/l	624	614	543 - 692	Acceptable
<u>PCBs in H₂O (Standard #1)</u>					
Aroclor 1016/1242	µg/l	2.7	5.79	1.84 - 7.99	Check for Error
Aroclor 1221	µg/l	NR	0	NR	Acceptable
Aroclor 1232	µg/l	NR	0	NR	Acceptable
Aroclor 1248	µg/l	NR	0	NR	Acceptable

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**Table 8.16 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., WP-76,
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Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Aroclor 1254	µg/l	NR	0	NR	Acceptable
Aroclor 1260	µg/l	NR	0	NR	Acceptable
<u>PCBs in H₂O (Standard #2)</u>					
Aroclor 1016/1242	µg/l	NR	0	NR	Acceptable
Aroclor 1221	µg/l	NR	0	NR	Acceptable
Aroclor 1232	µg/l	NR	0	NR	Acceptable
Aroclor 1248	µg/l	NR	0	NR	Acceptable
Aroclor 1254	µg/l	NR	0	NR	Acceptable
Aroclor 1260	µg/l	0.8	3.52	1.82 - 4.62	Not Acceptable
<u>PCBs in Oil (Standard #1)</u>					
Aroclor 1016/1242	mg/Kg	NR	0	NR	Acceptable
Aroclor 1254	mg/Kg	9.29	29.9	3.67 - 44.9	Check for Error
Aroclor 1260	mg/Kg	NR	0	NR	Acceptable
<u>PCBs in Oil (Standard #2)</u>					
Aroclor 1016/1242	mg/Kg	20.1	41.7	7.72 - 55.8	Acceptable
Aroclor 1254	mg/Kg	NR	0	NR	Acceptable
Aroclor 1260	mg/Kg	NR	0	NR	Acceptable
<u>Volatiles</u>					
Acetone	µg/l	<10.0	0	NR	Acceptable
Acetonitrile	µg/l	NR	0	NR	No Evaluation
Acrylonitrile	µg/l	<1.00	0	NR	Acceptable
Acrolein	µg/l	NR	0	NR	No Evaluation
Benzene	µg/l	35.1	30.8	22.0 - 39.9	Acceptable
Bromodichloromethane	µg/l	17.6	15.7	10.9 - 20.6	Acceptable
Bromoform	µg/l	50.6	44.9	29.1 - 61.5	Acceptable
Bromomethane	µg/l	< 1.00	0	NR	Acceptable
2-Butanone (MEK)	µg/l	< 5.00	0	NR	Acceptable
Carbon disulfide	µg/l	< 1.00	0	NR	Acceptable
Carbon tetrachloride	µg/l	50.9	44.3	27.4 - 62.5	Acceptable
Chlorobenzene	µg/l	17	16.2	12.0 - 20.4	Acceptable
Chlorodibromomethane	µg/l	22.1	21.5	14.2 - 28.5	Acceptable
Chloroethane	µg/l	< 1.00	0	NR	Acceptable
2-Chloroethylvinylether	µg/l	< 5.00	0	NR	Acceptable
Chloroform	µg/l	61.7	53.7	37.3 - 68.8	Acceptable
Chloromethane	µg/l	< 1.00	0	NR	Acceptable
DBCP	µg/l	< 5.00	0	NR	Acceptable
1,2-Dibromoethane (EDB)	µg/l	< 1.00	0	NR	Acceptable
Dibromomethane	µg/l	< 1.00	0	NR	Acceptable
1,2-Dichlorobenzene	µg/l	36.6	33.9	23.8 - 43.1	Acceptable
1,3-Dichlorobenzene	µg/l	16.2	16.3	11.2 - 20.7	Acceptable
1,4-Dichlorobenzene	µg/l	55.9	48.4	33.3 - 62.4	Acceptable
Dichlorodifluoromethane	µg/l	< 1.00	0	NR	Acceptable
1,1-Dichloroethane	µg/l	< 1.00	0	NR	Acceptable
1,2-Dichloroethane	µg/l	49.5	44.7	30.9 - 59.6	Acceptable
1,1-Dichloroethylene	µg/l	100	86.9	48.3 - 132	Acceptable

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**Table 8.16 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., WP-76,
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Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
cis-1,2-Dichloroethylene	µg/l	2.01	0	NR	Not Acceptable
trans-1,2-Dichloroethylene	µg/l	110	94.1	59.5 - 129	Acceptable
1,2-Dichloropropane	µg/l	54.2	49.7	34.2 - 62.9	Acceptable
cis-1,3-Dichloropropylene	µg/l	2.82	0.911	0.00 - 2.59	Not Acceptable
trans-1,3-Dichloropropylene	µg/l	32.3	41.4	14.9 - 61.2	Acceptable
Ethylbenzene	µg/l	52.9	47.3	31.6 - 61.8	Acceptable
2-Hexanone	µg/l	< 5.00	0	NR	Acceptable
Methylene chloride	µg/l	19.5	19.1	12.1 - 26.9	Acceptable
4-Methyl-2-pentanone (MIBK)	µg/l	< 5.00	0	NR	Acceptable
Styrene	µg/l	< 1.00	0	NR	Acceptable
1,1,1,2-Tetrachloroethane	µg/l	< 1.00	0	NR	Acceptable
1,1,2,2-Tetrachloroethane	µg/l	67.5	62.4	36.4 - 87.2	Acceptable
Tetrachloroethylene	µg/l	53.1	66.1	43.8 - 84.5	Acceptable
Toluene	µg/l	57.7	50.5	36.3 - 63.0	Acceptable
1,1,1-Trichloroethane	µg/l	27.5	26.9	17.6 - 35.5	Acceptable
1,1,2-Trichloroethane	µg/l	63.9	58.2	39.9 - 75.5	Acceptable
Trichloroethylene	µg/l	29.9	29	18.9 - 37.6	Acceptable
Trichlorofluoromethane	µg/l	69.8	65.3	14.0 - 114	Acceptable
1,2,3-Trichloropropane	µg/l	< 1.00	0	NR	Acceptable
Vinyl acetate	µg/l	NR	0	NR	No Evaluation
Vinyl chloride	µg/l	< 1.00	0	NR	Acceptable
Xylenes, total	µg/l	133	116	66.3 - 156	Acceptable
<u>Acids</u>					
Benzoic acid	µg/l	< 5.00	0	NR	Acceptable
4-Chloro-3-methylphenol	µg/l	128	114	44.4 - 147	Acceptable
2-Chlorophenol	µg/l	56	65.4	20.1 - 82.9	Acceptable
2,4-Dichlorophenol	µg/l	122	112	40.4 - 135	Acceptable
2,6-Dichlorophenol	µg/l	< 5.00	0	NR	Acceptable
2,4-Dimethylphenol	µg/l	63.7	64.9	12.2 - 86.2	Acceptable
4,6-Dinitro-2-methylphenol	µg/l	< 5.00	0	NR	Acceptable
2,4-Dinitrophenol	µg/l	78.9	92.1	0.00 - 127	Acceptable
2-Methylphenol	µg/l	< 5.00	0	NR	Acceptable
3-Methylphenol	µg/l	NR	0	NR	No Evaluation
4-Methylphenol	µg/l	< 5.00	0	NR	Acceptable
2-Nitrophenol	µg/l	27	27.6	9.16 - 35.3	Acceptable
3-Nitrophenol	µg/l	NR	0	NR	No Evaluation
4-Nitrophenol	µg/l	< 5.00	33.1	0.00 - 52.5	Acceptable
Pentachlorophenol	µg/l	102	112	29.1 - 155	Acceptable
Phenol	µg/l	34.3	95.1	0.00 - 129	Acceptable
2,4,5-Trichlorophenol	µg/l	101	87.3	35.1 - 111	Acceptable
2,4,6-Trichlorophenol	µg/l	94.5	88.3	29.4 - 117	Acceptable
<u>Base Naturals</u>					
Acenaphthene	µg/l	97.5	106	39.6 - 135	Acceptable
Acenaphthylene	µg/l	32.2	30.6	11.4 - 38.9	Acceptable
Aniline	µg/l	< 5.00	0	NR	Acceptable

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**Table 8.16 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., WP-76,
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Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Anthracene	µg/l	89	0	NR	Not Acceptable
Benzidine	µg/l	< 5.00	0	NR	Acceptable
Benzo(a)anthracene	µg/l	131	96.5	49.2 - 119	Not Acceptable
Benzo(b)fluoranthene	µg/l	26.2	26.2	11.9 - 34.5	Acceptable
Benzo(k)fluoranthene	µg/l	30.7	30.3	6.61 - 47.2	Acceptable
Benzo(g,h,i)perylene	µg/l	< 5.00	0	NR	Acceptable
Benzo(a)pyrene	µg/l	32.3	33.8	5.22 - 45.0	Acceptable
Benzyl alcohol	µg/l	< 5.00	0	NR	Acceptable
4-Bromophenyl-phenylether	µg/l	124	111	47.5 - 142	Acceptable
Butylbenzylphthalate	µg/l	144	134	0.00 - 212	Acceptable
Carbazole	µg/l	NR	0	NR	No Evaluation
4-Chloroaniline	µg/l	< 5.00	0	NR	Acceptable
bis(2-Chloroethoxy)methane	µg/l	< 5.00	0	NR	Acceptable
bis(2-Chloroethyl)ether	µg/l	94.5	113	30.5 - 138	Acceptable
bis(2-Chloroisopropyl)ether	µg/l	< 5.00	0	NR	Acceptable
1-Chloronaphthalene	µg/l	< 5.00	0	NR	Acceptable
2-Chloronaphthalene	µg/l	38.6	45.6	17.7 - 55.5	Acceptable
4-Chlorophenyl-phenylether	µg/l	155	145	51.2 - 185	Acceptable
Chrysene	µg/l	52.8	36.7	16.6 - 47.2	Not Acceptable
Dibenz(a,h)anthracene	µg/l	< 5.00	0	NR	Acceptable
Dibenzofuran	µg/l	< 5.00	0	NR	Acceptable
Di-n-butylphthalate	µg/l	85.7	78.3	14.8 - 111	Acceptable
1,2-Dichlorobenzene	µg/l	< 5.00	0	NR	Acceptable
1,3-Dichlorobenzene	µg/l	< 5.00	0	NR	Acceptable
1,4-Dichlorobenzene	µg/l	< 5.00	0	NR	Acceptable
3,3'-Dichlorobenzidine	µg/l	< 5.00	0	NR	Acceptable
Diethylphthalate	µg/l	119	108	0.00 - 165	Acceptable
Dimethylphthalate	µg/l	111	101	0.00 - 155	Acceptable
2,4-Dinitrotoluene	µg/l	34	27.7	7.23 - 35.9	Acceptable
2,6-Dinitrotoulene	µg/l	85.5	70.8	27.1 - 91.7	Acceptable
Di-n-octylphthalate	µg/l	< 5.00	80.8	13.4 - 118	Not Acceptable
bis(2-ethylhexyl)phthalate	µg/l	59.1	46.6	16.4 - 67.2	Acceptable
Fluoranthene	µg/l	27.3	23.5	12.8 - 29.8	Acceptable
Fluorene	µg/l	20.3	17.6	7.65 - 23.7	Acceptable
Hexachlorobenzene	µg/l	22	19.1	8.24 - 25.1	Acceptable
Hexachlorobutadiene	µg/l	< 5.00	0	NR	Acceptable
Hexachlorocyclopentadiene	µg/l	< 5.00	0	NR	Acceptable
Hexachloroethane	µg/l	25.9	46.6	6.28 - 57.5	Acceptable
Indeno(1,2,3-cd)pyrene	µg/l	< 5.00	0	NR	Acceptable
Isophorone	µg/l	49.3	46.2	18.2 - 60.4	Acceptable
1-Methylnaphthalene	µg/l	< 5.00	0	NR	Acceptable
2-Methylnaphthalene	µg/l	< 5.00	0	NR	Acceptable
Naphthalene	µg/l	71.2	84.4	22.2 - 110	Acceptable
2-Nitroaniline	µg/l	< 5.00	0	NR	Acceptable
3-Nitroaniline	µg/l	< 5.00	0	NR	Acceptable

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**Table 8.16 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., WP-76,
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Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
4-Nitroaniline	µg/l	< 5.00	0	NR	Acceptable
Nitrobenzene	µg/l	< 5.00	0	NR	Acceptable
N-Nitrosodiethylamine	µg/l	NR	0	NR	No Evaluation
N-Nitrosodimethylamine	µg/l	< 5.00	59.8	0.00 - 73.2	Acceptable
N-Nitrosodiphenylamine	µg/l	< 5.00	0	NR	Acceptable
N-Nitroso-di-n-propylamine	µg/l	< 5.00	0	NR	Acceptable
Phenanthrene	µg/l	89	81.3	32.6 - 105	Acceptable
Pyrene	µg/l	< 5.00	0	NR	Acceptable
Pyridine	µg/l	< 5.00	0	NR	Acceptable
1,2,4-Trichlorobenzene	µg/l	38.8	51.6	14.8 - 63.7	Acceptable

^a Not Reported

^b Check for Error indicates result is above the warning limit, but within the acceptance limit.

**Table 8.17 - Environmental Resource Associates® Assessment of Trace Analysis, Inc., UST-34,
June 15, 2001**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
<u>Gasoline in Water</u>					
Unleaded Gasoline	µg/l	3530	3910	1140 - 7260	Acceptable
Benzene	µg/l	23.6	18.5	4.67 - 34.1	Acceptable
Ethylbenzene	µg/l	87	91.5	18.7 - 148	Acceptable
Toluene	µg/l	236	249	74.8 - 365	Acceptable
Xylenes, total	µg/l	446	528	226 - 655	Acceptable
<u>Diesel in Water</u>					
No. 2 Diesel	µg/l	4200	3410	0.00 - 5440	Acceptable
<u>TPH in Water</u>					
TPH (gravimetric)	mg/bttl	NR ^a	120	28.8 - 175	NR
TPH (IR)	mg/bttl	184	144	17.5 - 309	Acceptable
<u>BTEX in Water</u>					
Benzene	mg/l	59.2	58.6	34.6 - 79.6	Acceptable
Ethylbenzene	mg/l	9.8	10	4.63 - 14.1	Acceptable
Toluene	mg/l	74.9	73.9	36.1 - 106	Acceptable
Xylenes, total	mg/l	197	225	99.6 - 332	Acceptable

^a Not Reported

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**Table 8.18 - Environmental Resource Associates® Pesticides assessment Trace Analysis, Inc.,
QuiK™ Response, March 8, 2001**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Aldrin	µg/l	0.92	1.16	0.295 - 1.57	Acceptable
alpha-BHC	µg/l	2.5	5.24	2.00 - 7.22	Acceptable
beta-BHC	µg/l	2.5	3.01	0.983 - 4.51	Acceptable
delta-BHC	µg/l	< 0.0001	< 0.100	NR ^a	Acceptable
gamma-BHC (Lindane)	µg/l	2.8	6.32	2.14 - 9.10	Acceptable
alpha-Chlordane	µg/l	< 0.0001	< 0.100	NR	Acceptable
gamma-Chlordane	µg/l	1.9	2.7	0.744 - 4.78	Acceptable
Chlordane, technical	µg/l	NR	< 0.100	NR	Acceptable
4,4'-DDD	µg/l	1.9	2.04	0.995 - 2.85	Acceptable
4,4'-DDE	µg/l	1.1	1.05	0.490 - 1.43	Acceptable
4,4'-DDT	µg/l	4	5.52	2.53 - 7.46	Acceptable
Dieldrin	µg/l	2.1	2.88	1.49 - 3.98	Acceptable
Endrin	µg/l	0.93	1.09	0.577 - 1.21	Acceptable
Endrin aldehyde	µg/l	< 0.0001	< 0.100	NR	Acceptable
Endrin ketone	µg/l	< 0.0001	< 0.100	NR	Acceptable
Endosulfan I	µg/l	1.5	2.19	0.886 - 2.95	Acceptable
Endosulfan II	µg/l	2.4	3.83	0.823 - 6.09	Acceptable
Endosulfan sulfate	µg/l	6	7.77	2.02 - 12.3	Acceptable
Heptachlor	µg/l	1.7	2.6	0.686 - 3.62	Acceptable
Heptachlor epoxide	µg/l	1.7	2.14	1.09 - 2.75	Acceptable
Methoxychlor	µg/l	5	6.39	2.42 - 9.64	Acceptable
Toxaphene	µg/l	NR	< 0.100	NR	Acceptable

^a Not Reported

Table 8.19 - Environmental Resource Associates® Assessment of Wastren, May 17, 2001

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
pH	S.U.	8.19	8.1	7.87 - 8.33	Acceptable
<u>Minerals</u>					
Total Dissolved Solids	mg/l	333	329	248 - 410	Acceptable
Chloride	mg/l	103	104	94.5 - 113	Acceptable
Fluoride	mg/l	2.57	2.63	2.29 - 2.94	Acceptable
Potassium	mg/l	14.1	14.3	12.2 - 16.5	Acceptable
Sodium	mg/l	93.9	94.6	85.5 - 103	Acceptable
Sulfate	mg/l	10.5	10.9	7.86 - 13.7	Acceptable
<u>Hardness</u>					
Total suspended solids	mg/l	82	79.9	61.8 - 86.2	Acceptable
Calcium	mg/l	90.9	86.4	77.4 - 97.7	Acceptable
Magnesium	mg/l	12.7	12.5	10.9 - 14.1	Acceptable
<u>Nutrients</u>					
Ammonia as N	mg/l	14.2	13	10.1 - 15.8	Acceptable
Nitrate as N	mg/l	7.15	7.78	6.14 - 9.26	Acceptable
Ortho-phosphate as P	mg/l	5.16	3.73	3.18 - 4.31	Not Acceptable

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Table 8.19 - Environmental Resource Associates® Assessment of Wastren, May 17, 2001

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
<u>PCBs In Water (Standard #1)</u>					
Aroclor 1016/1242	µg/l	4.24	4.28	1.53 - 5.77	Acceptable
Aroclor 1221	µg/l	< 1.0	0	NR ^a	Acceptable
Aroclor 1232	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1248	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1254	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1260	µg/l	< 1.0	0	NR	Acceptable
<u>PCBs In Water (Standard #2)</u>					
Aroclor 1016/1242	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1221	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1232	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1248	µg/l	4.63	4.99	2.07 - 7.05	Acceptable
Aroclor 1254	µg/l	< 1.0	0	NR	Acceptable
Aroclor 1260	µg/l	< 1.0	0	NR	Acceptable
<u>PCBs In Oil (Standard #1)</u>					
Aroclor 1016/1242	mg/Kg	< 9.9	0	NR	Acceptable
Aroclor 1254	mg/Kg	29.8	40.6	6.51 - 59.0	Acceptable
Aroclor 1260	mg/Kg	< 9.9	0	NR	Acceptable
<u>PCBs In Oil (Standard #2)</u>					
Aroclor 1016/1242	mg/Kg	< 9.9	0	NR	Acceptable
Aroclor 1254	mg/Kg	< 9.9	0	NR	Acceptable
Aroclor 1260	mg/Kg	22.1	32	5.87 - 45.3	Acceptable
<u>Volatiles</u>					
Acetone	µg/l	0	0	NR	Acceptable
Acetonitrile	µg/l	0	0	NR	Acceptable
Acrylonitrile	µg/l	0	0	NR	Acceptable
Acrolein	µg/l	0	0	NR	Acceptable
Benzene	µg/l	47.1	44.3	31.9 - 57.1	Acceptable
Bromodichloromethane	µg/l	48.5	45.4	32.2 - 59.1	Acceptable
Bromoform	µg/l	33.4	29.9	19.0 - 41.1	Acceptable
Bromomethane	µg/l	0	0	NR	Acceptable
2-Butanone (MEK)	µg/l	0	0	NR	Acceptable
Carbon disulfide	µg/l	0	0	NR	Acceptable
Carbon tetrachloride	µg/l	27.8	29.1	18.2 - 41.1	Acceptable
Chlorobenzene	µg/l	65.5	60.5	42.5 - 77.1	Acceptable
Chlorodibromomethane	µg/l	12.2	11.9	7.79 - 15.7	Acceptable
Chloroethane	µg/l	0	0	NR	Acceptable
2-Chloroethylvinylether	µg/l	0	0	NR	Acceptable
Chloroform	µg/l	37.5	36.7	25.6 - 47.2	Acceptable
Chloromethane	µg/l	0	0	NR	Acceptable
DBCP	µg/l	0	0	NR	Acceptable
1,2-Dibromoethane (EDB)	µg/l	0	0	NR	Acceptable
Dibromomethane	µg/l	0	0	NR	Acceptable
1,2-Dichlorobenzene	µg/l	58.7	53.1	37.5 - 67.0	Acceptable
1,3-Dichlorobenzene	µg/l	26.5	27.4	19.2 - 34.4	Acceptable

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Table 8.19 - Environmental Resource Associates® Assessment of Wastren, May 17, 2001

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
1,4-Dichlorobenzene	µg/l	62.9	58	39.9 - 74.6	Acceptable
Dichlorodifluoromethane	µg/l	0	0	NR	Acceptable
1,1-Dichloroethane	µg/l	0	0	NR	Acceptable
1,2-Dichloroethane	µg/l	13.7	13.7	9.67 - 18.8	Acceptable
1,1-Dichloroethylene	µg/l	79.6	78.8	43.6 - 120	Acceptable
cis-1,2-Dichloroethylene	µg/l	0	0	NR	Acceptable
trans-1,2-Dichloroethylene	µg/l	21.2	20.3	11.0 - 29.4	Acceptable
1,2-Dichloropropane	µg/l	69.9	67.2	45.7 - 85.3	Acceptable
cis-1,3-Dichloropropylene	µg/l	0	1.54	0.00 - 9.46	Acceptable
trans-1,3-Dichloropropylene	µg/l	90.8	70.2	23.3 - 106	Acceptable
Ethylbenzene	µg/l	27.3	26.5	17.8 - 34.5	Acceptable
2-Hexanone	µg/l	0	0	NR	Acceptable
Methylene chloride	µg/l	65.4	63.8	40.3 - 87.6	Acceptable
4-Methyl-2-pentanone (MIBK)	µg/l	0	0	NR	Acceptable
Styrene	µg/l	0	0	NR	Acceptable
1,1,1,2-Tetrachloroethane	µg/l	0	0	NR	Acceptable
1,1,2,2-Tetrachloroethane	µg/l	63.2	53	30.8 - 74.1	Acceptable
Tetrachloroethylene	µg/l	58.2	54.6	36.1 - 69.9	Acceptable
Toluene	µg/l	41.4	37.9	27.1 - 47.5	Acceptable
1,1,1-Trichloroethane	µg/l	15.8	16.3	10.8 - 21.5	Acceptable
1,1,2-Trichloroethane	µg/l	33.4	29.1	20.4 - 37.6	Acceptable
Trichloroethylene	µg/l	18.8	14.1	9.29 - 18.4	Acceptable
Trichlorofluoromethane	µg/l	77.4	69.6	14.4 - 121	Acceptable
1,2,3-Trichloropropane	µg/l	0	0	NR	Acceptable
Vinyl acetate	µg/l	0	0	NR	Acceptable
Vinyl chloride	µg/l	0	0	NR	Acceptable
Xylenes, total	µg/l	235	210	121 - 280	Acceptable
<u>Acids</u>					
Benzoic acid	µg/l	< 10.0	0	NR	Acceptable
4-Chloro-3-methylphenol	µg/l	137	132	51.7 - 170	Acceptable
2-Chlorophenol	µg/l	74	78.4	23.5 - 99.1	Acceptable
2,4-Dichlorophenol	µg/l	75.2	80.4	29.0 - 98.0	Acceptable
2,6-Dichlorophenol	µg/l	NR	0	NR	Acceptable
2,4-Dimethylphenol	µg/l	82.8	99	20.6 - 130	Acceptable
4,6-Dinitro-2-methylphenol	µg/l	81.6	88.7	16.5 - 121	Acceptable
2,4-Dinitrophenol	µg/l	99.1	118	0.00 - 156	Acceptable
2-Methylphenol	µg/l	< 10	0	NR	Acceptable
3-Methylphenol	µg/l	NR	0	NR	Acceptable
4-Methylphenol	µg/l	< 10	0	NR	Acceptable
2-Nitrophenol	µg/l	40.4	55.2	17.1 - 71.9	Acceptable
3-Nitrophenol	µg/l	NR	0	NR	Acceptable
4-Nitrophenol	µg/l	10.3	27.1	0.00 - 44.8	Acceptable
Pentachlorophenol	µg/l	59.4	67.4	15.1 - 93.2	Acceptable
Phenol	µg/l	37.2	85.6	0.00 - 116	Acceptable

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Table 8.19 - Environmental Resource Associates® Assessment of Wastren, May 17, 2001

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
2,4,5-Trichlorophenol	µg/l	100	112	42.6 - 142	Acceptable
2,4,6-Trichlorophenol	µg/l	40.2	48.7	17.2 - 63.6	Acceptable
Base Naturals					
Acenaphthene	µg/l	15	18.5	8.24 - 23.7	Acceptable
Acenaphthylene	µg/l	< 10.0	0	NR	Acceptable
Aniline	µg/l	< 10.0	0	NR	Acceptable
Anthracene	µg/l	91.5	92.6	33.6 - 120	Acceptable
Benzidine	µg/l	NR	0	NR	Acceptable
Benzo(a)anthracene	µg/l	98.6	91.7	46.9 - 113	Acceptable
Benzo(b)fluoranthene	µg/l	43.2	43.7	14.5 - 60.3	Acceptable
Benzo(k)fluoranthene	µg/l	< 10.0	0	NR	Acceptable
Benzo(g,h,i)perylene	µg/l	27.6	27	2.14 - 40.7	Acceptable
Benzo(a)pyrene	µg/l	64.5	60.9	14.1 - 79.6	Acceptable
Benzyl alcohol	µg/l	< 10.0	0	NR	Acceptable
4-Bromophenyl-phenylether	µg/l	87.7	86.8	37.8 - 111	Acceptable
Butylbenzylphthalate	µg/l	138	149	0.00 - 235	Acceptable
Carbazole	µg/l	< 10.0	0	NR	Acceptable
4-Chloroaniline	µg/l	< 10.0	0	NR	Acceptable
bis(2-Chloroethoxy)methane	µg/l	38	45.2	17.6 - 54.9	Acceptable
bis(2-Chloroethyl)ether	µg/l	138	157	41.5 - 189	Acceptable
bis(2-Chloroisopropyl)ether	µg/l	< 10.0	0	NR	Acceptable
1-Chloronaphthalene	µg/l	NR	0	NR	Acceptable
2-Chloronaphthalene	µg/l	107	120	48.2 - 136	Acceptable
4-Chlorophenyl-phenylether	µg/l	< 10.0	0	NR	Acceptable
Chrysene	µg/l	< 10.0	0	NR	Acceptable
Dibenz(a,h)anthracene	µg/l	14.1	13.9	3.41 - 18.4	Acceptable
Dibenzofuran	µg/l	< 10.0	0	NR	Acceptable
Di-n-butylphthalate	µg/l	118	102	15.4 - 143	Acceptable
1,2-Dichlorobenzene	µg/l	< 10.0	0	NR	Acceptable
1,3-Dichlorobenzene	µg/l	< 10.0	0	NR	Acceptable
1,4-Dichlorobenzene	µg/l	< 10.0	0	NR	Acceptable
3,3'-Dichlorobenzidine	µg/l	< 10.0	0	NR	Acceptable
Diethylphthalate	µg/l	42	40.5	10.3 - 61.1	Acceptable
Dimethylphthalate	µg/l	54.4	53.6	2.70 - 81.8	Acceptable
2,4-Dinitrotoluene	µg/l	49.1	48.9	17.1 - 64.4	Acceptable
2,6-Dinitrotoluene	µg/l	< 10.0	0	NR	Acceptable
Di-n-octylphthalate	µg/l	113	97	14.9 - 142	Acceptable
bis(2-ethylhexyl)phthalate	µg/l	57.4	57.2	16.8 - 82.9	Acceptable
Fluoranthene	µg/l	64.6	61	27.7 - 78.5	Acceptable
Fluorene	µg/l	< 10.0	0	NR	Acceptable
Hexachlorobenzene	µg/l	38.8	47.7	20.8 - 61.8	Acceptable
Hexachlorobutadiene	µg/l	< 10.0	0	NR	Acceptable
Hexachlorocyclopentadiene	µg/l	75.9	110	0.00 - 141	Acceptable
Hexachloroethane	µg/l	69.9	85.4	8.41 - 108	Acceptable
Indeno(1,2,3-cd)pyrene	µg/l	< 10.0	0	NR	Acceptable

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Table 8.19 - Environmental Resource Associates® Assessment of Wastren, May 17, 2001

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Isophorone	µg/l	115	123	41.9 - 164	Acceptable
1-Methylnaphthalene	µg/l	NR	0	NR	Acceptable
2-Methylnaphthalene	µg/l	< 10.0	0	NR	Acceptable
Naphthalene	µg/l	36.8	44.9	14.0 - 59.1	Acceptable
2-Nitroaniline	µg/l	< 10.0	0	NR	Acceptable
3-Nitroaniline	µg/l	< 10.0	0	NR	Acceptable
4-Nitroaniline	µg/l	< 10.0	0	NR	Acceptable
Nitrobenzene	µg/l	65.2	88.2	29.1 - 115	Acceptable
N-Nitrosodiethylamine	µg/l	NR	0	NR	Acceptable
N-Nitrosodimethylamine	µg/l	< 10.0	0	NR	Acceptable
N-Nitrosodiphenylamine	µg/l	< 10.0	0	NR	Acceptable
N-Nitroso-di-n-propylamine	µg/l	< 10.0	0	NR	Acceptable
Phenanthrene	µg/l	41.2	46.4	23.7 - 58.2	Acceptable
Pyrene	µg/l	22.7	26.9	8.55 - 40.9	Acceptable
Pyridine	µg/l	< 10.0	0	NR	Acceptable
1,2,4-Trichlorobenzene	µg/l	45.8	61.9	17.9 - 75.5	Acceptable
Bromide					
Bromide	µg/l	677	352	302 - 408	Not Acceptable

^a Not Reported

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**Appendix A
Acronyms, Abbreviations, and Symbols**

A

ACAA	Accelerated Corrective Action Approach
AMSL	above mean sea level
ANOVA	Analysis of Variance
ANSI	American National Standards Institute
AOC	Area of Concern
APP	affirmative procurement plan
ASTM	American Society for Testing and Materials

B

BCG	Biota Concentration Guides
BLM	United States Department of the Interior, Bureau of Land Management
BLS	below land surface
Bq	becquerel
Bq/l	becquerels per liter
Bq/m ³	becquerels per cubic meter

C

C of C	Certificate of Compliance
CAP88	computer code for calculating both dose and risk from radionuclide emissions
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	<i>Code of Federal Regulations</i>
Ci	curie
cm	centimeter
CMS	Corrective Measures Study
CY	calendar year

D

DOE	United States Department of Energy
DOT	United States Department of Transportation

E

EA	Environmental Assessment
EEG	Environmental Evaluation Group
Eh	Intensity Factor
EIS	Environmental Impact Statement
EML	Environmental Measurements Laboratory
EMP	WIPP Environmental Monitoring Plan
EMS	Environmental Management System
EPA	United States Environmental Protection Agency

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F	
ft	foot
ft ³	cubic foot
FEIS	Final Environmental Impact Statement
FR	<i>Federal Register</i>
FY	fiscal year
G	
g	gram
gal	gallon
Gy	Gray
H	
HalfPACT	Short Transuranic Package Transporter
HEPA	high efficiency particulate arresting
HWFP	Hazardous Waste Facility Permit
I	
ISO	International Organization for Standardization
K	
kg	kilogram
km	kilometer
km ²	square kilometers
L	
l	liter
LMP	Land Management Plan
LUR	Land Use Request
M	
m ³	cubic meters
mBq	millibecquerel
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
mg	milligram
mg/l	milligram per liter
mi	mile
mi ²	square miles
ml	milliliter
MOU	Memorandum of Understanding
mrem	millirem
mrem/yr	millirem per year
MSDS	material safety data sheet
mSv	millisievert
mSv/yr	millisievert per year
mt	metric tons

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N

N/A	not applicable
NCRP	National Council for Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NMAC	New Mexico Administrative Code
NMDG&F	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMIMT	New Mexico Institute of Mining Technology
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NQA	Nuclear Quality Assurance
NR	not reported
NRC	Nuclear Regulatory Commission

O

oz	ounce
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P

P2	pollution prevention
Pub. L.	Public Law
PCB	polychlorinated biphenyl
pCi	picoCuries
pCi/l	picoCuries per liter
ppbv	parts per billion by volume
PPOA	Pollution Prevention Opportunity Assessment

Q

QA	quality assurance
QAP	Quality Assurance Program
QC	quality control

R

RCRA	Resource Conservation and Recovery Act
rem	Roentgen equivalent man
RER	Relative Error Ratio
RFI	RCRA Facility Investigation
RFI/CMS	RCRA Facility Investigation/Corrective Measures Study
RL	Reporting Limit
ROD	Record of Decision
RN	Radionuclide

S

SARA	Superfund Amendments and Reauthorization Act
SD	soil deep

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SD	Standard Deviation
SDWA	Safe Drinking Water Act
SEIS-I	First Supplemental Environmental Impact Statement
SEIS-II	Second Supplemental Environmental Impact Statement
SI	Soil Intermediate
SMA	Special Management Area
SNL	Sandia National Laboratories
SPDV	Site Preliminary Design and Validation
SS	Soil Surface
SU	Standard Unit
SWMU	Solid Waste Management Unit
T	
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solid
TOC	Top of Casing
TPU	Total Propagated Uncertainty
TRANSCOM	Transportation Tracking and Communications (system)
TRU	Transuranic (waste)
TRUPACT-II	Transuranic Package Transporter Model II
U	
U.S.C.	<i>United States Code</i>
USF&WS	United States Department of the Interior, Fish and Wildlife Service
UTLV	Upper Tolerance Limit Value
V	
VOC	Volatile Organic Compound
W	
WIPP	Waste Isolation Pilot Plant
WQSP	WIPP Groundwater Quality Sampling Program
WRP	WIPP Raptor Program
WTS	Westinghouse TRU Solutions LLC

Symbols

σ	sigma
$^{\circ}\text{C}$	Degrees Celsius
$^{\circ}\text{F}$	Degrees Fahrenheit
μCi	microcurie
μg	microgram
μmhos	micromhos
%	Percent
[RN]	Radionuclide concentration

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**Appendix B
Location Codes**

Table B.1 - Codes Used to Identify the Sites from Which Samples Were Collected

Code	Location	Code	Location
BHT	Bottom of the Hill Tank	RCP	Rainwater Catchment Pond
BRA	Brantley Lake	RED	Red Tank
CBD	Carlsbad	RNS	Rinse Aid Blank
COW	Coyote Well (deionized water blank)	SE1	South East 1
COY	Coyote (surface water duplicate)	SE2	South East 2
CT1	Control 1	SEC	South East Control
CT2	Control 2	SMR	Smith Ranch
FWT	Fresh Water Tank	SOO	Sample Of Opportunity
HIL	Hill Tank	SWL	Sewage Lagoons
IDN	Indian Tank	TUT	Tut Tank
LAG	Laguna Grande del Sol	UPR	Upper Pecos River
LST	Lost Tank	WAB	WIPP Air Blank
MLR	Mills Ranch	WE1	WIPP East 1
NOY	Noya Tank	WEE	WIPP East
NW1	NorthWest1	WIP	WIPP 16 Sections
NW2	NorthWest2	WFF	WIPP Far Field
PCN	Pierce Canyon	WQSP	Water Quality Sample Program
PEC	Pecos River	WSS	WIPP South
PKT	Poker Trap		

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**Appendix C
Equations**

Minimum Detectable Concentration (MDC)

MDC is equal to the mean of a distribution such that 95 percent of the measurements of the distribution will produce analytical results that have the activity above that of a blank. It is possible to achieve a very low level of detection by analyzing a large sample size and counting for a very long time.

The laboratory used the following equation for calculating the MDCs for each radionuclide in various sample matrices:

$$MDC = \frac{4.65 S_b}{K T} + \frac{3}{K T}$$

Where:

S_b	=	Standard deviation of the background
K	=	A correction factor that includes items such as unit conversions, sample volume/weight, decay correction, detector efficiency, chemical recovery and abundance correction, etc.
T	=	Counting time

For further evaluation of MDC, refer to HPS N13.30-1996, *Performance Criteria for Bioassay*.

Total Propagated Uncertainty (TPU)

Total propagated uncertainty for each data point must be reported at 2σ level. The TPU was calculated by using the following equation:

$$TPU_{1\sigma} = \sigma_{ACT} = \frac{\sqrt{\sigma_{NCR}^2 + (NCR)^2 * (RE_{EFF}^2 + RE_{ALI}^2 + RE_R^2 + \Sigma RE_{CF}^2)}}{2.22 * EFF * ALI * R * ABN_s * e^{-\lambda t} * CF}$$

Where:

EFF	=	Detector Efficiency
ALI	=	Sample Aliquot Volume or Mass
R	=	Sample Tracer/Carrier Recovery
ABN _s	=	Abundance Fraction of the Emissions Used for Identification/Quantification
σ ² _{NCR}	=	Variance of the Net Sample Count Rate
NCR	=	Net Sample Count Rate

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RE_{EFF}^2	=	Square of the Relative Error of the Efficiency Term
RE_{ALI}^2	=	Square of the Relative Error of the Aliquot
RE_R^2	=	Square of the Relative Error of the Sample Recovery
RE_{CF}^2	=	Square of the Relative Error of Other Correction Factors
λ	=	Analyte Decay Constant = $\ln 2 / (\text{half-life})$ [Same units as the half-life used to compute λ]
t	=	Time from Sample Collection to Radionuclide Separation or Mid-Point of Count Time (Same units as half-life)
CF	=	Other Correction Factors as Appropriate (i.e., Ingrowth factor, self-absorption factor, etc.).

Relative Error Ratio (RER)

The Relative Error Ratio is a method, similar to a t-test, with which to compare duplicate results (see Chapters 4 and 8; WP 02-EM 3004).

$$RER = \frac{|x_A - x_B|}{\sqrt{(2\sigma_A)^2 + (2\sigma_B)^2}}$$

Where:

X_A	=	Mean Activity of Population A
X_B	=	Mean Activity of Population B
σ_A	=	Standard Deviation of Population A
σ_B	=	Standard Deviation of Population B.

Percent Bias (% Bias)

A measure of the accuracy of radiochemical separation methods and counting instruments; that is, a measure of how reliable the results of analyses are when compared to the actual values.

$$\% \text{ BIAS} = \left[\frac{A_m - A_k}{A_k} \right] * 100$$

Where:

% BIAS	=	Percent Bias
A_m	=	Measured Sample Activity
A_k	=	Known Sample Activity.

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**Appendix D
Concentrations of Alpha and Beta Activities in Air Particulate**

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
Carlsbad					
1	AL-CBD-20010103 1.1	5.07×10 ⁻⁵	2.44×10 ⁻⁵	1.12×10 ⁻³	1.48×10 ⁻⁴
2	AL-CBD-20010110 1.1	4.88×10 ⁻⁵	2.32×10 ⁻⁵	7.66×10 ⁻⁴	1.07×10 ⁻⁴
3	AL-CBD-20010117 1.1	3.31×10 ⁻⁵	1.92×10 ⁻⁵	1.02×10 ⁻³	1.33×10 ⁻⁴
4	AL-CBD-20010124 1.1	3.35×10 ⁻⁵	1.93×10 ⁻⁵	8.45×10 ⁻⁴	1.15×10 ⁻⁴
5	AL-CBD-20010131 1.1	7.60×10 ⁻⁵	2.95×10 ⁻⁵	1.24×10 ⁻³	1.58×10 ⁻⁴
6	AL-CBD-20010207 1.1	2.31×10 ⁻⁵	1.57×10 ⁻⁵	1.01×10 ⁻³	1.32×10 ⁻⁴
7	AL-CBD-20010214 1.1	3.65×10 ⁻⁵	1.92×10 ⁻⁵	1.00×10 ⁻³	1.30×10 ⁻⁴
8	AL-CBD-20010221 1.1	5.77×10 ⁻⁵	2.47×10 ⁻⁵	6.47×10 ⁻⁴	9.46×10 ⁻⁵
9	AL-CBD-20010228 1.1	3.82×10 ⁻⁵	2.07×10 ⁻⁵	8.94×10 ⁻⁴	1.22×10 ⁻⁴
10	AL-CBD-20010307 1.1	3.80×10 ⁻⁵	2.05×10 ⁻⁵	5.59×10 ⁻⁴	8.70×10 ⁻⁵
11	AL-CBD-20010314 1.1	6.41×10 ⁻⁵	2.57×10 ⁻⁵	6.50×10 ⁻⁴	9.51×10 ⁻⁵
12	AL-CBD-20010321 1.1	6.04×10 ⁻⁵	2.68×10 ⁻⁵	7.14×10 ⁻⁴	1.05×10 ⁻⁴
13	AL-CBD-20010328 1.1	3.44×10 ⁻⁵	2.01×10 ⁻⁵	8.07×10 ⁻⁴	1.13×10 ⁻⁴
14	AL-CBD-20010404 1.1	6.60×10 ⁻⁵	2.64×10 ⁻⁵	6.92×10 ⁻⁴	9.94×10 ⁻⁵
15	AL-CBD-20010411 1.1	5.77×10 ⁻⁵	2.50×10 ⁻⁵	8.41×10 ⁻⁴	1.16×10 ⁻⁴
16	AL-CBD-20010418 1.1	6.70×10 ⁻⁵	2.82×10 ⁻⁵	6.42×10 ⁻⁴	9.72×10 ⁻⁵
17	AL-CBD-20010425 1.1	6.83×10 ⁻⁵	2.83×10 ⁻⁵	9.48×10 ⁻⁴	1.28×10 ⁻⁴
18	AL-CBD-20010502 1.1	6.65×10 ⁻⁵	2.72×10 ⁻⁵	7.93×10 ⁻⁴	1.12×10 ⁻⁴
19	AL-CBD-20010509 1.1	4.55×10 ⁻⁵	2.17×10 ⁻⁵	8.04×10 ⁻⁴	1.11×10 ⁻⁴
20	AL-CBD-20010516 1.1	2.77×10 ⁻⁵	1.76×10 ⁻⁵	6.21×10 ⁻⁴	9.39×10 ⁻⁵
21	AL-CBD-20010523 1.1	8.87×10 ⁻⁵	3.23×10 ⁻⁵	8.55×10 ⁻⁴	1.16×10 ⁻⁴
22	AL-CBD-20010530 1.1	4.86×10 ⁻⁵	2.39×10 ⁻⁵	9.22×10 ⁻⁴	1.22×10 ⁻⁴
23	AL-CBD-20010606 1.1	5.96×10 ⁻⁵	2.56×10 ⁻⁵	7.37×10 ⁻⁴	1.05×10 ⁻⁴
24	AL-CBD-20010613 1.1	5.61×10 ⁻⁵	2.46×10 ⁻⁵	7.06×10 ⁻⁴	1.01×10 ⁻⁴
25	AL-CBD-20010620 1.1	4.48×10 ⁻⁵	2.18×10 ⁻⁵	7.90×10 ⁻⁴	1.10×10 ⁻⁴
26	AL-CBD-20010627 1.1	7.08×10 ⁻⁵	2.98×10 ⁻⁵	7.93×10 ⁻⁴	1.16×10 ⁻⁴
27	AL-CBD-20010704 1.1	4.45×10 ⁻⁵	2.05×10 ⁻⁵	5.84×10 ⁻⁴	8.38×10 ⁻⁵
28	AL-CBD-20010711 1.1	4.52×10 ⁻⁵	2.31×10 ⁻⁵	7.84×10 ⁻⁴	1.10×10 ⁻⁴
29	AL-CBD-20010718 1.1	6.17×10 ⁻⁵	2.54×10 ⁻⁵	6.88×10 ⁻⁴	9.90×10 ⁻⁵
30	AL-CBD-20010725 1.1	4.03×10 ⁻⁵	2.02×10 ⁻⁵	6.97×10 ⁻⁴	9.88×10 ⁻⁵
31	AL-CBD-20010801 1.1	4.79×10 ⁻⁵	2.40×10 ⁻⁵	7.49×10 ⁻⁴	1.09×10 ⁻⁴
32	AL-CBD-20010808 1.1	5.24×10 ⁻⁵	2.46×10 ⁻⁵	7.74×10 ⁻⁴	1.09×10 ⁻⁴
33	AL-CBD-20010815 1.1	7.16×10 ⁻⁵	2.84×10 ⁻⁵	8.78×10 ⁻⁴	1.19×10 ⁻⁴
34	AL-CBD-20010822 1.1	4.64×10 ⁻⁵	2.42×10 ⁻⁵	6.19×10 ⁻⁴	9.37×10 ⁻⁵
35	AL-CBD-20010829 1.1	N/C ^b	N/C	N/C	N/C
36	AL-CBD-20010905 1.1	5.22×10 ⁻⁵	2.64×10 ⁻⁵	8.11×10 ⁻⁴	1.15×10 ⁻⁴
37	AL-CBD-20010912 1.1	2.11×10 ⁻⁵	1.74×10 ⁻⁵	8.14×10 ⁻⁴	1.14×10 ⁻⁴
38	AL-CBD-20010919 1.1	4.70×10 ⁻⁵	2.18×10 ⁻⁵	8.67×10 ⁻⁴	1.18×10 ⁻⁴
39	AL-CBD-20010926 1.1	6.31×10 ⁻⁵	2.62×10 ⁻⁵	1.29×10 ⁻³	1.63×10 ⁻⁴
40	AL-CBD-20011003 1.1	7.18×10 ⁻⁵	2.82×10 ⁻⁵	1.06×10 ⁻³	1.40×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
41	AL-CBD-20011010 1.1	N/C	N/C	N/C	N/C
42	AL-CBD-20011017 1.1	6.45×10 ⁻⁵	3.05×10 ⁻⁵	1.49×10 ⁻³	1.89×10 ⁻⁴
43	AL-CBD-20011024 1.1	1.30×10 ⁻⁴	3.87×10 ⁻⁵	1.16×10 ⁻³	1.48×10 ⁻⁴
44	AL-CBD-20011031 1.1	9.90×10 ⁻⁵	3.35×10 ⁻⁵	7.72×10 ⁻⁴	1.08×10 ⁻⁴
45	AL-CBD-20011107 1.1	1.16×10 ⁻⁴	3.77×10 ⁻⁵	1.70×10 ⁻³	2.04×10 ⁻⁴
46	AL-CBD-20011114 1.1	2.52×10 ⁻⁵	1.79×10 ⁻⁵	9.18×10 ⁻⁴	1.27×10 ⁻⁴
47	AL-CBD-20011121 1.1	1.23×10 ⁻⁴	3.51×10 ⁻⁵	9.02×10 ⁻⁴	1.17×10 ⁻⁴
48	AL-CBD-20011128 1.1	1.01×10 ⁻⁴	3.46×10 ⁻⁵	1.10×10 ⁻³	1.43×10 ⁻⁴
49	AL-CBD-20011205 1.1	7.69×10 ⁻⁵	2.63×10 ⁻⁵	6.83×10 ⁻³	9.41×10 ⁻⁵
50	AL-CBD-20011212 1.1	9.55×10 ⁻⁵	3.45×10 ⁻⁵	1.13×10 ⁻³	1.50×10 ⁻⁴
51	AL-CBD-20011219 1.1	6.02×10 ⁻⁵	2.60×10 ⁻⁵	1.05×10 ⁻³	1.38×10 ⁻⁴
52	AL-CBD-20011226 1.1	7.39×10 ⁻⁵	2.84×10 ⁻⁵	1.19×10 ⁻³	1.53×10 ⁻⁴
Mills Ranch					
1	AL-MLR-20010103 1.1	5.42×10 ⁻⁵	2.48×10 ⁻⁵	1.12×10 ⁻³	1.46×10 ⁻⁴
2	AL-MLR-20010110 1.1	3.58×10 ⁻⁵	1.98×10 ⁻⁵	7.48×10 ⁻⁴	1.05×10 ⁻⁴
3	AL-MLR-20010117 1.1	5.07×10 ⁻⁵	2.35×10 ⁻⁵	1.19×10 ⁻³	1.50×10 ⁻⁴
4	AL-MLR-20010124 1.1	2.30×10 ⁻⁵	1.71×10 ⁻⁵	8.05×10 ⁻⁴	1.13×10 ⁻⁴
5	AL-MLR-20010131 1.1	6.29×10 ⁻⁵	2.68×10 ⁻⁵	1.24×10 ⁻³	1.58×10 ⁻⁴
6	AL-MLR-20010207 1.1	4.92×10 ⁻⁵	2.36×10 ⁻⁵	8.93×10 ⁻⁴	1.22×10 ⁻⁴
7	AL-MLR-20010214 1.1	3.38×10 ⁻⁵	1.85×10 ⁻⁵	1.21×10 ⁻³	1.51×10 ⁻⁴
8	AL-MLR-20010221 1.1	5.03×10 ⁻⁵	2.42×10 ⁻⁵	5.77×10 ⁻⁴	8.99×10 ⁻⁵
9	AL-MLR-20010228 1.1	3.74×10 ⁻⁵	1.95×10 ⁻⁵	8.11×10 ⁻⁴	1.11×10 ⁻⁴
10	AL-MLR-20010307 1.1	1.77×10 ⁻⁵	1.45×10 ⁻⁵	6.24×10 ⁻⁴	9.46×10 ⁻⁵
11	AL-MLR-20010314 1.1	5.23×10 ⁻⁵	2.38×10 ⁻⁵	7.09×10 ⁻⁴	1.03×10 ⁻⁴
12	AL-MLR-20010321 1.1	4.45×10 ⁻⁵	2.19×10 ⁻⁵	7.15×10 ⁻⁴	1.02×10 ⁻⁴
13	AL-MLR-20010328 1.1	2.65×10 ⁻⁵	1.70×10 ⁻⁵	8.26×10 ⁻⁴	1.13×10 ⁻⁴
14	AL-MLR-20010404 1.1	3.52×10 ⁻⁵	1.97×10 ⁻⁵	7.38×10 ⁻⁴	1.05×10 ⁻⁴
15	AL-MLR-20010411 1.1	7.32×10 ⁻⁵	2.48×10 ⁻⁵	9.68×10 ⁻⁴	1.28×10 ⁻⁴
16	AL-MLR-20010418 1.1	9.17×10 ⁻⁵	3.31×10 ⁻⁵	7.05×10 ⁻⁴	1.04×10 ⁻⁴
17	AL-MLR-20010425 1.1	9.43×10 ⁻⁵	3.37×10 ⁻⁵	1.07×10 ⁻³	1.42×10 ⁻⁴
18	AL-MLR-20010502 1.1	5.39×10 ⁻⁵	2.45×10 ⁻⁵	8.41×10 ⁻⁴	1.17×10 ⁻⁴
19	AL-MLR-20010509 1.1	6.21×10 ⁻⁵	2.53×10 ⁻⁵	8.44×10 ⁻⁴	1.15×10 ⁻⁴
20	AL-MLR-20010516 1.1	4.70×10 ⁻⁵	2.30×10 ⁻⁵	7.15×10 ⁻⁴	1.04×10 ⁻⁴
21	AL-MLR-20010523 1.1	7.45×10 ⁻⁵	2.94×10 ⁻⁵	9.20×10 ⁻⁴	1.23×10 ⁻⁴
22	AL-MLR-20010530 1.1	6.69×10 ⁻⁵	2.84×10 ⁻⁵	8.23×10 ⁻⁴	1.14×10 ⁻⁴
23	AL-MLR-20010606 1.1	5.40×10 ⁻⁵	2.49×10 ⁻⁵	7.99×10 ⁻⁴	1.12×10 ⁻⁴
24	AL-MLR-20010613 1.1	5.19×10 ⁻⁵	2.39×10 ⁻⁵	6.91×10 ⁻⁴	1.00×10 ⁻⁴
25	AL-MLR-20010620 1.1	7.96×10 ⁻⁵	2.96×10 ⁻⁵	7.90×10 ⁻⁴	1.11×10 ⁻⁴
26	AL-MLR-20010627 1.1	3.94×10 ⁻⁵	2.26×10 ⁻⁵	8.24×10 ⁻⁴	1.20×10 ⁻⁴
27	AL-MLR-20010704 1.2	2.50×10 ⁻⁵	1.63×10 ⁻⁵	6.34×10 ⁻⁴	9.07×10 ⁻⁵
28	AL-MLR-20010711 1.2	6.25×10 ⁻⁵	2.73×10 ⁻⁵	8.97×10 ⁻⁴	1.23×10 ⁻⁴
29	AL-MLR-20010718 1.2	6.90×10 ⁻⁵	2.79×10 ⁻⁵	7.06×10 ⁻⁴	1.03×10 ⁻⁴
30	AL-MLR-20010725 1.2	5.34×10 ⁻⁵	2.46×10 ⁻⁵	6.60×10 ⁻⁴	9.83×10 ⁻⁵

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
31	AL-MLR-20010801 1.2	3.96×10 ⁻⁵	2.11×10 ⁻⁵	6.86×10 ⁻⁴	1.01×10 ⁻⁴
32	AL-MLR-20010808 1.2	7.59×10 ⁻⁵	2.96×10 ⁻⁵	7.82×10 ⁻⁴	1.10×10 ⁻⁴
33	AL-MLR-20010815 1.2	8.28×10 ⁻⁵	3.07×10 ⁻⁵	8.34×10 ⁻⁴	1.15×10 ⁻⁴
34	AL-MLR-20010822 1.2	3.28×10 ⁻⁵	2.17×10 ⁻⁵	6.88×10 ⁻⁴	1.03×10 ⁻⁴
35	AL-MLR-20010829 1.2	4.36×10 ⁻⁵	2.27×10 ⁻⁵	6.04×10 ⁻⁴	9.04×10 ⁻⁵
36	AL-MLR-20010905 1.2	4.70×10 ⁻⁵	2.53×10 ⁻⁵	7.25×10 ⁻⁴	1.07×10 ⁻⁴
37	AL-MLR-20010912 1.2	2.50×10 ⁻⁵	1.79×10 ⁻⁵	7.50×10 ⁻⁴	1.06×10 ⁻⁴
38	AL-MLR-20010919 1.2	5.99×10 ⁻⁵	2.59×10 ⁻⁵	8.80×10 ⁻⁴	1.22×10 ⁻⁴
39	AL-MLR-20010926 1.2	5.92×10 ⁻⁵	2.56×10 ⁻⁵	1.25×10 ⁻³	1.60×10 ⁻⁴
40	AL-MLR-20011003 1.1	3.09×10 ⁻⁵	1.80×10 ⁻⁵	1.08×10 ⁻³	1.40×10 ⁻⁴
41	AL-MLR-20011010 1.1	5.62×10 ⁻⁵	2.64×10 ⁻⁵	6.78×10 ⁻⁴	1.00×10 ⁻⁴
42	AL-MLR-20011017 1.1	5.50×10 ⁻⁵	2.60×10 ⁻⁵	1.42×10 ⁻³	1.75×10 ⁻⁴
43	AL-MLR-20011024 1.1	1.33×10 ⁻⁴	4.03×10 ⁻⁵	1.05×10 ⁻³	1.39×10 ⁻⁴
44	AL-MLR-20011031 1.1	8.82×10 ⁻⁵	3.10×10 ⁻⁵	8.32×10 ⁻⁴	1.13×10 ⁻⁴
45	AL-MLR-20011107 1.1	1.24×10 ⁻⁴	3.89×10 ⁻⁵	1.56×10 ⁻³	1.91×10 ⁻⁴
46	AL-MLR-20011114 1.1	2.75×10 ⁻⁵	1.85×10 ⁻⁵	8.29×10 ⁻⁴	1.17×10 ⁻⁴
47	AL-MLR-20011121 1.1	1.03×10 ⁻⁴	3.17×10 ⁻⁵	8.38×10 ⁻⁴	1.11×10 ⁻⁴
48	AL-MLR-20011128 1.1	9.91×10 ⁻⁵	3.34×10 ⁻⁵	9.58×10 ⁻⁴	1.27×10 ⁻⁴
49	AL-MLR-20011205 1.1	NC	NC	NC	NC
50	AL-MLR-20011212 1.1	NC	NC	NC	NC
51	AL-MLR-20011219 1.1	7.86×10 ⁻⁵	2.98×10 ⁻⁵	1.06×10 ⁻³	1.39×10 ⁻⁴
52	AL-MLR-20011226 1.1	8.32×10 ⁻⁵	2.97×10 ⁻⁵	1.18×10 ⁻³	1.51×10 ⁻⁴
Southeast Control					
1	AL-SEC-20010103 1.1	5.52×10 ⁻⁵	2.47×10 ⁻⁵	1.21×10 ⁻³	1.55×10 ⁻⁴
2	AL-SEC-20010110 1.1	5.75×10 ⁻⁵	2.48×10 ⁻⁵	7.62×10 ⁻⁴	1.06×10 ⁻⁴
3	AL-SEC-20010117 1.1	3.10×10 ⁻⁵	1.96×10 ⁻⁵	1.12×10 ⁻³	1.45×10 ⁻⁴
4	AL-SEC-20010124 1.1	4.50×10 ⁻⁵	2.26×10 ⁻⁵	7.99×10 ⁻⁴	1.11×10 ⁻⁴
5	AL-SEC-20010131 1.1	8.11×10 ⁻⁵	2.95×10 ⁻⁵	1.12×10 ⁻³	1.43×10 ⁻⁴
6	AL-SEC-20010207 1.1	5.92×10 ⁻⁵	2.57×10 ⁻⁵	9.78×10 ⁻⁴	1.31×10 ⁻⁴
7	AL-SEC-20010214 1.1	4.14×10 ⁻⁵	2.06×10 ⁻⁵	1.26×10 ⁻³	1.57×10 ⁻⁴
8	AL-SEC-20010221 1.1	5.40×10 ⁻⁵	2.47×10 ⁻⁵	7.37×10 ⁻⁴	1.06×10 ⁻⁴
9	AL-SEC-20010228 1.1	5.84×10 ⁻⁵	2.54×10 ⁻⁵	8.61×10 ⁻⁴	1.18×10 ⁻⁴
10	AL-SEC-20010307 1.1	3.10×10 ⁻⁵	1.80×10 ⁻⁵	6.13×10 ⁻⁴	9.12×10 ⁻⁵
11	AL-SEC-20010314 1.1	4.61×10 ⁻⁵	2.21×10 ⁻⁵	7.31×10 ⁻⁴	1.04×10 ⁻⁴
12	AL-SEC-20010321 1.1	2.54×10 ⁻⁵	1.71×10 ⁻⁵	7.24×10 ⁻⁴	1.03×10 ⁻⁴
13	AL-SEC-20010328 1.1	4.71×10 ⁻⁵	2.26×10 ⁻⁵	8.37×10 ⁻⁴	1.15×10 ⁻⁴
14	AL-SEC-20010404 1.1	8.00×10 ⁻⁵	2.94×10 ⁻⁵	7.70×10 ⁻⁴	1.08×10 ⁻⁴
15	AL-SEC-20010411 1.1	5.61×10 ⁻⁵	2.44×10 ⁻⁵	9.60×10 ⁻⁴	1.27×10 ⁻⁴
16	AL-SEC-20010418 1.1	8.11×10 ⁻⁵	3.02×10 ⁻⁵	7.56×10 ⁻⁴	1.08×10 ⁻⁴
17	AL-SEC-20010425 1.1	4.34×10 ⁻⁵	2.32×10 ⁻⁵	9.68×10 ⁻⁴	1.31×10 ⁻⁴
18	AL-SEC-20010502 1.1	3.99×10 ⁻⁵	2.03×10 ⁻⁵	8.58×10 ⁻⁴	1.17×10 ⁻⁴
19	AL-SEC-20010509 1.1	4.60×10 ⁻⁵	2.14×10 ⁻⁵	8.04×10 ⁻⁴	1.10×10 ⁻⁴
20	AL-SEC-20010516 1.1	4.83×10 ⁻⁵	2.36×10 ⁻⁵	7.06×10 ⁻⁴	1.04×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
21	AL-SEC-20010523 1.1	8.14×10 ⁻⁵	3.05×10 ⁻⁵	9.18×10 ⁻⁴	1.22×10 ⁻⁴
22	AL-SEC-20010530 1.1	6.51×10 ⁻⁵	2.77×10 ⁻⁵	8.63×10 ⁻⁴	1.17×10 ⁻⁴
23	AL-SEC-20010606 1.1	1.01×10 ⁻⁴	3.35×10 ⁻⁵	8.01×10 ⁻⁴	1.11×10 ⁻⁴
24	AL-SEC-20010613 1.1	6.44×10 ⁻⁵	2.43×10 ⁻⁵	7.05×10 ⁻⁴	9.66×10 ⁻⁵
25	AL-SEC-20010620 1.1	7.67×10 ⁻⁵	3.16×10 ⁻⁵	8.89×10 ⁻⁴	1.27×10 ⁻⁴
26	AL-SEC-20010627 1.1	4.80×10 ⁻⁵	2.40×10 ⁻⁵	8.47×10 ⁻⁴	1.20×10 ⁻⁴
27	AL-SEC-20010704 1.2	3.82×10 ⁻⁵	1.96×10 ⁻⁵	7.14×10 ⁻⁴	9.88×10 ⁻⁵
28	AL-SEC-20010711 1.2	4.56×10 ⁻⁵	2.32×10 ⁻⁵	9.08×10 ⁻⁴	1.23×10 ⁻⁴
29	AL-SEC-20010718 1.2	5.02×10 ⁻⁵	2.37×10 ⁻⁵	8.10×10 ⁻⁴	1.14×10 ⁻⁴
30	AL-SEC-20010725 1.2	3.54×10 ⁻⁵	1.89×10 ⁻⁵	6.64×10 ⁻⁴	9.52×10 ⁻⁵
31	AL-SEC-20010801 1.2	2.95×10 ⁻⁵	1.77×10 ⁻⁵	8.06×10 ⁻⁴	1.11×10 ⁻⁴
32	AL-SEC-20010808 1.2	7.14×10 ⁻⁵	2.78×10 ⁻⁵	7.72×10 ⁻⁴	1.07×10 ⁻⁴
33	AL-SEC-20010815 1.2	5.41×10 ⁻⁵	2.48×10 ⁻⁵	8.54×10 ⁻⁴	1.17×10 ⁻⁴
34	AL-SEC-20010822 1.2	5.22×10 ⁻⁵	2.56×10 ⁻⁵	6.41×10 ⁻⁴	9.64×10 ⁻⁵
35	AL-SEC-20010829 1.2	5.76×10 ⁻⁵	2.61×10 ⁻⁵	6.68×10 ⁻⁴	9.78×10 ⁻⁵
36	AL-SEC-20010905 1.2	4.38×10 ⁻⁵	2.44×10 ⁻⁵	7.77×10 ⁻⁴	1.12×10 ⁻⁴
37	AL-SEC-20010912 1.2	2.46×10 ⁻⁵	1.77×10 ⁻⁵	8.25×10 ⁻⁴	1.13×10 ⁻⁴
38	AL-SEC-20010919 1.2	4.19×10 ⁻⁵	2.11×10 ⁻⁵	8.89×10 ⁻⁴	1.22×10 ⁻⁴
39	AL-SEC-20010926 1.2	5.96×10 ⁻⁵	2.52×10 ⁻⁵	1.24×10 ⁻³	1.57×10 ⁻⁴
40	AL-SEC-20011003 1.1	3.13×10 ⁻⁵	1.83×10 ⁻⁵	9.65×10 ⁻⁴	1.29×10 ⁻⁴
41	AL-SEC-20011010 1.1	7.74×10 ⁻⁵	3.07×10 ⁻⁵	8.48×10 ⁻⁴	1.18×10 ⁻⁴
42	AL-SEC-20011017 1.1	4.96×10 ⁻⁵	2.41×10 ⁻⁵	1.43×10 ⁻³	1.75×10 ⁻⁴
43	AL-SEC-20011024 1.1	1.40×10 ⁻⁴	4.11×10 ⁻⁵	1.23×10 ⁻³	1.56×10 ⁻⁴
44	AL-SEC-20011031 1.1	7.72×10 ⁻⁵	2.93×10 ⁻⁵	8.68×10 ⁻⁴	1.17×10 ⁻⁴
45	AL-SEC-20011107 1.1	1.16×10 ⁻⁴	3.61×10 ⁻⁵	1.62×10 ⁻³	1.93×10 ⁻⁴
46	AL-SEC-20011114 1.1	2.58×10 ⁻⁵	1.83×10 ⁻⁵	8.37×10 ⁻⁴	1.19×10 ⁻⁴
47	AL-SEC-20011121 1.1	N/C	N/C	N/C	N/C
48	AL-SEC-20011128 1.1	9.01×10 ⁻⁵	3.20×10 ⁻⁵	1.02×10 ⁻³	1.34×10 ⁻⁴
49	AL-SEC-20011205 1.1	NC	NC	NC	NC
50	AL-SEC-20011212 1.1	1.25×10 ⁻⁴	4.07×10 ⁻⁵	9.93×10 ⁻⁴	1.38×10 ⁻⁴
51	AL-SEC-20011219 1.1	8.65×10 ⁻⁵	3.08×10 ⁻⁵	1.09×10 ⁻³	1.41×10 ⁻⁴
52	AL-SEC-20011226 1.1	7.64×10 ⁻⁵	2.76×10 ⁻⁵	1.12×10 ⁻³	1.43×10 ⁻⁴
Smith Ranch					
1	AL-SMR-20010103 1.2	N/C ^b	N/C	N/C	N/C
2	AL-SMR-20010110 1.2	6.77×10 ⁻⁵	2.70×10 ⁻⁵	7.75×10 ⁻⁴	1.08×10 ⁻⁴
3	AL-SMR-20010117 1.2	3.70×10 ⁻⁵	2.06×10 ⁻⁵	1.18×10 ⁻³	1.50×10 ⁻⁴
4	AL-SMR-20010124 1.2	2.49×10 ⁻⁵	1.74×10 ⁻⁵	8.26×10 ⁻⁴	1.14×10 ⁻⁴
5	AL-SMR-20010131 1.2	6.79×10 ⁻⁵	2.78×10 ⁻⁵	1.18×10 ⁻³	1.52×10 ⁻⁴
6	AL-SMR-20010207 1.2	3.22×10 ⁻⁵	1.81×10 ⁻⁵	8.07×10 ⁻⁴	1.10×10 ⁻⁴
7	AL-SMR-20010214 1.2	5.50×10 ⁻⁵	2.45×10 ⁻⁵	1.17×10 ⁻³	1.50×10 ⁻⁴
8	AL-SMR-20010221 1.2	4.15×10 ⁻⁵	2.19×10 ⁻⁵	6.01×10 ⁻⁴	9.19×10 ⁻⁵
9	AL-SMR-20010228 1.2	4.30×10 ⁻⁵	2.12×10 ⁻⁵	8.71×10 ⁻⁴	1.18×10 ⁻⁴
10	AL-SMR-20010307 1.2	1.52×10 ⁻⁵	1.37×10 ⁻⁵	5.68×10 ⁻⁴	8.89×10 ⁻⁵

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
11	AL-SMR-20010314 1.2	2.81×10 ⁻⁵	1.73×10 ⁻⁵	7.37×10 ⁻⁴	1.05×10 ⁻⁴
12	AL-SMR-20010321 1.2	2.77×10 ⁻⁵	1.85×10 ⁻⁵	6.36×10 ⁻⁴	9.62×10 ⁻⁵
13	AL-SMR-20010328 1.2	3.09×10 ⁻⁵	1.89×10 ⁻⁵	7.60×10 ⁻⁴	1.08×10 ⁻⁴
14	AL-SMR-20010404 1.1	6.46×10 ⁻⁵	2.68×10 ⁻⁵	7.91×10 ⁻⁴	1.11×10 ⁻⁴
15	AL-SMR-20010411 1.1	6.43×10 ⁻⁵	2.84×10 ⁻⁵	6.82×10 ⁻⁴	1.04×10 ⁻⁴
16	AL-SMR-20010418 1.1	7.02×10 ⁻⁵	2.96×10 ⁻⁵	6.92×10 ⁻⁴	1.04×10 ⁻⁴
17	AL-SMR-20010425 1.1	6.25×10 ⁻⁵	2.76×10 ⁻⁵	9.32×10 ⁻⁴	1.28×10 ⁻⁴
18	AL-SMR-20010502 1.1	4.58×10 ⁻⁵	2.26×10 ⁻⁵	7.78×10 ⁻⁴	1.11×10 ⁻⁴
19	AL-SMR-20010509 1.1	5.63×10 ⁻⁵	2.49×10 ⁻⁵	8.09×10 ⁻⁴	1.14×10 ⁻⁴
20	AL-SMR-20010516 1.1	3.32×10 ⁻⁵	1.92×10 ⁻⁵	6.31×10 ⁻⁴	9.52×10 ⁻⁵
21	AL-SMR-20010523 1.1	9.96×10 ⁻⁵	3.68×10 ⁻⁵	9.75×10 ⁻⁴	1.33×10 ⁻⁴
22	AL-SMR-20010530 1.1	5.26×10 ⁻⁵	2.58×10 ⁻⁵	8.29×10 ⁻⁴	1.15×10 ⁻⁴
23	AL-SMR-20010606 1.1	8.24×10 ⁻⁵	2.97×10 ⁻⁵	6.91×10 ⁻⁴	9.89×10 ⁻⁵
24	AL-SMR-20010613 1.1	4.28×10 ⁻⁵	2.14×10 ⁻⁵	6.33×10 ⁻⁴	9.31×10 ⁻⁵
25	AL-SMR-20010620 1.1	5.96×10 ⁻⁵	2.62×10 ⁻⁵	8.19×10 ⁻⁴	1.16×10 ⁻⁴
26	AL-SMR-20010627 1.1	N/C	N/C	N/C	N/C
27	AL-SMR-20010704 1.1	6.20×10 ⁻⁵	2.51×10 ⁻⁵	6.14×10 ⁻⁴	8.88×10 ⁻⁵
28	AL-SMR-20010711 1.1	6.47×10 ⁻⁵	2.71×10 ⁻⁵	8.11×10 ⁻⁴	1.12×10 ⁻⁴
29	AL-SMR-20010718 1.1	5.71×10 ⁻⁵	2.57×10 ⁻⁵	4.71×10 ⁻⁴	7.88×10 ⁻⁵
30	AL-SMR-20010725 1.1	4.11×10 ⁻⁵	2.12×10 ⁻⁵	6.89×10 ⁻⁴	1.00×10 ⁻⁴
31	AL-SMR-20010801 1.1	5.26×10 ⁻⁵	2.31×10 ⁻⁵	7.62×10 ⁻⁴	1.06×10 ⁻⁴
32	AL-SMR-20010808 1.1	6.68×10 ⁻⁵	2.80×10 ⁻⁵	7.42×10 ⁻⁴	1.07×10 ⁻⁴
33	AL-SMR-20010815 1.1	3.98×10 ⁻⁵	2.18×10 ⁻⁵	8.29×10 ⁻⁴	1.16×10 ⁻⁴
34	AL-SMR-20010822 1.1	4.70×10 ⁻⁵	2.53×10 ⁻⁵	5.70×10 ⁻⁴	9.07×10 ⁻⁵
35	AL-SMR-20010829 1.1	3.52×10 ⁻⁵	2.12×10 ⁻⁵	6.34×10 ⁻⁴	9.45×10 ⁻⁵
36	AL-SMR-20010905 1.1	4.47×10 ⁻⁵	2.49×10 ⁻⁵	7.23×10 ⁻⁴	1.07×10 ⁻⁴
37	AL-SMR-20010912 1.1	3.54×10 ⁻⁵	2.17×10 ⁻⁵	8.09×10 ⁻⁴	1.14×10 ⁻⁴
38	AL-SMR-20010919 1.1	3.78×10 ⁻⁵	1.97×10 ⁻⁵	8.54×10 ⁻⁴	1.17×10 ⁻⁴
39	AL-SMR-20010926 1.1	4.80×10 ⁻⁵	2.29×10 ⁻⁵	1.20×10 ⁻³	1.54×10 ⁻⁴
40	AL-SMR-20011003 1.2	4.23×10 ⁻⁵	2.21×10 ⁻⁵	1.02×10 ⁻³	1.37×10 ⁻⁴
41	AL-SMR-20011010 1.2	7.41×10 ⁻⁵	3.05×10 ⁻⁵	8.20×10 ⁻⁴	1.16×10 ⁻⁴
42	AL-SMR-20011017 1.2	3.66×10 ⁻⁵	2.18×10 ⁻⁵	1.39×10 ⁻³	1.73×10 ⁻⁴
43	AL-SMR-20011024 1.2	1.08×10 ⁻⁴	3.63×10 ⁻⁵	1.19×10 ⁻³	1.53×10 ⁻⁴
44	AL-SMR-20011031 1.2	N/C	N/C	N/C	N/C
45	AL-SMR-20011107 1.2	N/C	N/C	N/C	N/C
46	AL-SMR-20011114 1.2	N/C	N/C	N/C	N/C
47	AL-SMR-20011121 1.2	N/C	N/C	N/C	N/C
48	AL-SMR-20011128 1.2	9.20×10 ⁻⁵	3.23×10 ⁻⁵	9.38×10 ⁻⁴	1.25×10 ⁻⁴
49	AL-SMR-20011205 1.2	4.27×10 ⁻⁵	1.98×10 ⁻⁵	6.89×10 ⁻⁴	9.55×10 ⁻⁵
50	AL-SMR-20011212 1.2	7.72×10 ⁻⁵	3.07×10 ⁻⁵	1.13×10 ⁻³	1.50×10 ⁻⁴
51	AL-SMR-20011219 1.2	4.28×10 ⁻⁵	2.16×10 ⁻⁵	1.09×10 ⁻³	1.41×10 ⁻⁴
52	AL-SMR-20011226 1.2	6.77×10 ⁻⁵	2.68×10 ⁻⁵	1.16×10 ⁻³	1.49×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
WIPP Air Blank					
1	AL-WAB-20010103 1.1	2.62×10 ⁻³	5.00×10 ⁻³	4.48×10 ⁻²	1.77×10 ⁻²
2	AL-WAB-20010110 1.1	1.49×10 ⁻³	5.13×10 ⁻³	2.76×10 ⁻²	1.66×10 ⁻²
3	AL-WAB-20010117 1.1	-1.54×10 ⁻³	5.16×10 ⁻³	2.34×10 ⁻²	1.60×10 ⁻²
4	AL-WAB-20010124 1.1	-1.80×10 ⁻⁵	4.21×10 ⁻³	1.77×10 ⁻²	1.51×10 ⁻²
5	AL-WAB-20010131 1.1	4.30×10 ⁻³	5.75×10 ⁻³	8.08×10 ⁻²	2.23×10 ⁻²
6	AL-WAB-20010207 1.1	7.31×10 ⁻³	7.10×10 ⁻³	5.06×10 ⁻²	1.82×10 ⁻²
7	AL-WAB-20010214 1.1	-1.57×10 ⁻³	4.16×10 ⁻³	5.35×10 ⁻²	1.86×10 ⁻²
8	AL-WAB-20010221 1.1	1.74×10 ⁻³	5.02×10 ⁻³	3.82×10 ⁻²	1.73×10 ⁻²
9	AL-WAB-20010228 1.1	1.40×10 ⁻³	4.04×10 ⁻³	5.27×10 ⁻²	1.93×10 ⁻²
10	AL-WAB-20010307 1.1	2.88×10 ⁻³	4.98×10 ⁻³	5.15×10 ⁻²	1.91×10 ⁻²
11	AL-WAB-20010314 1.1	2.88×10 ⁻³	4.99×10 ⁻³	3.68×10 ⁻²	1.73×10 ⁻²
12	AL-WAB-20010321 1.1	2.84×10 ⁻³	5.70×10 ⁻³	3.77×10 ⁻²	1.72×10 ⁻²
13	AL-WAB-20010328 1.1	2.83×10 ⁻³	5.69×10 ⁻³	4.55×10 ⁻²	1.83×10 ⁻²
14	AL-WAB-20010404 1.1	1.44×10 ⁻³	4.14×10 ⁻³	5.44×10 ⁻²	1.99×10 ⁻²
15	AL-WAB-20010411 1.1	9.01×10 ⁻³	7.87×10 ⁻³	5.16×10 ⁻²	1.95×10 ⁻²
16	AL-WAB-20010418 1.1	7.29×10 ⁻³	8.17×10 ⁻³	5.27×10 ⁻²	2.02×10 ⁻²
17	AL-WAB-20010425 1.1	5.83×10 ⁻³	7.64×10 ⁻³	4.48×10 ⁻²	1.91×10 ⁻²
18	AL-WAB-20010502 1.1	7.34×10 ⁻³	7.14×10 ⁻³	5.09×10 ⁻²	1.98×10 ⁻²
19	AL-WAB-20010509 1.1	1.33×10 ⁻²	9.26×10 ⁻³	4.57×10 ⁻²	1.89×10 ⁻²
20	AL-WAB-20010516 1.1	1.44×10 ⁻³	4.08×10 ⁻³	3.54×10 ⁻²	1.75×10 ⁻²
21	AL-WAB-20010523 1.1	1.48×10 ⁻³	6.52×10 ⁻³	5.49×10 ⁻²	1.88×10 ⁻²
22	AL-WAB-20010530 1.1	-1.50×10 ⁻³	6.53×10 ⁻³	6.94×10 ⁻²	2.08×10 ⁻²
23	AL-WAB-20010606 1.1	2.95×10 ⁻³	5.04×10 ⁻³	6.71×10 ⁻²	2.00×10 ⁻²
24	AL-WAB-20010613 1.1	1.04×10 ⁻²	8.30×10 ⁻³	6.87×10 ⁻²	2.02×10 ⁻²
25	AL-WAB-20010620 1.1	2.94×10 ⁻³	5.01×10 ⁻³	5.99×10 ⁻²	2.02×10 ⁻²
26	AL-WAB-20010627 1.1	4.41×10 ⁻³	5.79×10 ⁻³	4.64×10 ⁻²	1.84×10 ⁻²
27	AL-WAB-20010704 1.1	-3.02×10 ⁻³	5.90×10 ⁻³	4.67×10 ⁻²	1.73×10 ⁻²
28	AL-WAB-20010711 1.1	1.47×10 ⁻³	5.78×10 ⁻³	3.11×10 ⁻²	1.63×10 ⁻²
29	AL-WAB-20010718 1.1	5.90×10 ⁻³	6.50×10 ⁻³	4.65×10 ⁻²	1.83×10 ⁻²
30	AL-WAB-20010725 1.1	4.43×10 ⁻³	5.81×10 ⁻³	3.68×10 ⁻²	1.69×10 ⁻²
31	AL-WAB-20010801 1.1	1.47×10 ⁻³	4.09×10 ⁻³	3.70×10 ⁻²	1.70×10 ⁻²
32	AL-WAB-20010808 1.1	8.93×10 ⁻³	8.30×10 ⁻³	5.61×10 ⁻²	1.91×10 ⁻²
33	AL-WAB-20010815 1.1	1.48×10 ⁻³	5.05×10 ⁻³	6.00×10 ⁻²	1.97×10 ⁻²
34	AL-WAB-20010822 1.1	1.50×10 ⁻³	6.60×10 ⁻³	2.20×10 ⁻²	1.66×10 ⁻²
35	AL-WAB-20010829 1.1	-3.01×10 ⁻³	7.23×10 ⁻³	2.45×10 ⁻²	1.70×10 ⁻²
36	AL-WAB-20010905 1.1	-3.01×10 ⁻³	7.23×10 ⁻³	1.68×10 ⁻²	1.59×10 ⁻²
37	AL-WAB-20010912 1.1	1.49×10 ⁻³	5.89×10 ⁻³	6.06×10 ⁻²	1.98×10 ⁻²
38	AL-WAB-20010919 1.1	7.54×10 ⁻³	6.67×10 ⁻³	3.87×10 ⁻²	1.82×10 ⁻²
39	AL-WAB-20010926 1.1	4.53×10 ⁻³	5.15×10 ⁻³	2.32×10 ⁻²	1.60×10 ⁻²
40	AL-WAB-20011003 1.1	2.88×10 ⁻³	4.99×10 ⁻³	6.92×10 ⁻²	2.15×10 ⁻²
41	AL-WAB-20011010 1.1	-2.78×10 ⁻⁵	5.11×10 ⁻³	3.53×10 ⁻²	1.71×10 ⁻²
42	AL-WAB-20011017 1.1	4.49×10 ⁻³	7.22×10 ⁻³	2.50×10 ⁻²	1.56×10 ⁻²
43	AL-WAB-20011024 1.1	4.54×10 ⁻³	6.00×10 ⁻³	5.28×10 ⁻²	1.91×10 ⁻²

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
44	AL-WAB-20011031 1.1	-6.97×10 ⁻⁴	5.02×10 ⁻³	4.61×10 ⁻²	1.83×10 ⁻²
45	AL-WAB-20011107 1.1	6.08×10 ⁻³	6.73×10 ⁻³	4.83×10 ⁻²	1.85×10 ⁻²
46	AL-WAB-20011114 1.1	7.62×10 ⁻³	7.39×10 ⁻³	4.37×10 ⁻²	1.78×10 ⁻²
47	AL-WAB-20011121 1.1	3.08×10 ⁻³	6.06×10 ⁻³	3.77×10 ⁻²	1.77×10 ⁻²
48	AL-WAB-20011128 1.1	1.53×10 ⁻³	5.24×10 ⁻³	3.45×10 ⁻²	1.73×10 ⁻²
49	AL-WAB-20011205 1.1	6.03×10 ⁻³	6.66×10 ⁻³	4.60×10 ⁻²	1.81×10 ⁻²
50	AL-WAB-20011212 1.1	1.50×10 ⁻³	4.21×10 ⁻³	3.48×10 ⁻²	1.82×10 ⁻²
51	AL-WAB-20011219 1.1	3.00×10 ⁻³	5.14×10 ⁻³	4.96×10 ⁻²	1.86×10 ⁻²
52	AL-WAB-20011226 1.1	1.49×10 ⁻³	2.95×10 ⁻³	4.12×10 ⁻²	1.84×10 ⁻²
WIPP East					
1	AL-WEE-20010103 1.2	4.19×10 ⁻⁵	2.29×10 ⁻⁵	1.12×10 ⁻³	1.49×10 ⁻⁴
2	AL-WEE-20010110 1.2	2.94×10 ⁻⁵	1.85×10 ⁻⁵	7.95×10 ⁻⁴	1.10×10 ⁻⁴
3	AL-WEE-20010117 1.2	6.18×10 ⁻⁵	2.62×10 ⁻⁵	1.21×10 ⁻³	1.53×10 ⁻⁴
4	AL-WEE-20010124 1.2	3.22×10 ⁻⁵	1.93×10 ⁻⁵	7.73×10 ⁻⁴	1.08×10 ⁻⁴
5	AL-WEE-20010131 1.2	9.76×10 ⁻⁵	3.28×10 ⁻⁵	1.31×10 ⁻³	1.64×10 ⁻⁴
6	AL-WEE-20010207 1.2	4.93×10 ⁻⁵	2.36×10 ⁻⁵	8.69×10 ⁻⁴	1.20×10 ⁻⁴
7	AL-WEE-20010214 1.2	4.59×10 ⁻⁵	2.28×10 ⁻⁵	1.30×10 ⁻³	1.64×10 ⁻⁴
8	AL-WEE-20010221 1.2	4.27×10 ⁻⁵	2.19×10 ⁻⁵	7.20×10 ⁻⁴	1.03×10 ⁻⁴
9	AL-WEE-20010228 1.2	5.57×10 ⁻⁵	2.37×10 ⁻⁵	9.12×10 ⁻⁴	1.21×10 ⁻⁴
10	AL-WEE-20010307 1.2	2.99×10 ⁻⁵	1.81×10 ⁻⁵	5.54×10 ⁻⁴	8.61×10 ⁻⁵
11	AL-WEE-20010314 1.2	4.69×10 ⁻⁵	2.19×10 ⁻⁵	6.84×10 ⁻⁴	9.86×10 ⁻⁵
12	AL-WEE-20010321 1.2	3.56×10 ⁻⁵	2.08×10 ⁻⁵	7.69×10 ⁻⁴	1.10×10 ⁻⁴
13	AL-WEE-20010328 1.2	4.73×10 ⁻⁵	2.27×10 ⁻⁵	8.39×10 ⁻⁴	1.15×10 ⁻⁴
14	AL-WEE-20010404 1.1	8.49×10 ⁻⁵	3.13×10 ⁻⁵	8.36×10 ⁻⁴	1.17×10 ⁻⁴
15	AL-WEE-20010411 1.1	7.09×10 ⁻⁵	2.74×10 ⁻⁵	9.04×10 ⁻⁴	1.21×10 ⁻⁴
16	AL-WEE-20010418 1.1	6.64×10 ⁻⁵	2.74×10 ⁻⁵	6.44×10 ⁻⁴	9.61×10 ⁻⁵
17	AL-WEE-20010425 1.1	4.28×10 ⁻⁴	2.37×10 ⁻⁵	9.64×10 ⁻⁴	1.32×10 ⁻⁴
18	AL-WEE-20010502 1.1	7.04×10 ⁻⁵	2.68×10 ⁻⁵	8.16×10 ⁻⁴	1.12×10 ⁻⁴
19	AL-WEE-20010509 1.1	7.14×10 ⁻⁵	2.85×10 ⁻⁵	8.18×10 ⁻⁴	1.15×10 ⁻⁴
20	AL-WEE-20010516 1.1	2.71×10 ⁻⁵	1.72×10 ⁻⁵	5.80×10 ⁻⁴	8.89×10 ⁻⁵
21	AL-WEE-20010523 1.1	6.85×10 ⁻⁵	2.91×10 ⁻⁵	9.18×10 ⁻⁴	1.24×10 ⁻⁴
22	AL-WEE-20010530 1.1	6.95×10 ⁻⁵	2.95×10 ⁻⁵	8.10×10 ⁻⁴	1.13×10 ⁻⁴
23	AL-WEE-20010606 1.1	6.87×10 ⁻⁵	2.89×10 ⁻⁵	8.50×10 ⁻⁴	1.20×10 ⁻⁴
24	AL-WEE-20010613 1.1	4.96×10 ⁻⁵	2.35×10 ⁻⁵	7.21×10 ⁻⁴	1.03×10 ⁻⁴
25	AL-WEE-20010620 1.1	1.22×10 ⁻⁴	3.76×10 ⁻⁵	8.85×10 ⁻⁴	1.22×10 ⁻⁴
26	AL-WEE-20010627 1.1	6.70×10 ⁻⁵	2.88×10 ⁻⁵	7.85×10 ⁻⁴	1.15×10 ⁻⁴
27	AL-WEE-20010704 1.1	4.29×10 ⁻⁵	2.14×10 ⁻⁵	6.48×10 ⁻⁴	9.34×10 ⁻⁵
28	AL-WEE-20010711 1.1	1.03×10 ⁻⁴	3.52×10 ⁻⁵	8.37×10 ⁻⁴	1.17×10 ⁻⁴
29	AL-WEE-20010718 1.1	6.10×10 ⁻⁵	2.68×10 ⁻⁵	7.72×10 ⁻⁴	1.11×10 ⁻⁴
30	AL-WEE-20010725 1.1	5.84×10 ⁻⁵	2.57×10 ⁻⁵	6.73×10 ⁻⁴	9.94×10 ⁻⁵
31	AL-WEE-20010801 1.1	5.49×10 ⁻⁵	2.41×10 ⁻⁵	7.61×10 ⁻⁴	1.07×10 ⁻⁴
32	AL-WEE-20010808 1.1	9.02×10 ⁻⁵	3.25×10 ⁻⁵	6.94×10 ⁻⁴	1.01×10 ⁻⁴
33	AL-WEE-20010815 1.1	4.14×10 ⁻⁵	2.27×10 ⁻⁵	8.68×10 ⁻⁴	1.21×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
34	AL-WEE-20010822 1.1	4.08×10 ⁻⁵	2.36×10 ⁻⁵	5.80×10 ⁻⁴	9.12×10 ⁻⁵
35	AL-WEE-20010829 1.1	4.07×10 ⁻⁵	2.27×10 ⁻⁵	6.64×10 ⁻⁴	9.80×10 ⁻⁵
36	AL-WEE-20010905 1.1	5.71×10 ⁻⁵	2.72×10 ⁻⁵	7.46×10 ⁻⁴	1.08×10 ⁻⁴
37	AL-WEE-20010912 1.1	2.41×10 ⁻⁵	1.84×10 ⁻⁵	8.71×10 ⁻⁴	1.20×10 ⁻⁴
38	AL-WEE-20010919 1.1	7.01×10 ⁻⁵	2.75×10 ⁻⁵	8.51×10 ⁻⁴	1.18×10 ⁻⁴
39	AL-WEE-20010926 1.1	5.28×10 ⁻⁵	2.39×10 ⁻⁵	1.31×10 ⁻³	1.65×10 ⁻⁴
40	AL-WEE-20011003 1.1	4.69×10 ⁻⁵	2.30×10 ⁻⁵	1.05×10 ⁻³	1.39×10 ⁻⁴
41	AL-WEE-20011010 1.1	5.23×10 ⁻⁵	2.76×10 ⁻⁵	8.33×10 ⁻⁴	1.21×10 ⁻⁴
42	AL-WEE-20011017 1.1	5.89×10 ⁻⁵	2.65×10 ⁻⁵	1.45×10 ⁻³	1.78×10 ⁻⁴
43	AL-WEE-20011024 1.1	1.26×10 ⁻⁴	3.92×10 ⁻⁵	1.14×10 ⁻³	1.48×10 ⁻⁴
44	AL-WEE-20011031 1.1	6.89×10 ⁻⁵	2.85×10 ⁻⁵	8.15×10 ⁻⁴	1.14×10 ⁻⁴
45	AL-WEE-20011107 1.1	1.12×10 ⁻⁴	3.51×10 ⁻⁵	1.64×10 ⁻³	1.95×10 ⁻⁴
46	AL-WEE-20011114 1.1	4.59×10 ⁻⁵	2.47×10 ⁻⁵	7.66×10 ⁻⁴	1.13×10 ⁻⁴
47	AL-WEE-20011121 1.1	1.15×10 ⁻⁴	3.35×10 ⁻⁵	8.23×10 ⁻⁴	1.09×10 ⁻⁴
48	AL-WEE-20011128 1.1	8.50×10 ⁻⁵	3.11×10 ⁻⁵	1.01×10 ⁻³	1.33×10 ⁻⁴
49	AL-WEE-20011205 1.1	7.98×10 ⁻⁵	2.73×10 ⁻⁵	6.89×10 ⁻⁴	9.56×10 ⁻⁵
50	AL-WEE-20011212 1.1	1.07×10 ⁻⁴	3.65×10 ⁻⁵	1.19×10 ⁻³	1.55×10 ⁻⁴
51	AL-WEE-20011219 1.1	8.37×10 ⁻⁵	2.99×10 ⁻⁵	1.02×10 ⁻³	1.33×10 ⁻⁴
52	AL-WEE-20011226 1.1	1.02×10 ⁻⁴	3.35×10 ⁻⁵	1.11×10 ⁻³	1.44×10 ⁻⁴

WIPP Far Field

1	AL-WFF-20010103 1.1	N/C	N/C	N/C	N/C
2	AL-WFF-20010110 1.1	2.71×10 ⁻⁵	1.79×10 ⁻⁵	7.62×10 ⁻⁴	1.07×10 ⁻⁴
3	AL-WFF-20010117 1.1	4.55×10 ⁻⁵	2.22×10 ⁻⁵	1.10×10 ⁻³	1.41×10 ⁻⁴
4	AL-WFF-20010124 1.1	1.99×10 ⁻⁵	1.60×10 ⁻⁵	8.58×10 ⁻⁴	1.18×10 ⁻⁴
5	AL-WFF-20010131 1.1	1.07×10 ⁻⁴	3.51×10 ⁻⁵	1.36×10 ⁻³	1.70×10 ⁻⁴
6	AL-WFF-20010207 1.1	5.65×10 ⁻⁵	2.46×10 ⁻⁵	9.04×10 ⁻⁴	1.22×10 ⁻⁴
7	AL-WFF-20010214 1.1	3.20×10 ⁻⁵	1.90×10 ⁻⁵	1.29×10 ⁻³	1.63×10 ⁻⁴
8	AL-WFF-20010221 1.1	5.33×10 ⁻⁵	2.44×10 ⁻⁵	6.49×10 ⁻⁴	9.63×10 ⁻⁵
9	AL-WFF-20010228 1.1	4.41×10 ⁻⁵	2.17×10 ⁻⁵	9.10×10 ⁻⁴	1.23×10 ⁻⁴
10	AL-WFF-20010307 1.1	2.18×10 ⁻⁵	1.55×10 ⁻⁵	5.87×10 ⁻⁴	8.92×10 ⁻⁵
11	AL-WFF-20010314 1.1	3.47×10 ⁻⁵	1.90×10 ⁻⁵	9.13×10 ⁻⁴	1.22×10 ⁻⁴
12	AL-WFF-20010321 1.1	3.62×10 ⁻⁵	2.03×10 ⁻⁵	7.04×10 ⁻⁴	1.02×10 ⁻⁴
13	AL-WFF-20010328 1.1	3.86×10 ⁻⁵	2.03×10 ⁻⁵	9.33×10 ⁻⁴	1.24×10 ⁻⁴
14	AL-WFF-20010404 1.1	5.07×10 ⁻⁵	2.42×10 ⁻⁵	8.41×10 ⁻⁴	1.81×10 ⁻⁴
15	AL-WFF-20010411 1.1	4.83×10 ⁻⁵	2.25×10 ⁻⁵	9.16×10 ⁻⁴	1.22×10 ⁻⁴
16	AL-WFF-20010418 1.1	8.04×10 ⁻⁵	3.04×10 ⁻⁵	7.79×10 ⁻⁴	1.11×10 ⁻⁴
17	AL-WFF-20010425 1.1	6.43×10 ⁻⁵	2.72×10 ⁻⁵	1.07×10 ⁻³	1.40×10 ⁻⁴
18	AL-WFF-20010502 1.1	7.00×10 ⁻⁵	2.76×10 ⁻⁵	8.78×10 ⁻⁴	1.20×10 ⁻⁴
19	AL-WFF-20010509 1.1	1.14×10 ⁻⁴	4.07×10 ⁻⁵	1.18×10 ⁻³	1.61×10 ⁻⁴
20	AL-WFF-20010516 1.1	5.03×10 ⁻⁵	2.34×10 ⁻⁵	7.19×10 ⁻⁴	1.04×10 ⁻⁴
21	AL-WFF-20010523 1.1	5.57×10 ⁻⁵	2.59×10 ⁻⁵	8.38×10 ⁻⁴	1.15×10 ⁻⁴
22	AL-WFF-20010530 1.1	N/C	N/C	N/C	N/C
23	AL-WFF-20010606 1.1	6.57×10 ⁻⁵	3.11×10 ⁻⁵	9.80×10 ⁻⁴	1.39×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
24	AL-WFF-20010613 1.1	3.48×10 ⁻⁵	1.92×10 ⁻⁵	6.83×10 ⁻⁴	9.81×10 ⁻⁵
25	AL-WFF-20010620 1.1	9.22×10 ⁻⁵	3.23×10 ⁻⁵	9.67×10 ⁻⁴	1.30×10 ⁻⁴
26	AL-WFF-20010627 1.1	6.69×10 ⁻⁵	2.94×10 ⁻⁵	8.62×10 ⁻⁴	1.24×10 ⁻⁴
27	AL-WFF-20010704 1.1	4.76×10 ⁻⁵	2.25×10 ⁻⁵	6.41×10 ⁻⁴	9.25×10 ⁻⁵
28	AL-WFF-20010711 1.1	5.41×10 ⁻⁵	2.54×10 ⁻⁵	9.84×10 ⁻⁴	1.31×10 ⁻⁴
29	AL-WFF-20010718 1.1	7.50×10 ⁻⁵	2.92×10 ⁻⁵	7.14×10 ⁻⁴	1.04×10 ⁻⁴
30	AL-WFF-20010725 1.1	5.87×10 ⁻⁵	2.47×10 ⁻⁵	6.64×10 ⁻⁴	9.62×10 ⁻⁵
31	AL-WFF-20010801 1.1	3.51×10 ⁻⁵	2.02×10 ⁻⁵	8.29×10 ⁻⁴	1.16×10 ⁻⁴
32	AL-WFF-20010808 1.1	8.32×10 ⁻⁵	3.09×10 ⁻⁵	8.03×10 ⁻⁴	1.12×10 ⁻⁴
33	AL-WFF-20010815 1.1	4.77×10 ⁻⁵	2.44×10 ⁻⁵	8.00×10 ⁻⁴	1.14×10 ⁻⁴
34	AL-WFF-20010822 1.1	7.08×10 ⁻⁵	3.01×10 ⁻⁵	6.20×10 ⁻⁴	9.54×10 ⁻⁵
35	AL-WFF-20010829 1.1	3.14×10 ⁻⁵	1.98×10 ⁻⁵	7.20×10 ⁻⁴	1.02×10 ⁻⁴
36	AL-WFF-20010905 1.1	3.83×10 ⁻⁵	2.31×10 ⁻⁵	8.08×10 ⁻⁴	1.15×10 ⁻⁴
37	AL-WFF-20010912 1.1	3.87×10 ⁻⁵	2.19×10 ⁻⁵	8.24×10 ⁻⁴	1.14×10 ⁻⁴
38	AL-WFF-20010919 1.1	5.20×10 ⁻⁵	2.35×10 ⁻⁵	9.17×10 ⁻⁴	1.25×10 ⁻⁴
39	AL-WFF-20010926 1.1	4.31×10 ⁻⁵	2.12×10 ⁻⁵	1.26×10 ⁻³	1.58×10 ⁻⁴
40	AL-WFF-20011003 1.2	3.54×10 ⁻⁵	1.99×10 ⁻⁵	1.05×10 ⁻³	1.39×10 ⁻⁴
41	AL-WFF-20011010 1.2	4.76×10 ⁻⁵	2.61×10 ⁻⁵	7.94×10 ⁻⁴	1.16×10 ⁻⁴
42	AL-WFF-20011017 1.2	6.02×10 ⁻⁵	2.65×10 ⁻⁵	1.50×10 ⁻³	1.82×10 ⁻⁴
43	AL-WFF-20011024 1.2	1.52×10 ⁻⁴	4.27×10 ⁻⁵	1.30×10 ⁻³	1.63×10 ⁻⁴
44	AL-WFF-20011031 1.2	7.22×10 ⁻⁵	2.88×10 ⁻⁵	8.93×10 ⁻⁴	1.21×10 ⁻⁴
45	AL-WFF-20011107 1.2	9.91×10 ⁻⁵	3.33×10 ⁻⁵	1.66×10 ⁻³	1.98×10 ⁻⁴
46	AL-WFF-20011114 1.2	3.63×10 ⁻⁵	2.11×10 ⁻⁵	7.56×10 ⁻⁴	1.09×10 ⁻⁴
47	AL-WFF-20011121 1.2	N/C	N/C	N/C	N/C
48	AL-WFF-20011128 1.2	8.45×10 ⁻⁵	3.05×10 ⁻⁵	1.00×10 ⁻³	1.31×10 ⁻⁴
49	AL-WFF-20011205 1.2	7.10×10 ⁻⁵	2.57×10 ⁻⁵	6.46×10 ⁻⁴	9.11×10 ⁻⁵
50	AL-WFF-20011212 1.2	1.08×10 ⁻⁴	3.70×10 ⁻⁵	1.33×10 ⁻³	1.71×10 ⁻⁴
51	AL-WFF-20011219 1.2	7.79×10 ⁻⁵	2.86×10 ⁻⁵	1.15×10 ⁻³	1.46×10 ⁻⁴
52	AL-WFF-20011226 1.2	6.25×10 ⁻⁵	2.49×10 ⁻⁵	1.12×10 ⁻³	1.43×10 ⁻⁴
WIPP South					
1	AL-WSS-20010103 1.1	8.46×10 ⁻⁵	3.08×10 ⁻⁵	1.22×10 ⁻³	1.56×10 ⁻⁴
2	AL-WSS-20010110 1.1	3.52×10 ⁻⁵	1.95×10 ⁻⁵	7.95×10 ⁻⁴	1.09×10 ⁻⁴
3	AL-WSS-20010117 1.1	5.93×10 ⁻⁵	2.51×10 ⁻⁵	1.13×10 ⁻³	1.43×10 ⁻⁴
4	AL-WSS-20010124 1.1	2.79×10 ⁻⁵	1.84×10 ⁻⁵	8.74×10 ⁻⁴	1.20×10 ⁻⁴
5	AL-WSS-20010131 1.1	7.82×10 ⁻⁵	2.94×10 ⁻⁵	1.17×10 ⁻³	1.50×10 ⁻⁴
6	AL-WSS-20010207 1.1	5.17×10 ⁻⁵	2.41×10 ⁻⁵	8.28×10 ⁻⁴	1.15×10 ⁻⁴
7	AL-WSS-20010214 1.1	2.73×10 ⁻⁵	1.69×10 ⁻⁵	1.16×10 ⁻³	1.47×10 ⁻⁴
8	AL-WSS-20010221 1.1	5.38×10 ⁻⁵	2.52×10 ⁻⁵	6.05×10 ⁻⁴	9.34×10 ⁻⁵
9	AL-WSS-20010228 1.1	5.57×10 ⁻⁵	2.37×10 ⁻⁵	7.81×10 ⁻⁴	1.08×10 ⁻⁴
10	AL-WSS-20010307 1.1	3.23×10 ⁻⁵	1.88×10 ⁻⁵	6.68×10 ⁻⁴	9.81×10 ⁻⁵
11	AL-WSS-20010314 1.1	5.36×10 ⁻⁵	2.38×10 ⁻⁵	6.39×10 ⁻⁴	9.49×10 ⁻⁵
12	AL-WSS-20010321 1.1	4.29×10 ⁻⁵	2.17×10 ⁻⁵	7.43×10 ⁻⁴	1.05×10 ⁻⁴
13	AL-WSS-20010328 1.1	5.19×10 ⁻⁵	2.37×10 ⁻⁵	8.61×10 ⁻⁴	1.17×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
14	AL-WSS-20010404 1.2	8.69×10 ⁻⁵	3.15×10 ⁻⁵	7.40×10 ⁻⁴	1.06×10 ⁻⁴
15	AL-WSS-20010411 1.2	5.36×10 ⁻⁵	2.38×10 ⁻⁵	8.57×10 ⁻⁴	1.16×10 ⁻⁴
16	AL-WSS-20010418 1.2	7.32×10 ⁻⁵	2.87×10 ⁻⁵	7.83×10 ⁻⁴	1.10×10 ⁻⁴
17	AL-WSS-20010425 1.2	7.80×10 ⁻⁵	2.96×10 ⁻⁵	1.06×10 ⁻³	1.39×10 ⁻⁴
18	AL-WSS-20010502 1.2	7.54×10 ⁻⁵	2.92×10 ⁻⁵	7.88×10 ⁻⁴	1.12×10 ⁻⁴
19	AL-WSS-20010509 1.2	6.05×10 ⁻⁵	2.62×10 ⁻⁵	7.86×10 ⁻⁴	1.12×10 ⁻⁴
20	AL-WSS-20010516 1.2	4.32×10 ⁻⁵	2.18×10 ⁻⁵	6.44×10 ⁻⁴	9.62×10 ⁻⁵
21	AL-WSS-20010523 1.2	5.91×10 ⁻⁵	2.75×10 ⁻⁵	8.98×10 ⁻⁴	1.23×10 ⁻⁴
22	AL-WSS-20010530 1.2	8.27×10 ⁻⁵	3.15×10 ⁻⁵	8.72×10 ⁻⁴	1.19×10 ⁻⁴
23	AL-WSS-20010606 1.2	6.82×10 ⁻⁵	2.87×10 ⁻⁵	8.90×10 ⁻⁴	1.23×10 ⁻⁴
24	AL-WSS-20010613 1.2	5.27×10 ⁻⁵	2.43×10 ⁻⁵	6.68×10 ⁻⁴	9.81×10 ⁻⁵
25	AL-WSS-20010620 1.2	9.79×10 ⁻⁵	3.39×10 ⁻⁵	8.56×10 ⁻⁴	1.20×10 ⁻⁴
26	AL-WSS-20010627 1.2	7.38×10 ⁻⁵	3.04×10 ⁻⁵	7.49×10 ⁻⁴	1.11×10 ⁻⁴
27	AL-WSS-20010704 1.1	2.98×10 ⁻⁵	1.78×10 ⁻⁵	6.27×10 ⁻⁴	9.03×10 ⁻⁵
28	AL-WSS-20010711 1.1	6.42×10 ⁻⁵	2.80×10 ⁻⁵	7.86×10 ⁻⁴	1.12×10 ⁻⁴
29	AL-WSS-20010718 1.1	6.76×10 ⁻⁵	2.73×10 ⁻⁵	7.01×10 ⁻⁴	1.02×10 ⁻⁴
30	AL-WSS-20010725 1.1	4.10×10 ⁻⁵	2.11×10 ⁻⁵	6.93×10 ⁻⁴	1.01×10 ⁻⁴
31	AL-WSS-20010801 1.1	3.67×10 ⁻⁵	2.03×10 ⁻⁵	7.81×10 ⁻⁴	1.10×10 ⁻⁴
32	AL-WSS-20010808 1.1	5.44×10 ⁻⁵	2.50×10 ⁻⁵	6.90×10 ⁻⁴	1.00×10 ⁻⁴
33	AL-WSS-20010815 1.1	5.72×10 ⁻⁵	2.69×10 ⁻⁵	7.77×10 ⁻⁴	1.12×10 ⁻⁴
34	AL-WSS-20010822 1.1	3.21×10 ⁻⁵	2.02×10 ⁻⁵	6.05×10 ⁻⁴	9.10×10 ⁻⁵
35	AL-WSS-20010829 1.1	3.84×10 ⁻⁵	2.14×10 ⁻⁵	6.22×10 ⁻⁴	9.19×10 ⁻⁵
36	AL-WSS-20010905 1.1	4.57×10 ⁻⁵	2.46×10 ⁻⁵	7.70×10 ⁻⁴	1.11×10 ⁻⁴
37	AL-WSS-20010912 1.1	3.00×10 ⁻⁵	2.03×10 ⁻⁵	7.70×10 ⁻⁴	1.10×10 ⁻⁴
38	AL-WSS-20010919 1.1	6.50×10 ⁻⁵	2.70×10 ⁻⁵	9.65×10 ⁻⁴	1.31×10 ⁻⁴
39	AL-WSS-20010926 1.1	5.83×10 ⁻⁵	2.52×10 ⁻⁵	1.18×10 ⁻³	1.52×10 ⁻⁴
40	AL-WSS-20011003 1.1	4.55×10 ⁻⁵	2.23×10 ⁻⁵	1.03×10 ⁻³	1.36×10 ⁻⁴
41	AL-WSS-20011010 1.1	4.49×10 ⁻⁵	2.55×10 ⁻⁵	6.73×10 ⁻⁴	1.03×10 ⁻⁴
42	AL-WSS-20011017 1.1	7.05×10 ⁻⁵	2.97×10 ⁻⁵	1.44×10 ⁻³	1.78×10 ⁻⁴
43	AL-WSS-20011024 1.1	1.28×10 ⁻⁴	3.78×10 ⁻⁵	1.19×10 ⁻³	1.52×10 ⁻⁴
44	AL-WSS-20011031 1.1	6.62×10 ⁻⁵	2.74×10 ⁻⁵	7.95×10 ⁻⁴	1.11×10 ⁻⁴
45	AL-WSS-20011107 1.1	1.40×10 ⁻⁴	4.08×10 ⁻⁵	1.51×10 ⁻³	1.83×10 ⁻⁴
46	AL-WSS-20011114 1.1	2.47×10 ⁻⁵	1.76×10 ⁻⁵	8.25×10 ⁻⁴	1.16×10 ⁻⁴
47	AL-WSS-20011121 1.1	1.22×10 ⁻⁴	3.50×10 ⁻⁵	7.80×10 ⁻⁴	1.05×10 ⁻⁴
48	AL-WSS-20011128 1.1	1.23×10 ⁻⁴	3.69×10 ⁻⁵	1.17×10 ⁻³	1.47×10 ⁻⁴
49	AL-WSS-20011205 1.1	5.88×10 ⁻⁵	2.30×10 ⁻⁵	6.27×10 ⁻⁴	8.86×10 ⁻⁵
50	AL-WSS-20011212 1.1	N/C	N/C	N/C	N/C
51	AL-WSS-20011219 1.1	4.97×10 ⁻⁵	2.50×10 ⁻⁵	1.05×10 ⁻³	1.42×10 ⁻⁴
52	AL-WSS-20011226 1.1	9.08×10 ⁻⁵	3.07×10 ⁻⁵	1.09×10 ⁻³	1.40×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
Duplicate Samples					
WIPP East (WEE)					
1	AL-WEE-20010103 2.2	4.74×10 ⁻⁵	2.23×10 ⁻⁵	1.23×10 ⁻³	1.55×10 ⁻⁴
2	AL-WEE-20010110 2.2	6.17×10 ⁻⁵	2.55×10 ⁻⁵	7.78×10 ⁻⁴	1.07×10 ⁻⁴
3	AL-WEE-20010117 2.2	3.07×10 ⁻⁵	1.86×10 ⁻⁵	1.21×10 ⁻³	1.52×10 ⁻⁴
4	AL-WEE-20010124 2.2	5.77×10 ⁻⁵	2.54×10 ⁻⁵	8.34×10 ⁻⁴	1.15×10 ⁻⁴
5	AL-WEE-20010131 2.2	1.07×10 ⁻⁵	3.52×10 ⁻⁵	1.32×10 ⁻³	1.66×10 ⁻⁴
6	AL-WEE-20010207 2.2	4.19×10 ⁻⁵	2.13×10 ⁻⁵	9.19×10 ⁻⁴	1.24×10 ⁻⁴
7	AL-WEE-20010214 2.2	4.08×10 ⁻⁵	2.15×10 ⁻⁵	1.17×10 ⁻³	1.50×10 ⁻⁴
8	AL-WEE-20010221 2.2	3.75×10 ⁻⁵	2.13×10 ⁻⁵	7.49×10 ⁻⁴	1.08×10 ⁻⁴
9	AL-WEE-20010228 2.2	5.63×10 ⁻⁵	2.39×10 ⁻⁵	8.63×10 ⁻⁴	1.16×10 ⁻⁴
10	AL-WEE-20010307 2.2	1.67×10 ⁻⁵	1.37×10 ⁻⁵	5.77×10 ⁻⁴	8.80×10 ⁻⁵
11	AL-WEE-20010314 2.2	5.14×10 ⁻⁵	2.40×10 ⁻⁵	7.17×10 ⁻⁴	1.05×10 ⁻⁴
12	AL-WEE-20010321 2.2	3.95×10 ⁻⁵	2.13×10 ⁻⁵	6.97×10 ⁻⁴	1.02×10 ⁻⁴
13	AL-WEE-20010328 2.2	6.21×10 ⁻⁵	2.59×10 ⁻⁵	8.67×10 ⁻⁴	1.18×10 ⁻⁴
WIPP South (WSS)					
14	AL-WSS-20010404 2.2	7.63×10 ⁻⁵	2.94×10 ⁻⁵	7.01×10 ⁻⁴	1.02×10 ⁻⁴
15	AL-WSS-20010411 2.2	5.64×10 ⁻⁵	2.50×10 ⁻⁵	9.49×10 ⁻⁴	1.27×10 ⁻⁴
16	AL-WSS-20010418 2.2	7.40×10 ⁻⁵	2.90×10 ⁻⁵	7.68×10 ⁻⁴	1.09×10 ⁻⁴
17	AL-WSS-20010425 2.2	5.83×10 ⁻⁵	2.57×10 ⁻⁵	9.50×10 ⁻⁴	1.27×10 ⁻⁴
18	AL-WSS-20010502 2.2	6.39×10 ⁻⁵	2.66×10 ⁻⁵	7.35×10 ⁻⁴	1.06×10 ⁻⁴
19	AL-WSS-20010509 2.2	5.82×10 ⁻⁵	2.52×10 ⁻⁵	9.11×10 ⁻⁴	1.24×10 ⁻⁴
20	AL-WSS-20010516 2.2	3.80×10 ⁻⁵	2.04×10 ⁻⁵	6.32×10 ⁻⁴	9.51×10 ⁻⁵
21	AL-WSS-20010523 2.2	6.81×10 ⁻⁵	2.89×10 ⁻⁵	8.15×10 ⁻⁴	1.13×10 ⁻⁴
22	AL-WSS-20010530 2.2	6.98×10 ⁻⁵	2.91×10 ⁻⁵	8.65×10 ⁻⁴	1.18×10 ⁻⁴
23	AL-WSS-20010606 2.2	7.27×10 ⁻⁵	2.94×10 ⁻⁵	7.55×10 ⁻⁴	1.09×10 ⁻⁴
24	AL-WSS-20010613 2.2	5.83×10 ⁻⁵	2.56×10 ⁻⁵	6.37×10 ⁻⁴	9.50×10 ⁻⁵
25	AL-WSS-20010620 2.2	9.08×10 ⁻⁵	3.18×10 ⁻⁵	9.21×10 ⁻⁴	1.25×10 ⁻⁴
26	AL-WSS-20010627 2.2	7.27×10 ⁻⁵	3.06×10 ⁻⁵	7.75×10 ⁻⁴	1.15×10 ⁻⁴
Mills Ranch (MLR)					
27	AL-MLR-20010704 2.2	4.17×10 ⁻⁵	2.08×10 ⁻⁵	6.82×10 ⁻⁴	9.61×10 ⁻⁵
28	AL-MLR-20010711 2.2	5.70×10 ⁻⁵	2.61×10 ⁻⁵	9.08×10 ⁻⁴	1.24×10 ⁻⁴
29	AL-MLR-20010718 2.2	6.90×10 ⁻⁵	2.79×10 ⁻⁵	7.06×10 ⁻⁴	1.03×10 ⁻⁴
30	AL-MLR-20010725 2.2	3.39×10 ⁻⁵	1.95×10 ⁻⁵	7.24×10 ⁻⁴	1.04×10 ⁻⁴
31	AL-MLR-20010801 2.2	2.36×10 ⁻⁵	1.65×10 ⁻⁵	8.08×10 ⁻⁴	1.13×10 ⁻⁴
32	AL-MLR-20010808 2.2	9.41×10 ⁻⁵	3.25×10 ⁻⁵	7.73×10 ⁻⁴	1.08×10 ⁻⁴
33	AL-MLR-20010815 2.2	4.44×10 ⁻⁵	2.28×10 ⁻⁵	8.22×10 ⁻⁴	1.14×10 ⁻⁴
34	AL-MLR-20010822 2.2	2.75×10 ⁻⁵	2.04×10 ⁻⁵	7.00×10 ⁻⁴	1.04×10 ⁻⁴
35	AL-MLR-20010829 2.2	5.57×10 ⁻⁵	2.53×10 ⁻⁵	6.85×10 ⁻⁴	9.87×10 ⁻⁵
36	AL-MLR-20010905 2.2	5.23×10 ⁻⁵	2.64×10 ⁻⁵	7.80×10 ⁻⁴	1.12×10 ⁻⁴
37	AL-MLR-20010912 2.2	3.74×10 ⁻⁵	2.11×10 ⁻⁵	8.31×10 ⁻⁴	1.14×10 ⁻⁴
38	AL-MLR-20010919 2.2	3.65×10 ⁻⁵	1.84×10 ⁻⁵	7.23×10 ⁻⁴	1.01×10 ⁻⁴
39	AL-MLR-20010926 2.2	6.35×10 ⁻⁵	2.64×10 ⁻⁵	1.42×10 ⁻³	1.76×10 ⁻⁴

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Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

Week	Sample ID	Gross Alpha		Gross Beta	
		Concentration	2 x TPU ^a	Concentration	2 x TPU
Smith Ranch (SMR)					
40	AL-SMR-20011003 2.2	2.52×10 ⁻⁵	1.70×10 ⁻⁵	1.17×10 ⁻³	1.51×10 ⁻⁴
41	AL-SMR-20011010 2.2	N/C	N/C	N/C	N/C
42	AL-SMR-20011017 2.2	5.75×10 ⁻⁵	2.71×10 ⁻⁵	1.19×10 ⁻³	1.53×10 ⁻⁴
43	AL-SMR-20011024 2.2	1.18×10 ⁻⁴	3.87×10 ⁻⁵	1.12×10 ⁻³	1.47×10 ⁻⁴
44	AL-SMR-20011031 2.2	1.22×10 ⁻⁴	3.86×10 ⁻⁵	8.51×10 ⁻⁴	1.18×10 ⁻⁴
45	AL-SMR-20011107 2.2	1.63×10 ⁻⁴	4.59×10 ⁻⁵	1.75×10 ⁻³	2.11×10 ⁻⁴
46	AL-SMR-20011114 2.2	4.18×10 ⁻⁵	2.33×10 ⁻⁵	7.64×10 ⁻⁴	1.12×10 ⁻⁴
47	AL-SMR-20011121 2.2	8.81×10 ⁻⁵	3.01×10 ⁻⁵	8.12×10 ⁻⁴	1.09×10 ⁻⁴
48	AL-SMR-20011128 2.2	1.25×10 ⁻⁴	3.89×10 ⁻⁵	1.00×10 ⁻³	1.33×10 ⁻⁴
49	AL-SMR-20011205 2.2	6.04×10 ⁻⁵	2.41×10 ⁻⁵	7.34×10 ⁻⁴	1.01×10 ⁻⁴
50	AL-SMR-20011212 2.2	1.19×10 ⁻⁴	4.08×10 ⁻⁵	1.08×10 ⁻³	1.49×10 ⁻⁴
51	AL-SMR-20011219 2.2	4.10×10 ⁻⁵	2.13×10 ⁻⁵	1.04×10 ⁻³	1.36×10 ⁻⁴
52	AL-SMR-20011226 2.2	9.63×10 ⁻⁵	3.30×10 ⁻⁵	1.20×10 ⁻³	1.54×10 ⁻⁴

^a Total propagated uncertainty

^b Not collected

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**Appendix E
Air Sampling Data: Mass and Volume of Composite Air Samples**

Table E.1 - Mass (mg) of Air Particulates and Volume (m ³) of Air Sampled (First Quarter of 2001)											
Week	WIPP Far Field (WFF)			WIPP East (WEE) #1			WIPP East (WEE) #2			WIPP South (WSS)	
	Mass	Volume		Mass	Volume		Mass	Volume		Mass	Volume
1	N/C ^a	N/C		6	509.306		6.9	602.542		6.7	565.427
2	4	596.879		5.2	602.262		6.2	630.567		6.1	630.941
3	3.6	617.913		3.8	601.186		3.9	616.807		6.3	626.829
4	8.8	582.974		9.5	596.908		9.5	595.133		14.8	579.772
5	4.3	554.936		4.4	577.702		4.8	554.605		5.1	572.011
6	9.4	586.325		12.2	554.068		12.9	578.841		10.7	557.364
7	5	562.938		6	553.611		5.4	553.279		6.3	606.523
8	10.5	582.281		14.2	586.529		14.1	549.008		11.8	550.228
9	3.5	584.337		6.3	621.131		3.9	615.432		8.7	622.983
10	5.5	585.484		5.2	576.229		6	589.789		5.5	576.229
11	7.1	605.49		8.2	612.177		7.3	559.129		8.1	592.017
12	8.1	580.854		7.9	548.774		8	570.15		8.9	591.685
13	7.9	612.218		9.5	595.133		9.2	594.777		9.6	598.337
Total	77.7	7052.6		98.4	7535		98.1	7610.1		108.6	7670.3

^a Not collected

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Table E.1 - Mass (mg) of Air Particulates and Volume (m³) of Air Sampled (First Quarter of 2001)

Week	Mills Ranch (MLR)		Smith Ranch (SMR)		Carlsbad (CBD)		Southeast Control (SEC)	
	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
1	6.8	555.96	N/C ^a	N/C	10.9	536.51	6.3	572.24
2	6.1	621.968	10	619.756	11	610.824	5.2	623.914
3	5.1	612.948	7.6	594.759	7.2	620.862	4	565.828
4	8.6	573.718	11.8	589.759	9.6	617.913	8.8	595.843
5	5	546.725	8.3	550.228	10.5	549.394	4.6	588.34
6	9.3	554.397	16.9	617.697	17.6	597.623	11.4	559.034
7	7.1	619.756	10.6	571.328	10.9	619.649	6.4	612.177
8	10.8	559.78	19.8	570.038	15	615.14	17.3	574.06
9	4.5	612.948	4.6	599.752	7.8	559.958	4.4	568.825
10	5	555.93	8.6	551.212	11.5	570.184	4.5	601.094
11	7.3	577.702	20.3	598.328	17.9	610.519	7.9	590.073
12	8.8	603.695	8.4	553.611	12.1	543.136	7.4	597.326
13	10	620.636	13.2	583.394	21.3	565.643	7.5	597.98
Total	94.4	7616.2	140	6999.9	163	7617.4	95.7	7646.7

^a Not collected

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Table E.3 - Mass (mg) of Air Particulates and Volume (m³) of Air Sampled (Third Quarter of 2001).

Week	WIPP Far Field (WFF)		WIPP East (WEE)		WIPP South (WSS)		Mills Ranch (MLR) #1	
	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
27	11.5	625.667	12.6	625.341	13.5	647.463	12.5	653.288
28	14.7	570.184	13.2	556.261	14	550.556	14.1	564.483
29	9.7	550.884	9.7	531.393	12.7	567.333	N/C ^a	N/C
30	9.9	602.618	11.7	554.936	11.6	574.401	11.4	552.42
31	11.4	544.699	13	590.844	12.8	561.297	13.2	557.918
32	11.5	571.883	12.2	560.446	11.9	573.718	11.6	568.01
33	7.5	530.17	8.2	538.885	9.5	519.733	10.5	574.743
34	5.1	552.42	5.8	552.42	60.3	607.916	8.2	549.244
35	7	621.501	7.7	590.141	7.8	626.829	9.1	620.76
36	10.6	549.572	12.4	553.264	14.7	558.912	12	543.553
37	8.5	579.772	8.5	556.924	7.8	547.605	8.7	597.263
38	6.2	574.743	9	577.602	9.2	552.523	7.5	549.987
39	9.5	583.321	9.9	562.97	11.2	562.301	11.1	553.738
Total	123.1	7457.4	133.9	7351.4	197	7450.6	129.9	6885.4
Week	Mills Ranch (MLR) #2		Smith Ranch (SMR)		Carlsbad (CBD)		Southeast Control (SEC)	
	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
27	13.4	643.201	17.5	650.017	22.8	703.539	14.3	662.202
28	14.6	567.333	22.5	591.932	25.1	585.217	14.8	580.608
29	9.9	555.598	8.5	542.321	15.5	597.232	11.9	556.924
30	11.3	563.81	17	573.035	21	620.728	12.9	624.094
31	13.7	558.249	22.6	616.166	17.4	522.318	12.3	597.266
32	12.4	585.136	20.6	556.924	20.8	567.672	13.2	604.035
33	9.5	569.024	11.2	560.113	16.5	581.721	9.8	576.792
34	10.5	546.398	8.7	543.877	12.3	583.046	7.3	575.978
35	9.9	620.76	17.1	597.98	N/C	N/C	10.3	600.828
36	13.6	546.398	14.8	537.57	19.5	546.725	13.9	548.578
37	9.5	600.121	13.8	548.682	18.2	565.492	9	605.264
38	8.7	552.851	13.2	590.09	16.2	602.975	9.5	569.315
39	12.4	561.966	20.3	557.116	19.3	567.126	9.7	575.247
Total	149.4	7470.8	207.8	7465.8	224.6	7043.8	148.9	7677.1

^a Not collected

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Table E.4 - Mass (mg) of Air Particulates and Volume (m ³) of Air Sampled (Fourth Quarter of 2001)											
Week	WIPP Far Field (WFF)			WIPP East (WEE)			WIPP South (WSS)			Mills Ranch (MLR)	
	Mass	Volume	Volume	Mass	Volume	Volume	Mass	Volume	Volume	Mass	Volume
40	8.3	566.501	554.727	9.5	554.727	10.5	571.883	11.1	600.121	11.1	600.121
41	11.3	497.875	482.47	13.4	482.47	12.8	495.695	15	556.261	15	556.261
42	14.4	586.877	575.426	17	575.426	16.5	545.5	16.4	561.966	16.4	561.966
43	12	570.038	552.851	13.9	552.851	14.9	579.318	13.9	550.639	13.9	550.639
44	8.5	585.54	571.204	11.7	571.204	11.1	593.699	14.2	616.9	14.2	616.9
45	13.4	591.84	608.279	14.6	608.279	16.2	572.352	13.5	549.244	13.5	549.244
46	4.9	535.627	491.691	4.7	491.691	4.6	537.657	5	537.744	5	537.744
47	N/A	N/A	712.245	11.8	712.245	10.3	695.547	12	705.323	12	705.323
48	4.6	619.019	597.266	5.1	597.266	6.5	626.082	5.4	606.161	5.4	606.161
49	14.2	700.267	698.812	16.3	698.812	17.1	717	N/C ^a	N/C	N/C ^a	N/C
50	3.6	516.632	524.012	3.9	524.012	N/C	N/C	N/C	N/C	N/C	N/C
51	5.8	616.316	610.294	6	610.294	5.7	510.386	8.8	572.874	8.8	572.874
52	5.4	622.864	576.777	5.7	576.777	5.4	612.218	8.5	595.133	8.5	595.133
Total	106.4	7009.4	7556.1	133.6	7556.1	131.6	7057.3	123.8	6452.4	123.8	6452.4
Week	Smith Ranch (SMR) #1			Smith Ranch (SMR) #2			Carlsbad (CBD)			Southeast Control (SEC)	
	Mass	Volume	Volume	Mass	Volume	Volume	Mass	Volume	Volume	Mass	Volume
40	18.9	545.5	559.447	21.1	559.447	22.7	567.672	10.6	594.052	10.6	594.052
41	45.1	542.579	N/C	N/C	N/C	N/C	N/C	27.8	558.023	27.8	558.023
42	32.7	558.115	540.061	26.1	540.061	27	480.442	17.2	592.647	17.2	592.647
43	23.5	545.872	525.45	24.3	525.45	24.3	586.094	16.1	563.975	16.1	563.975
44	N/C	N/C	556.592	32.6	556.592	21.9	596.526	10.3	606.196	10.3	606.196
45	N/C	N/C	530.271	19.5	530.271	18.1	544.441	15.7	598.337	15.7	598.337
46	N/C	N/C	503.291	5.8	503.291	8.1	525.745	4.3	515.866	4.3	515.866
47	N/C	N/C	664.617	17.4	664.617	18.3	701.347	N/C	N/C	N/C	N/C
48	6.8	602.595	568.485	7.6	568.485	9.2	577.013	4.8	597.98	4.8	597.98
49	21.5	701.286	671.514	22.1	671.514	21.9	724.759	N/C	N/C	N/C	N/C
50	8.3	527.723	469.087	8	469.087	8.6	522.473	3.2	496.866	3.2	496.866
51	11.9	591.429	580.27	11.4	580.27	12.3	572.184	5.9	590.871	5.9	590.871
52	12.3	584.439	561.297	10.8	561.297	10.5	568.01	6.7	627.95	6.7	627.95
Total	181	5199.5	6730.4	206.7	6730.4	202.9	6966.7	122.6	6343.8	122.6	6343.8

^a Not collected

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Appendix F

Time Trend Plots for Detectable Constituents in Groundwater

The figures in this appendix show the concentrations of various groundwater constituents relative to a baseline concentration, and are in a form required by the NMED and the HWFP. Baseline concentrations were measured from 1995 through 2000. These plots indicate the maximum and minimum measurements, shown as whiskers, the 25th and 75th percentiles, shown as a box, and the median by a square point marker. Sampling round 12 occurred in March through May 2001 and sampling round 13 occurred in September through November 2001. See Chapter 6 for specific concentration information on the groundwater wells.

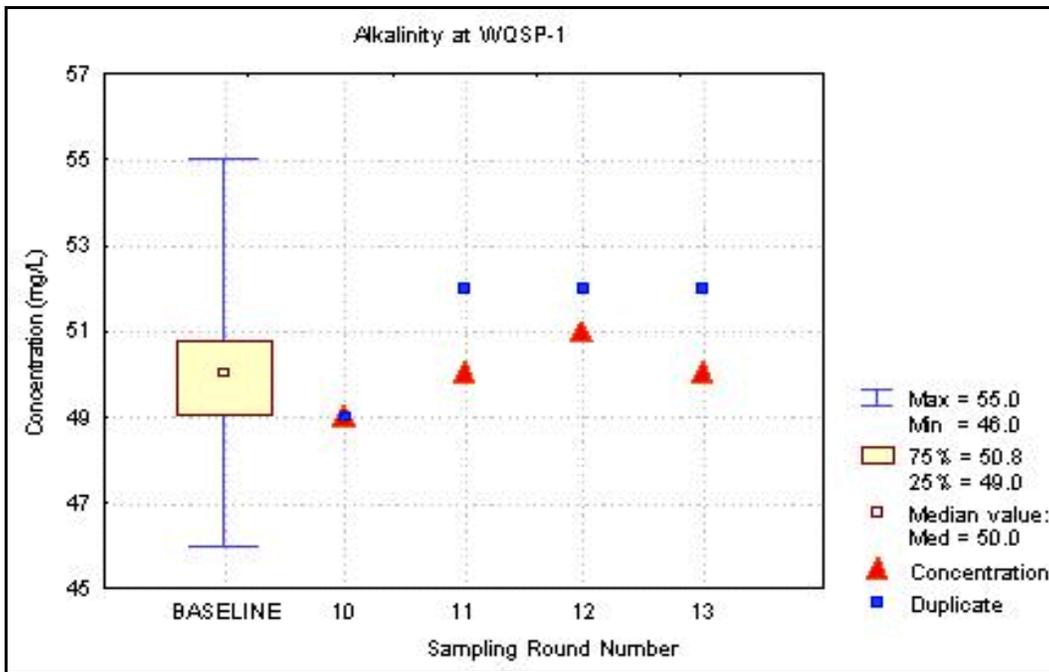


Figure F.1 - Time Trend Plot for Alkalinity at WQSP-1

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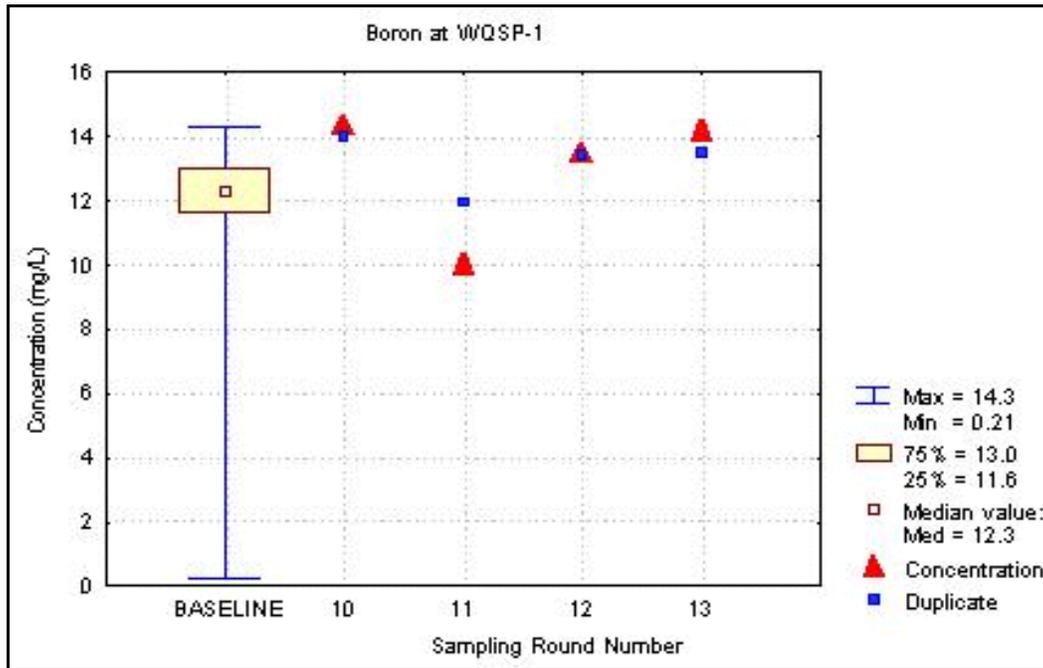


Figure F.2 - Time Trend Plot for Boron at WQSP-1

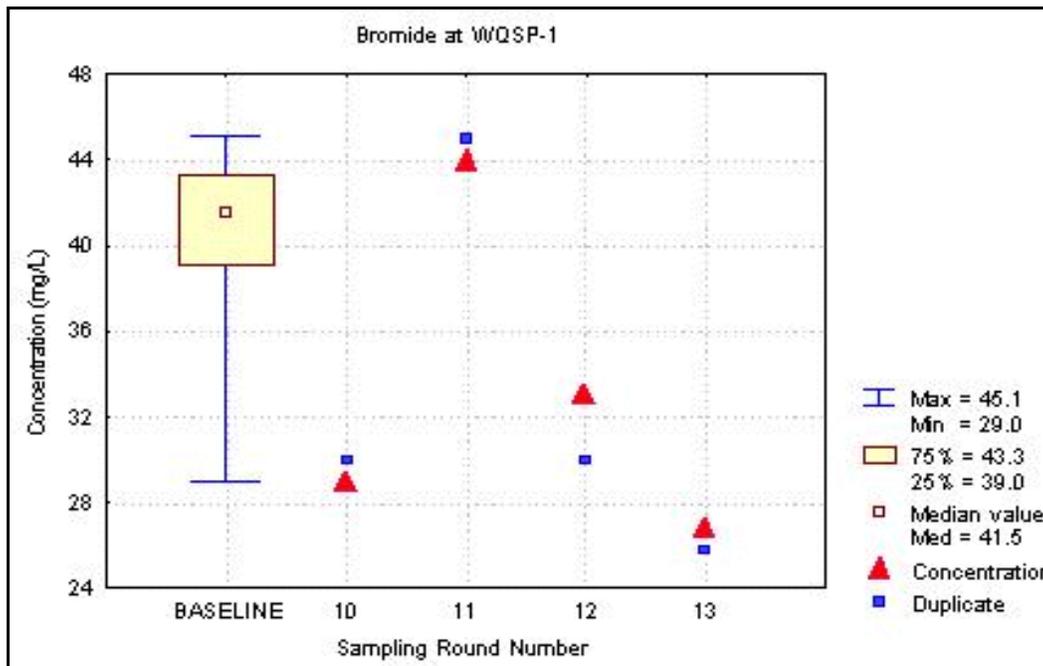


Figure F.3 - Time Trend Plot for Bromide at WQSP-1

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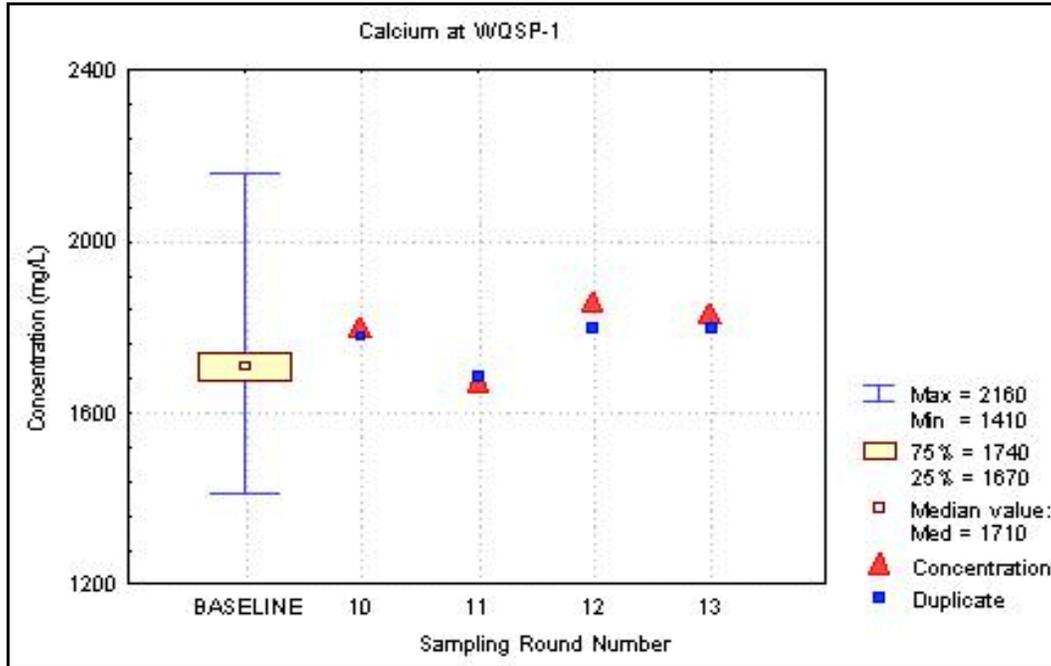


Figure F.4 - Time Trend Plot for Calcium at WQSP-1

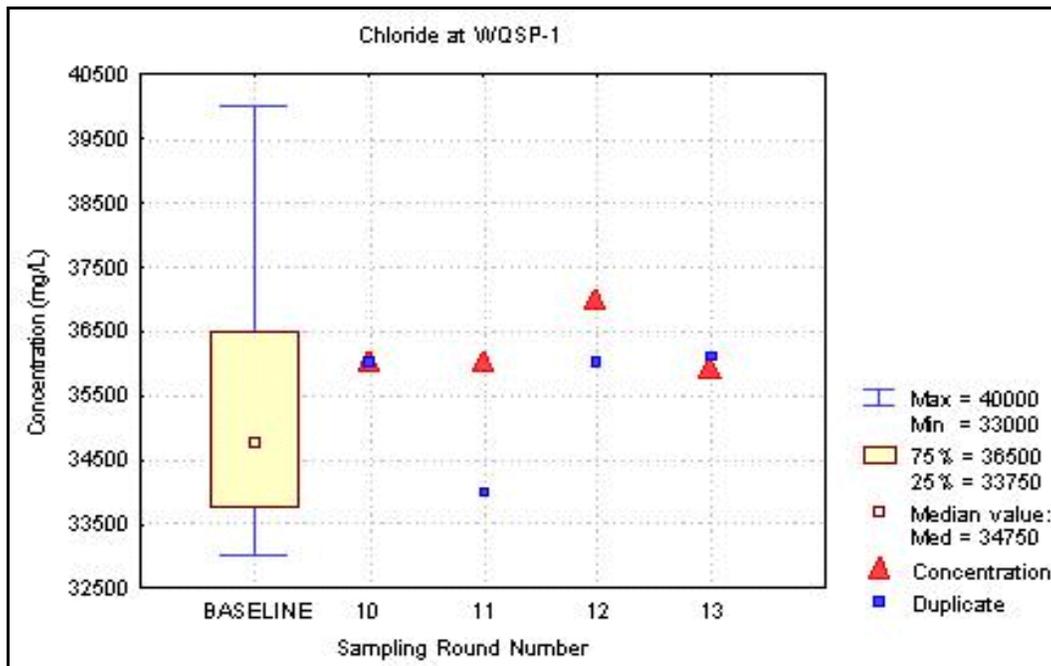


Figure F.5 - Time Trend Plot for Chloride at WQSP-1

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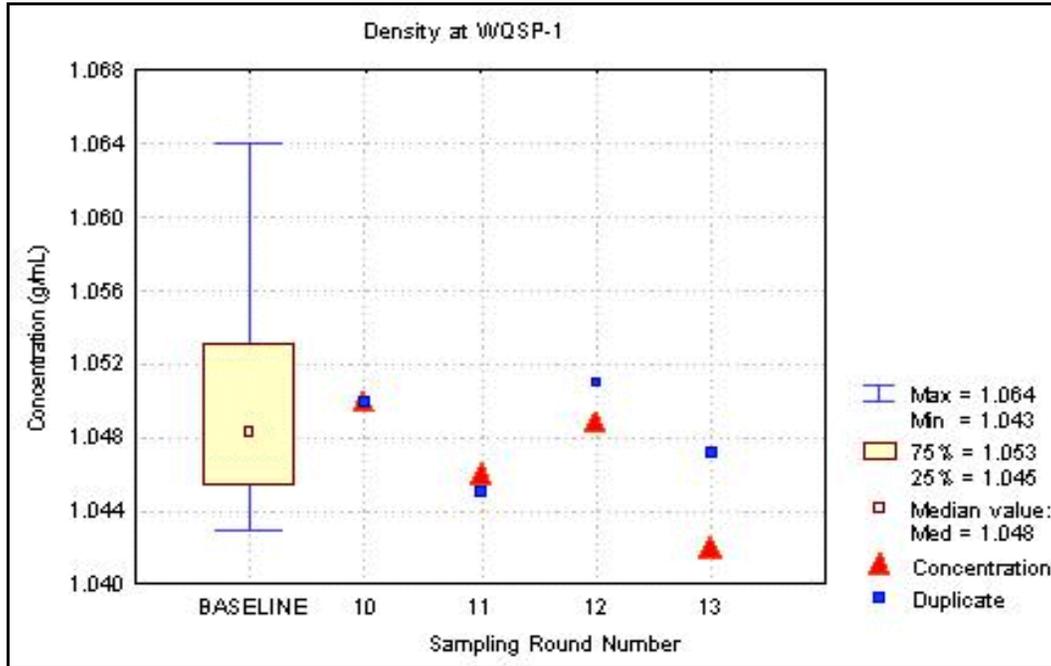


Figure F.6 - Time Trend Plot for Density at WQSP-1

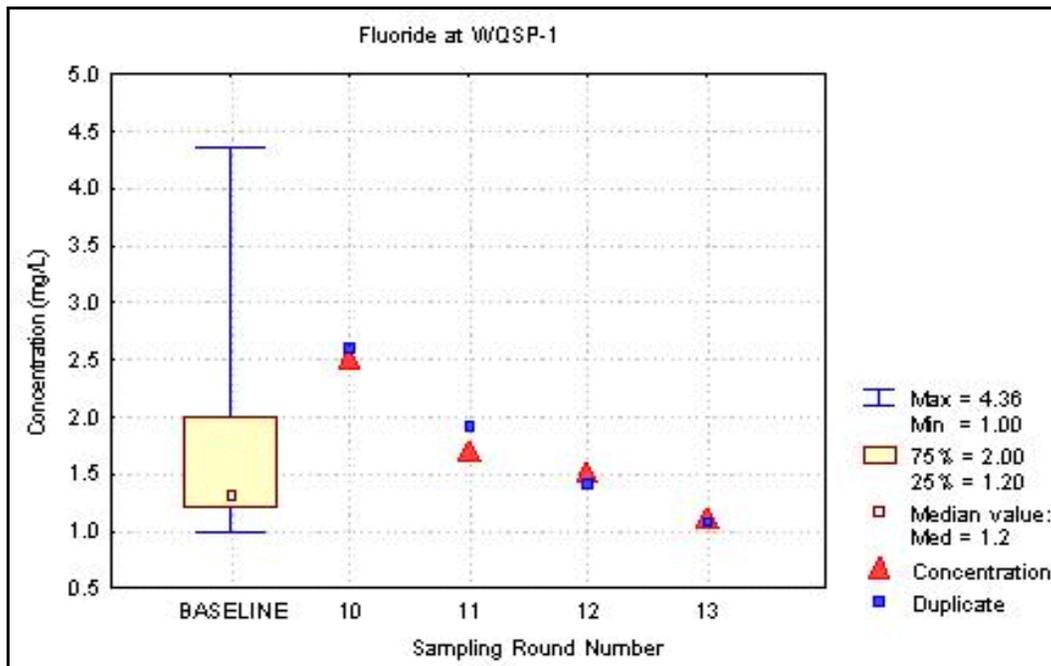


Figure F.7 - Time Trend Plot for Fluoride at WQSP-1

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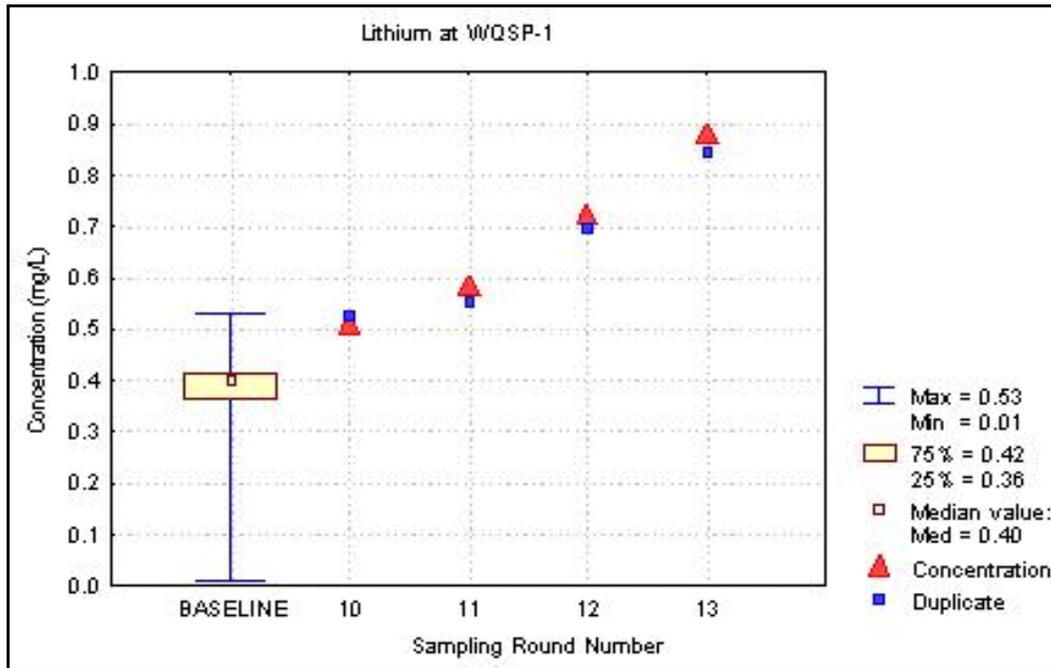


Figure F.8 - Time Trend Plot for Lithium at WQSP-1

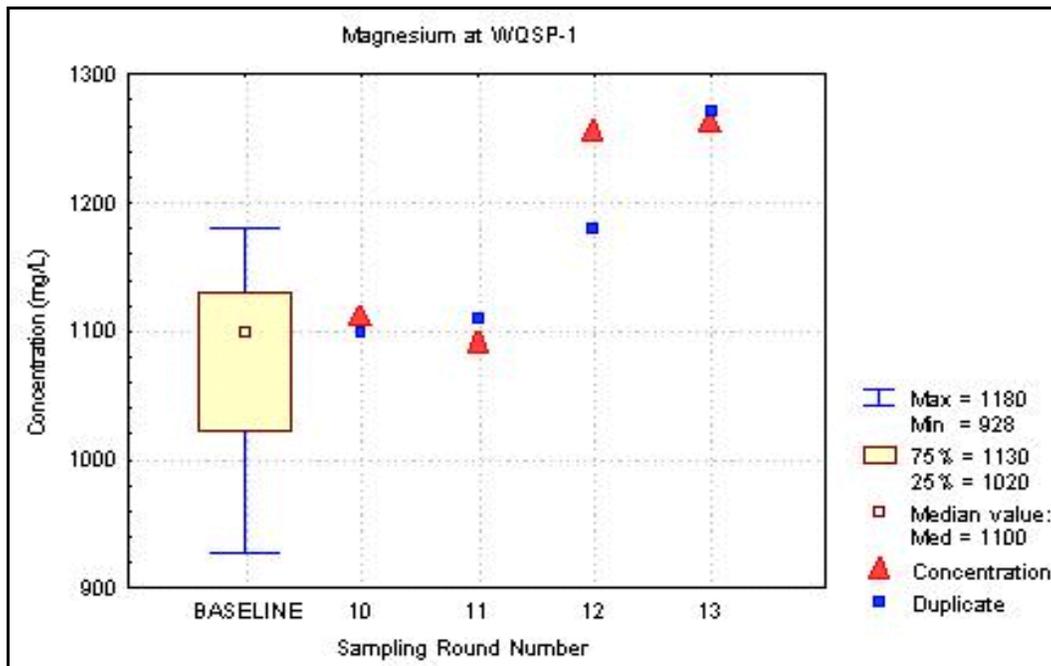


Figure F.9 - Time Trend Plot for Magnesium at WQSP-1

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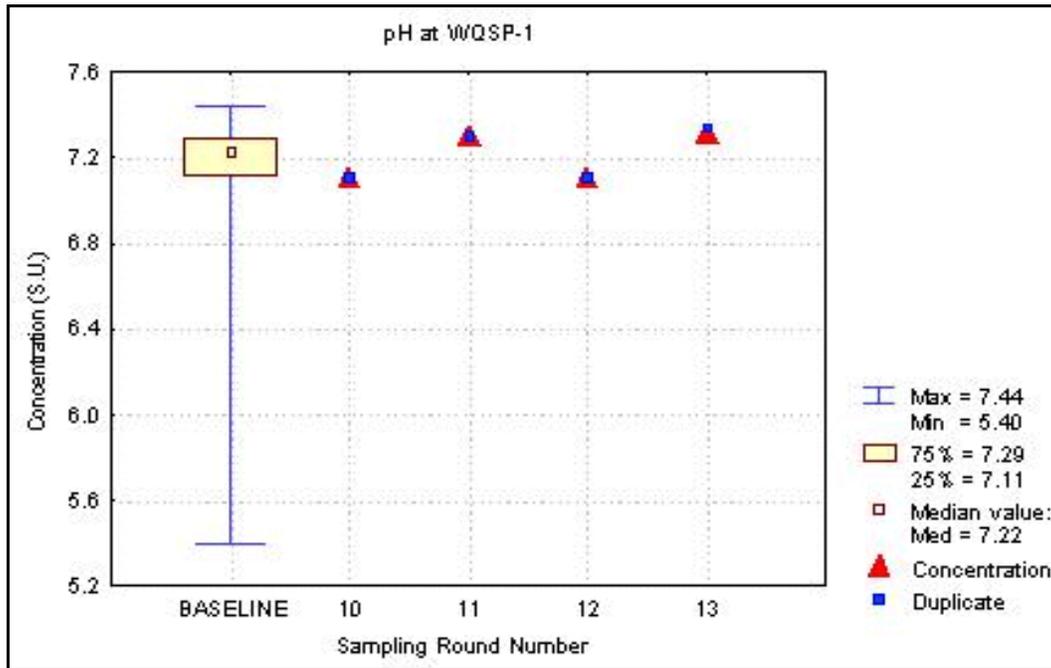


Figure F.10 - Time Trend Plot for pH at WQSP-1

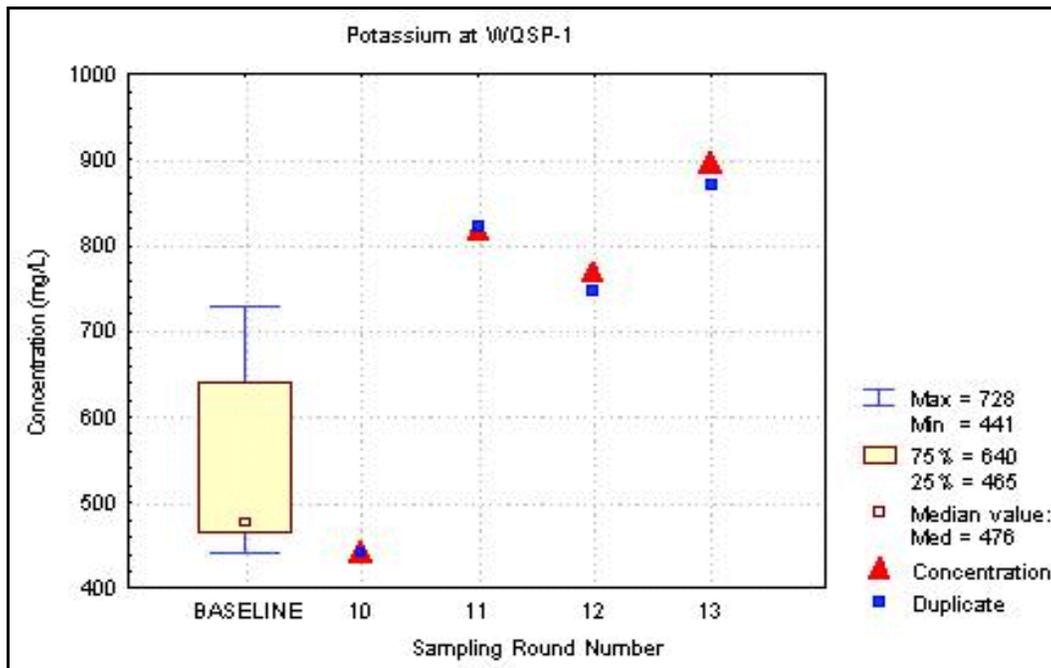


Figure F.11 - Time Trend Plot for Potassium at WQSP-1

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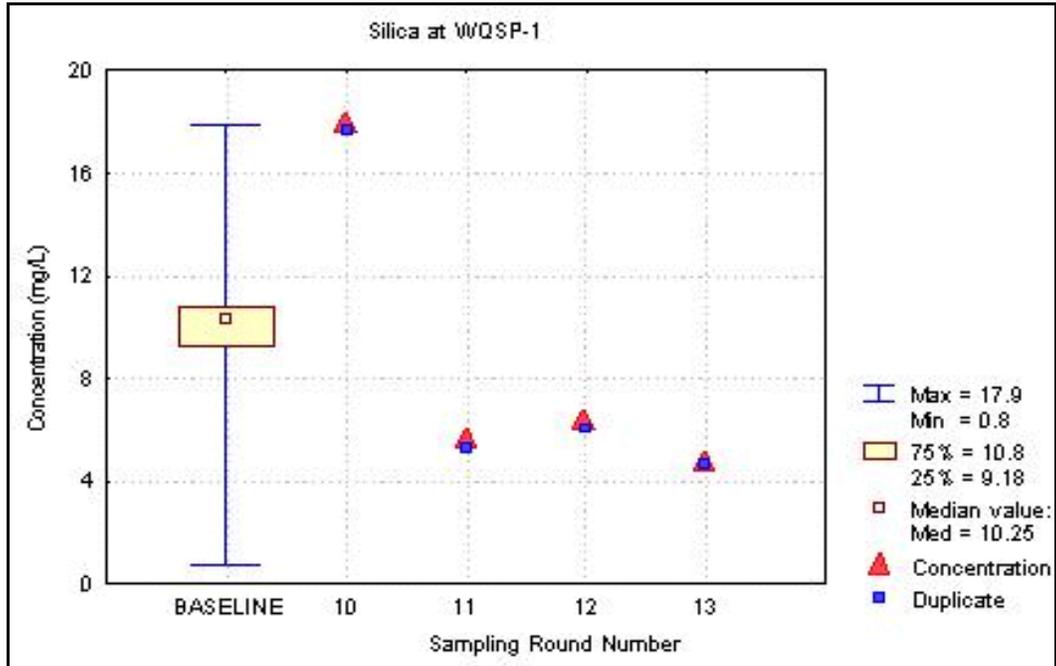


Figure F.12 - Time Trend Plot for Silica at WQSP-1

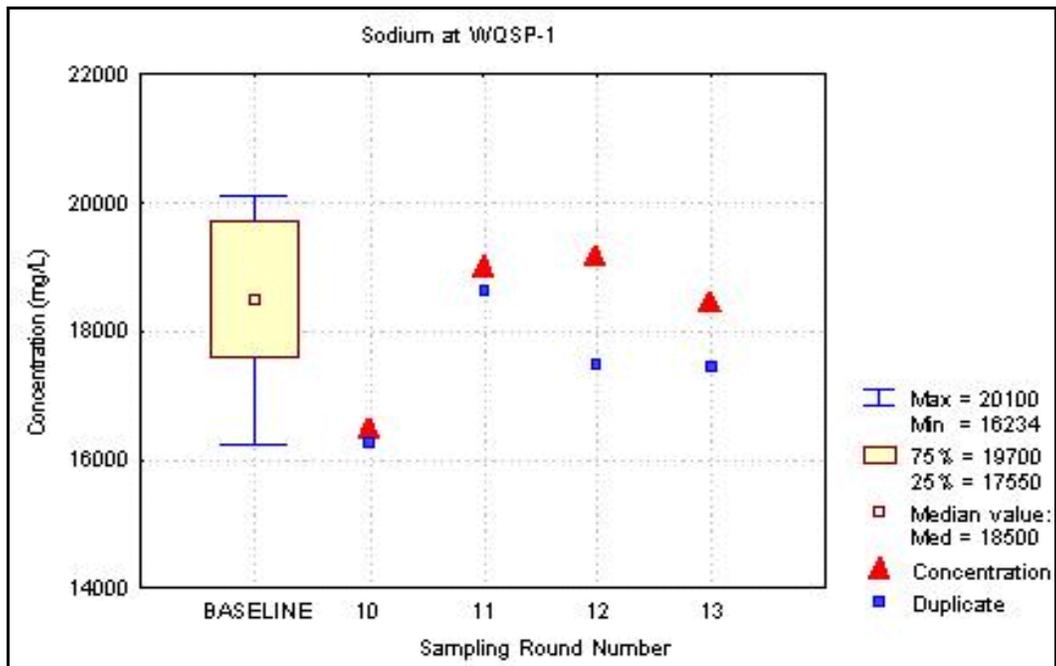


Figure F.13 - Time Trend Plot for Sodium at WQSP-1

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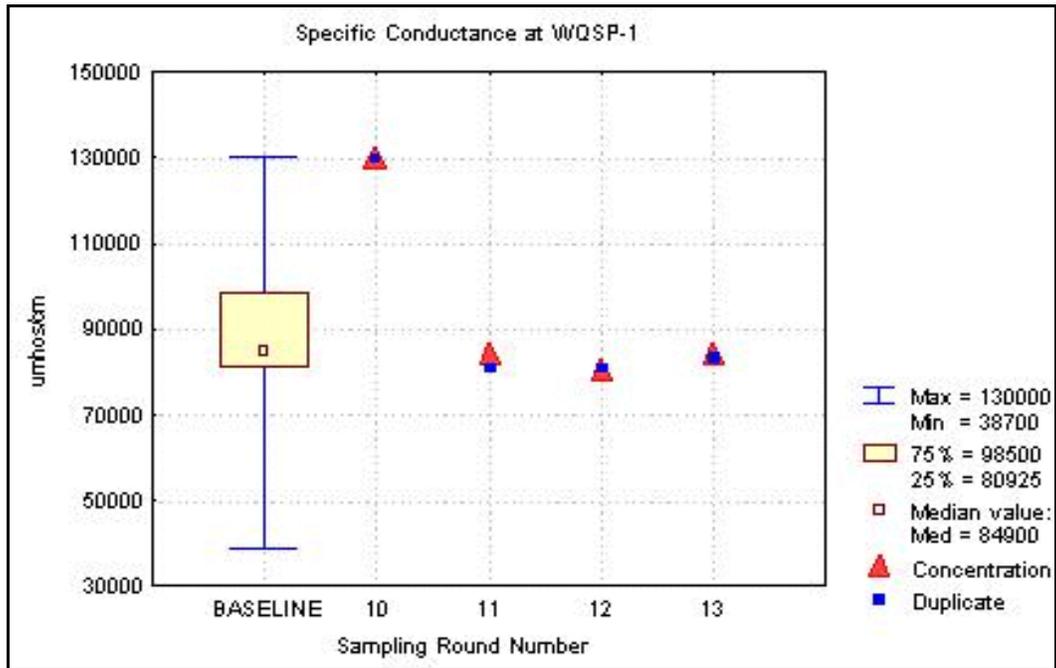


Figure F.14 - Time Trend Plot for Specific Conductance at WQSP-1

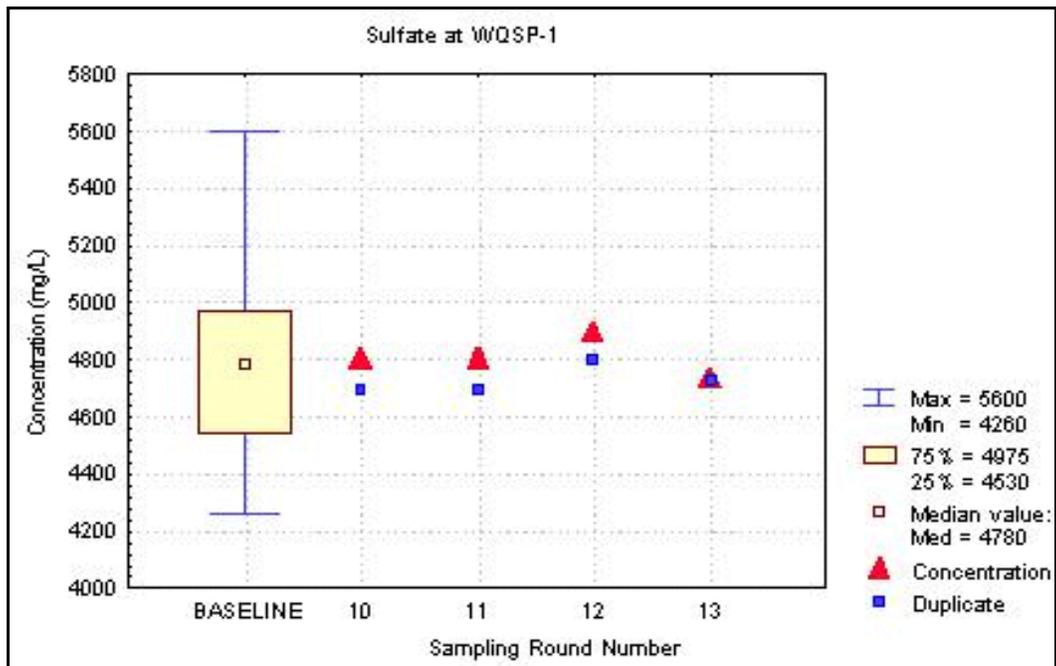


Figure F.15 - Time Trend Plot for Sulfate at WQSP-1

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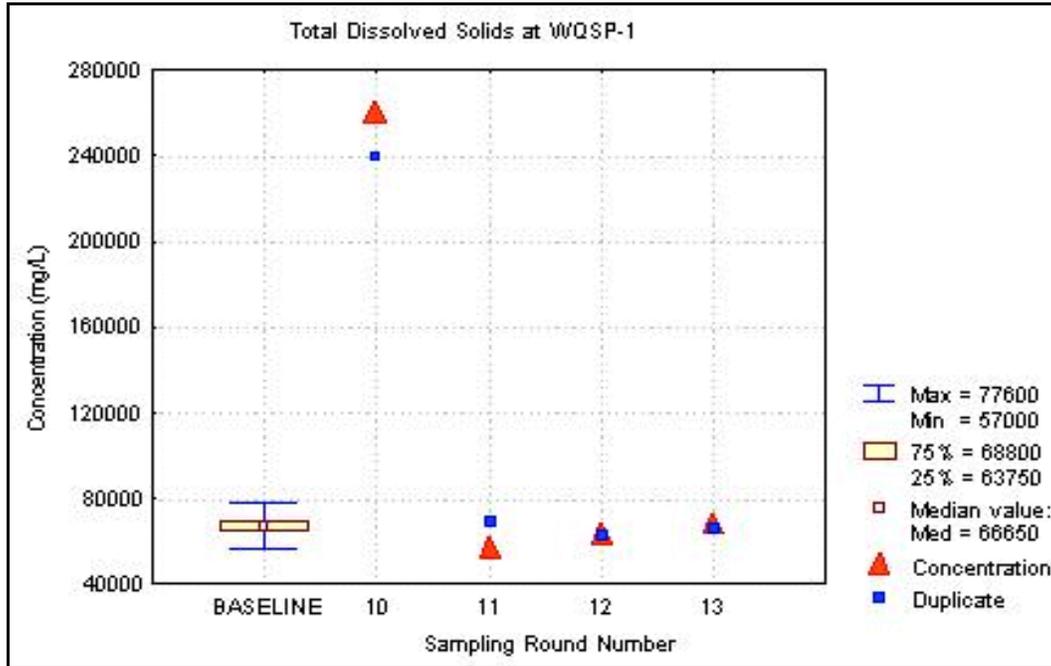


Figure F.16 - Time Trend Plot for Total Dissolved Solids at WQSP-1

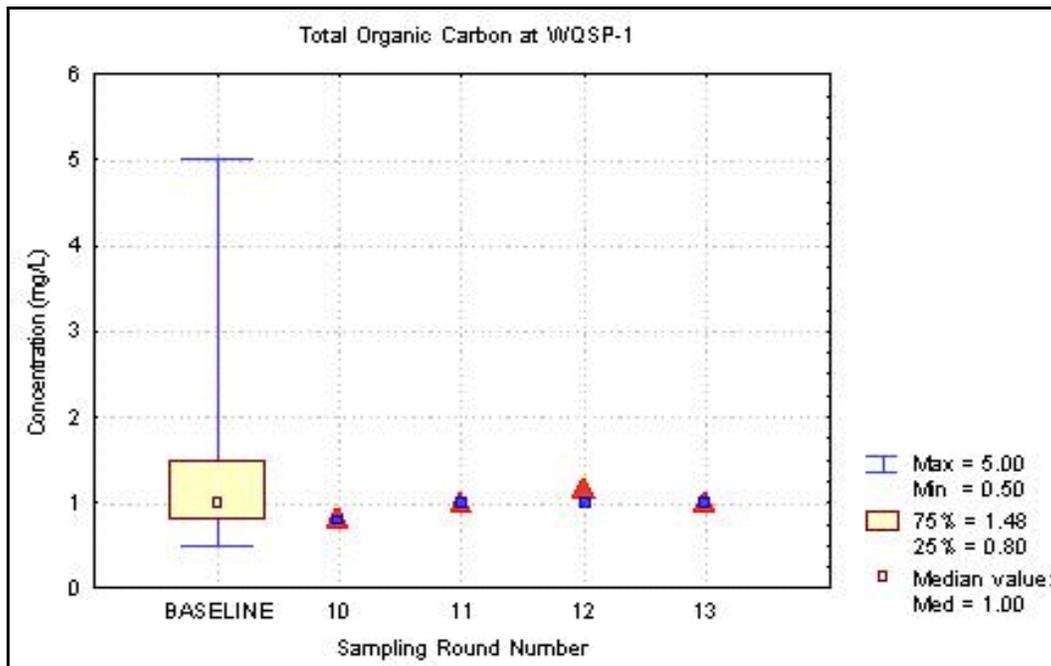


Figure F.17 - Time Trend Plot for Total Organic Carbon at WQSP-1

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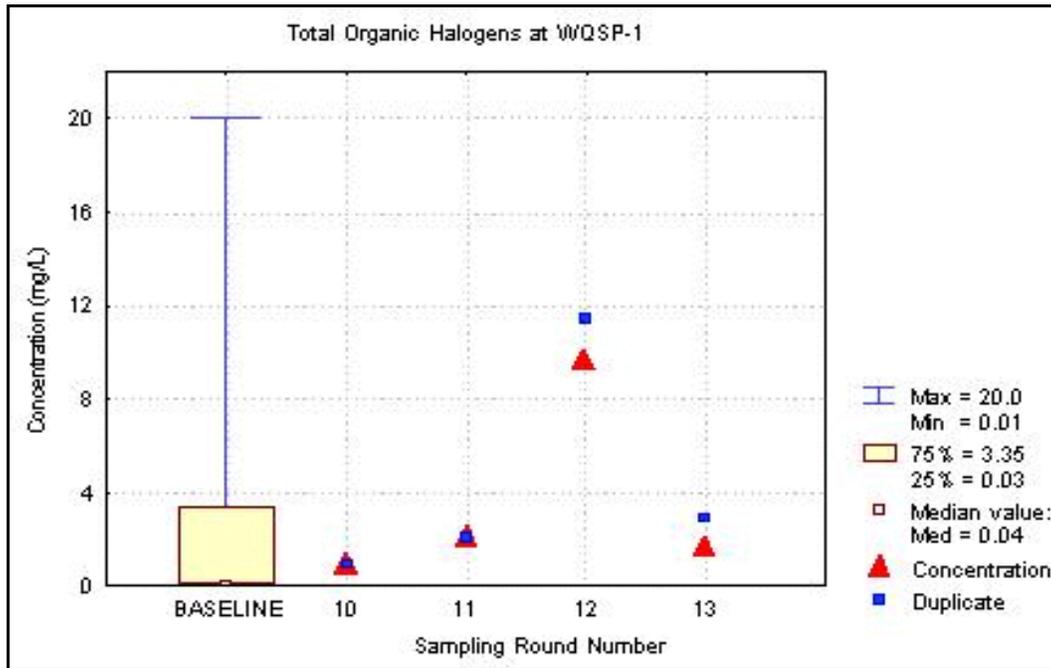


Figure F.18 - Time Trend Plot for Total Organic Halogens at WQSP-1

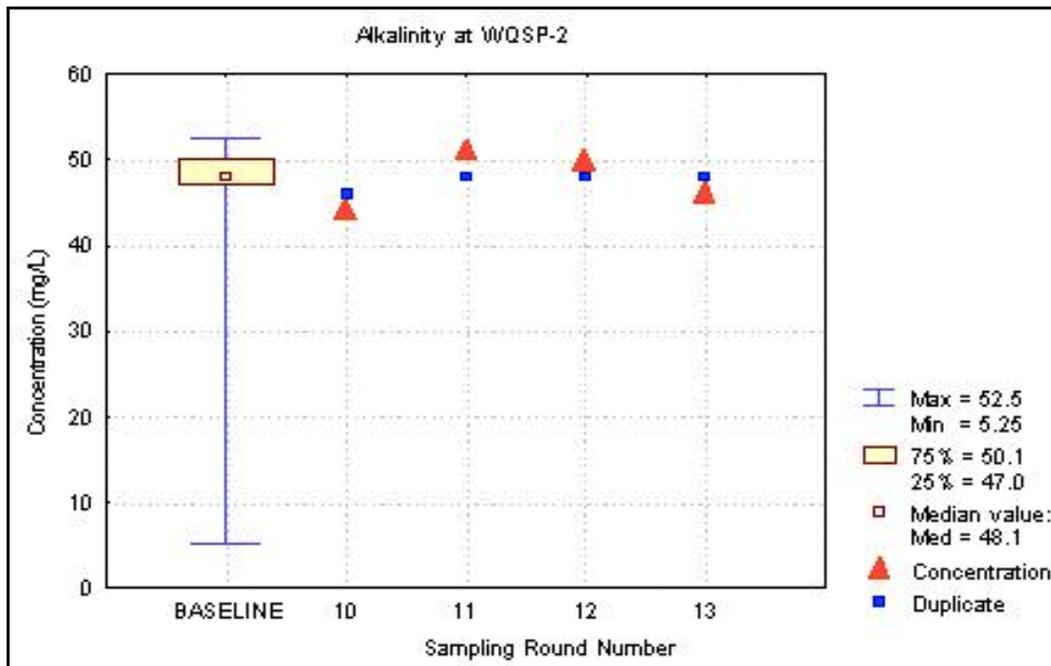


Figure F.19 - Time Trend Plot for Alkalinity at WQSP-2

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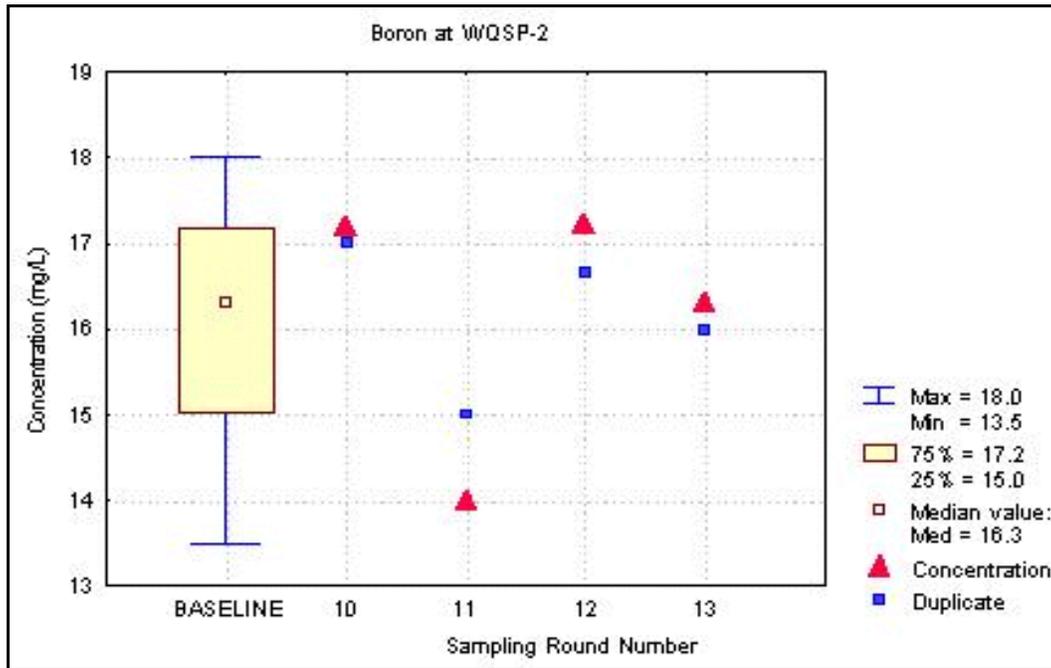


Figure F.20 - Time Trend Plot for Boron at WQSP-2

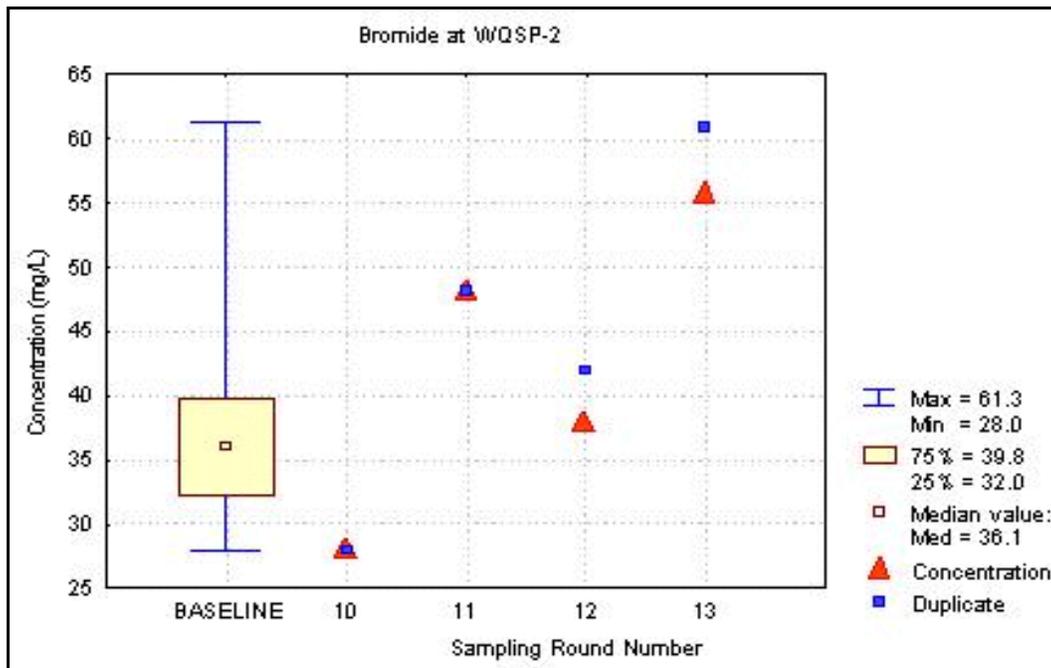


Figure F.21 - Time Trend Plot for Bromide at WQSP-1

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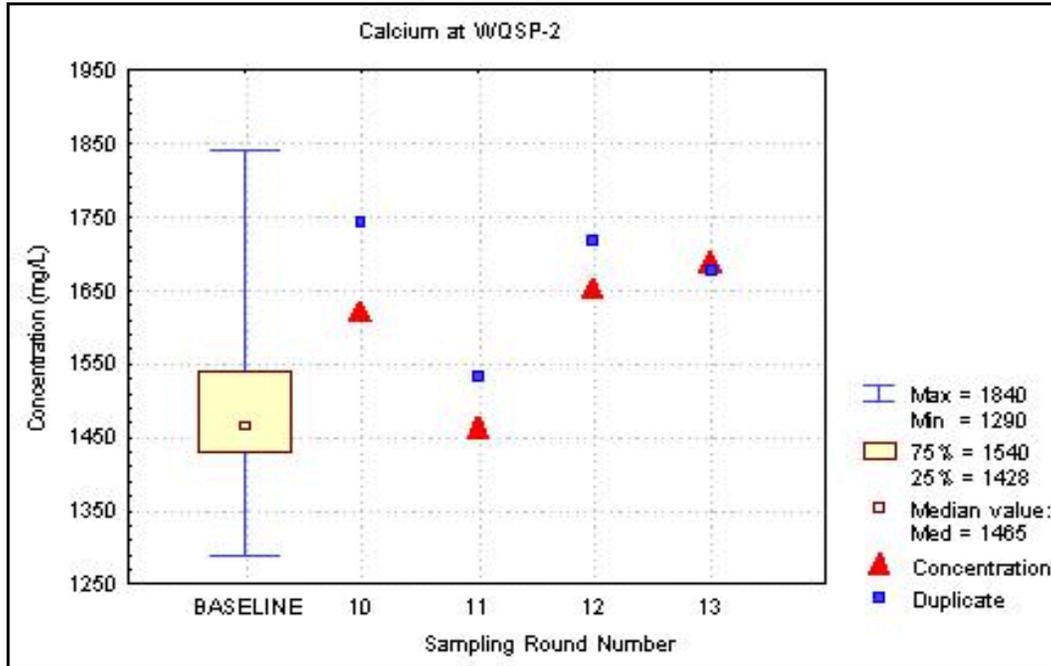


Figure F.22 - Time Trend Plot for Calcium at WQSP-2

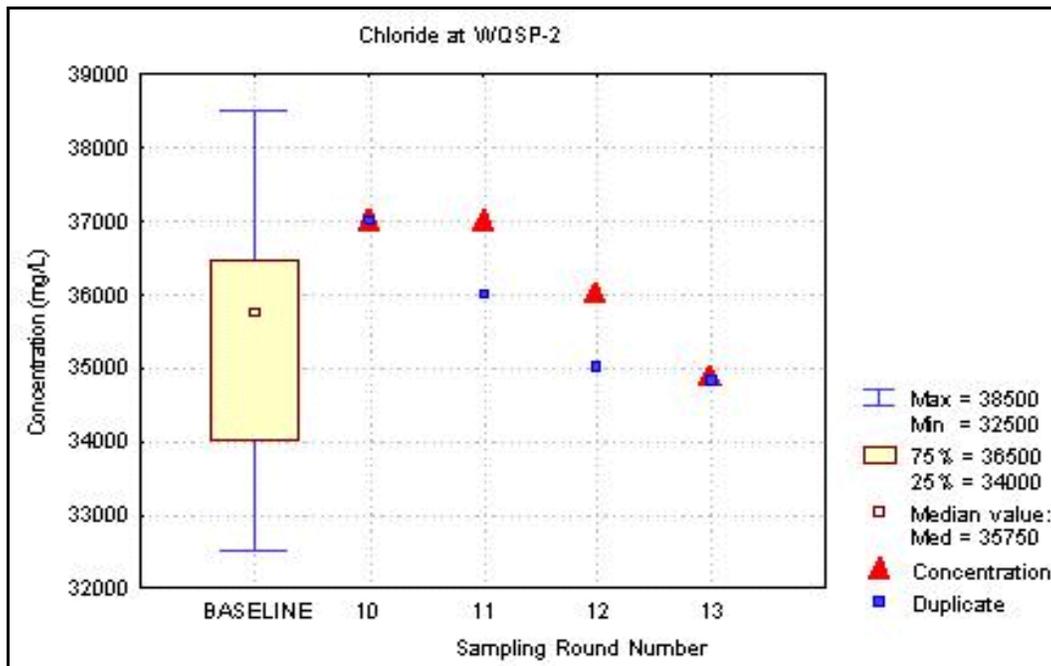


Figure F.23 - Time Trend Plot for Chloride at WQSP-2

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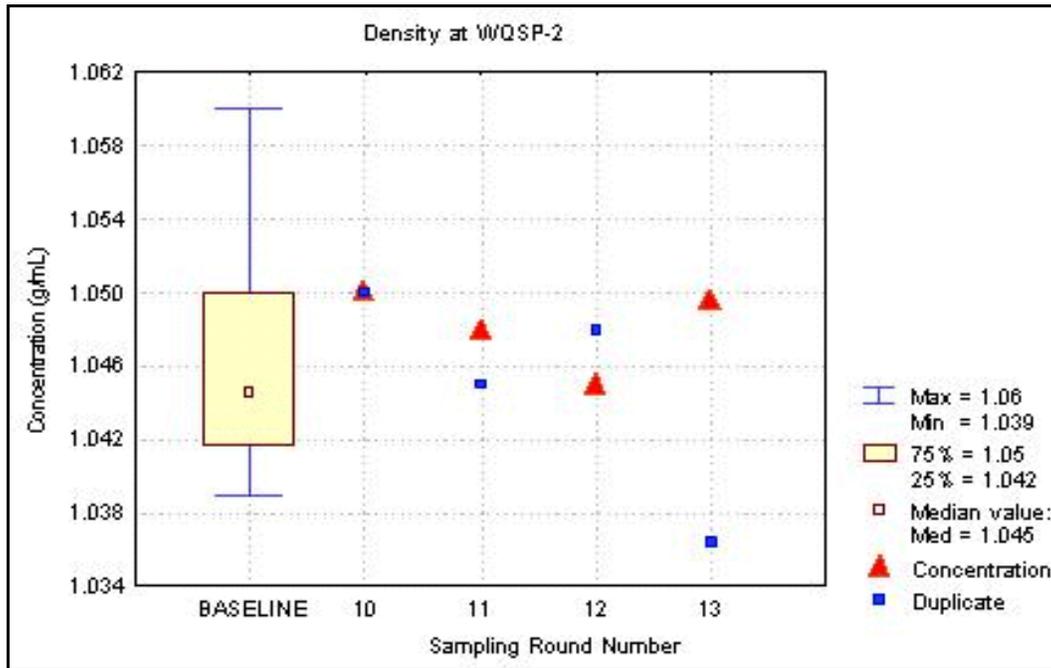


Figure F.24 - Time Trend Plot for Density at WQSP-1

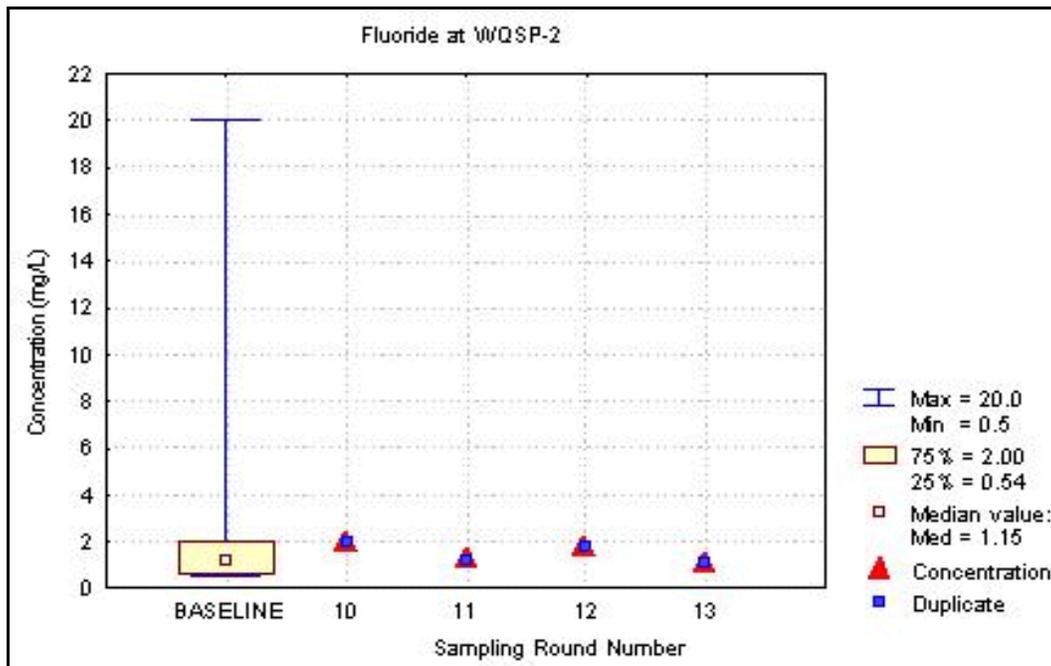


Figure F.25 - Time Trend Plot for Fluoride at WQSP-2

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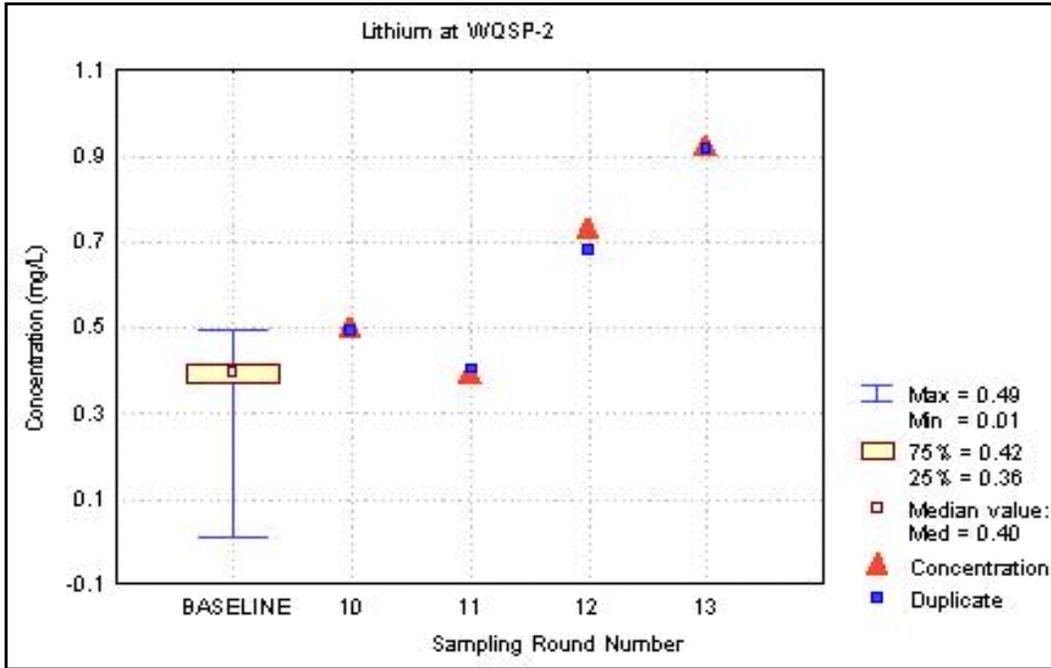


Figure F.26 - Time Trend Plot for Lithium at WQSP-2

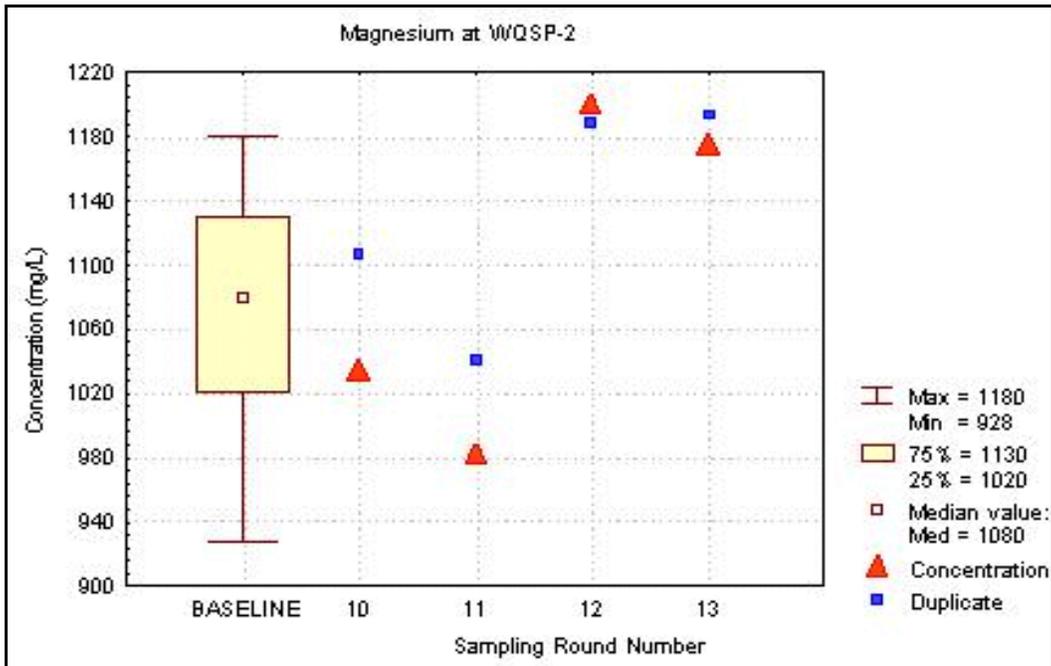


Figure F.27 - Time Trend Plot for Magnesium at WQSP-2

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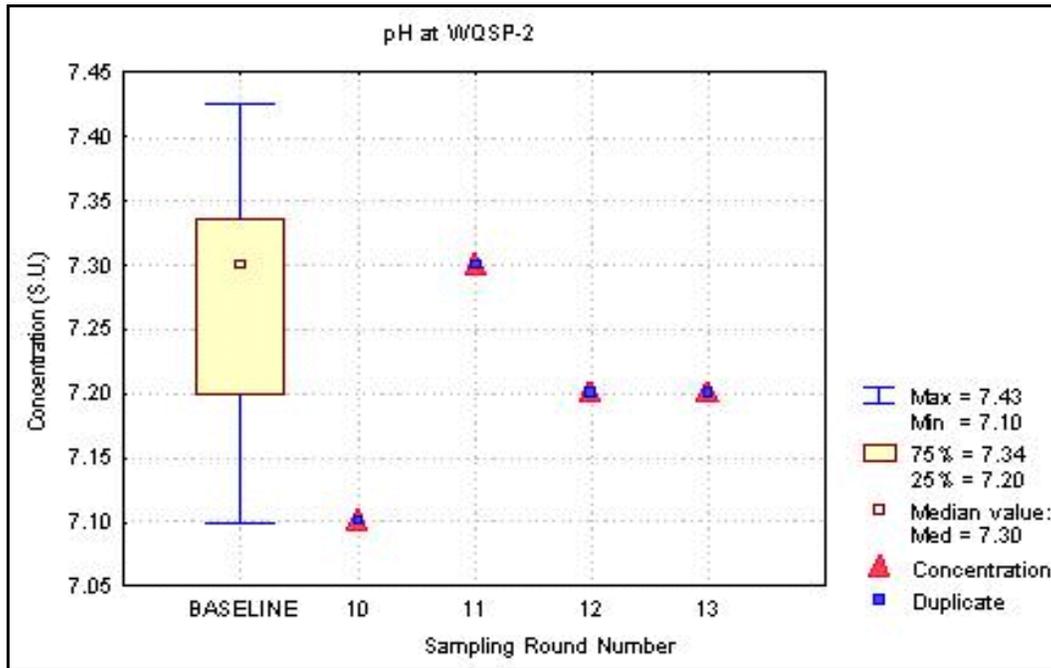


Figure F.28 - Time Trend Plot for pH at WQSP-2

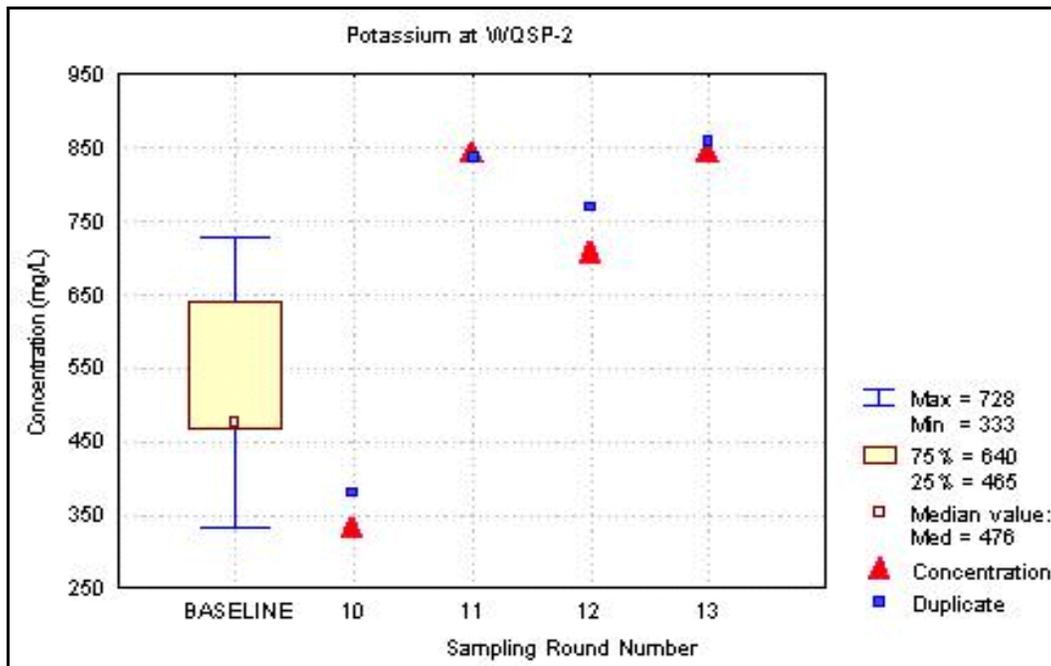


Figure F.29 - Time Trend Plot for Potassium at WQSP-2

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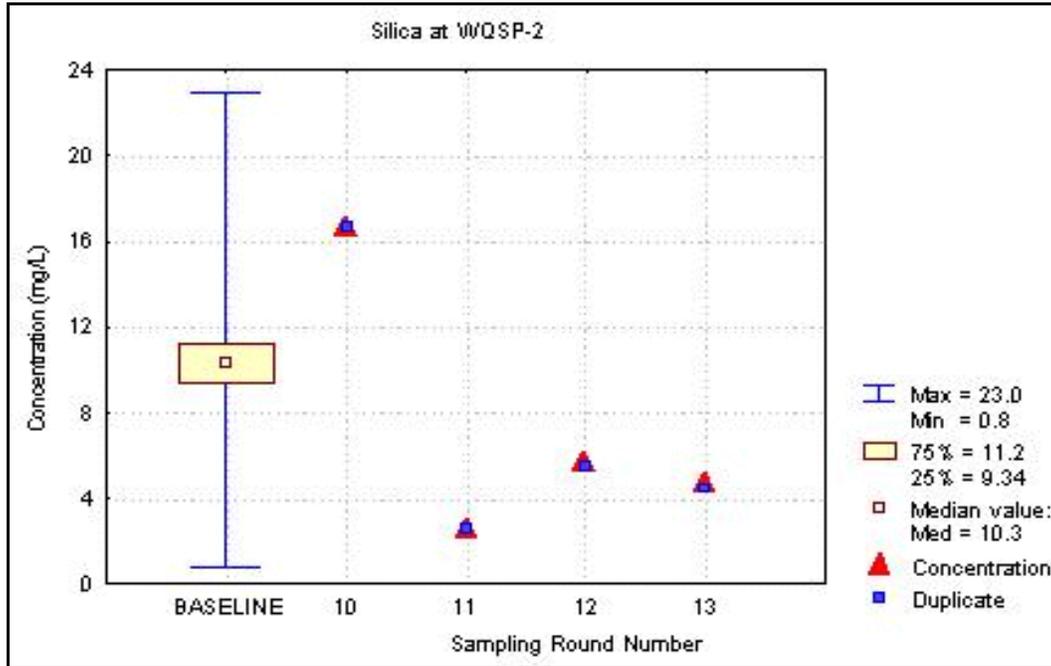


Figure F.30 - Time Trend Plot for Silica at WQSP-2

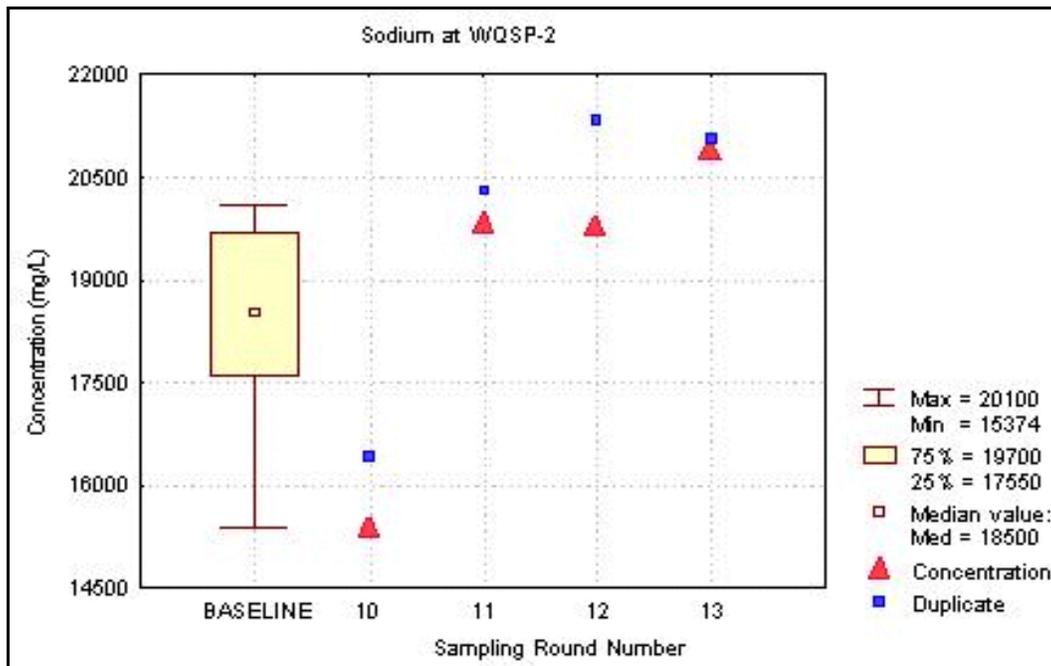


Figure F.31 - Time Trend Plot for Sodium at WQSP-2

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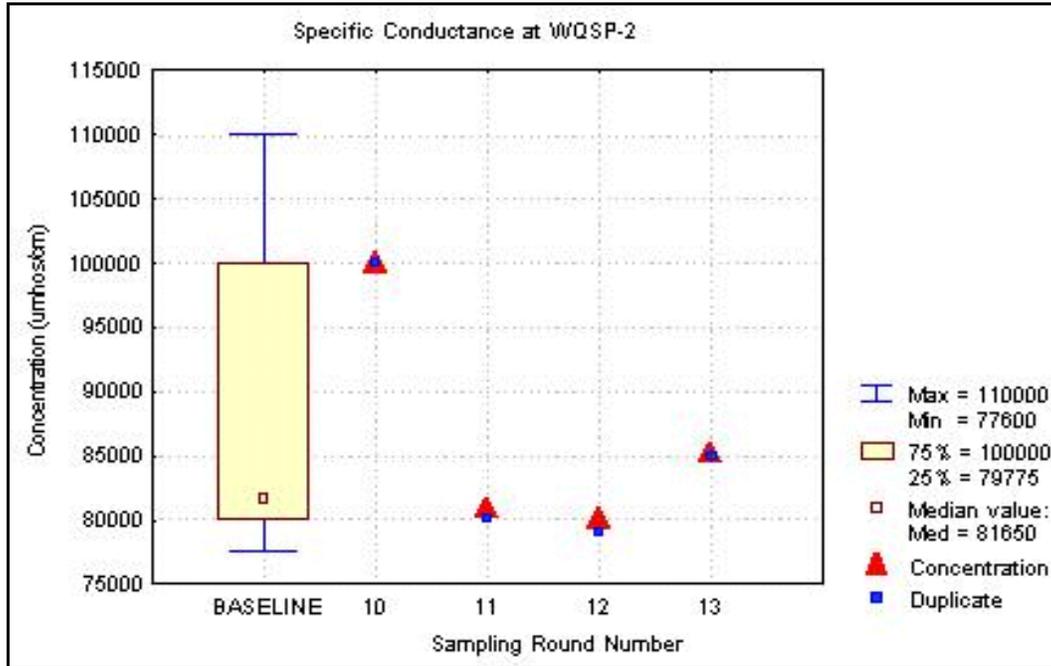


Figure F.32 - Time Trend Plot for Specific Conductance at WQSP-2

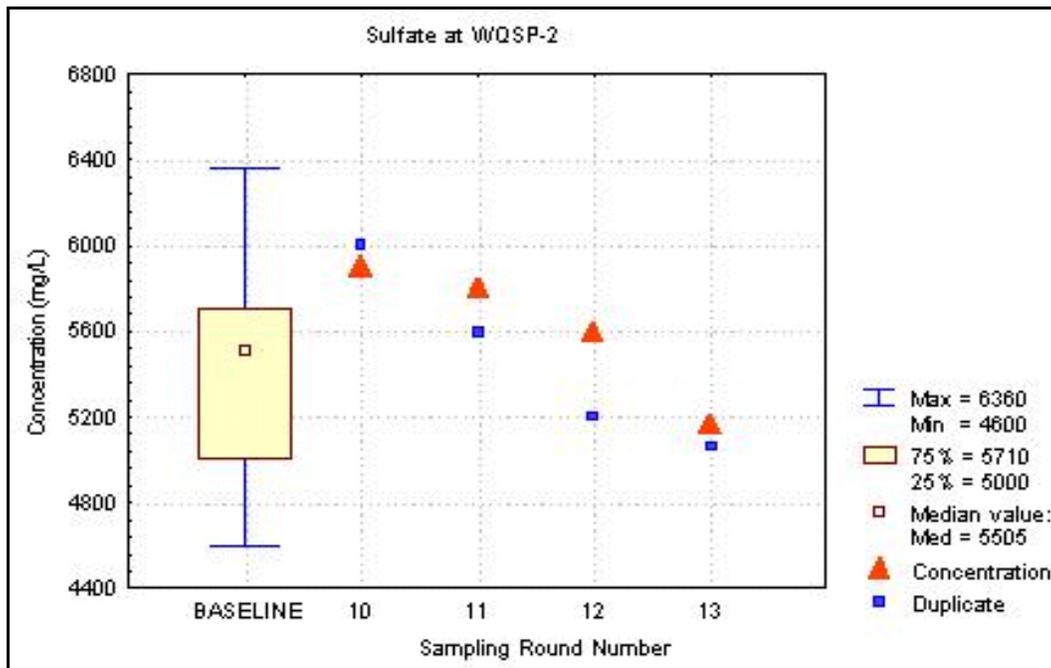


Figure F.33 - Time Trend Plot for Sulfate at WQSP-2

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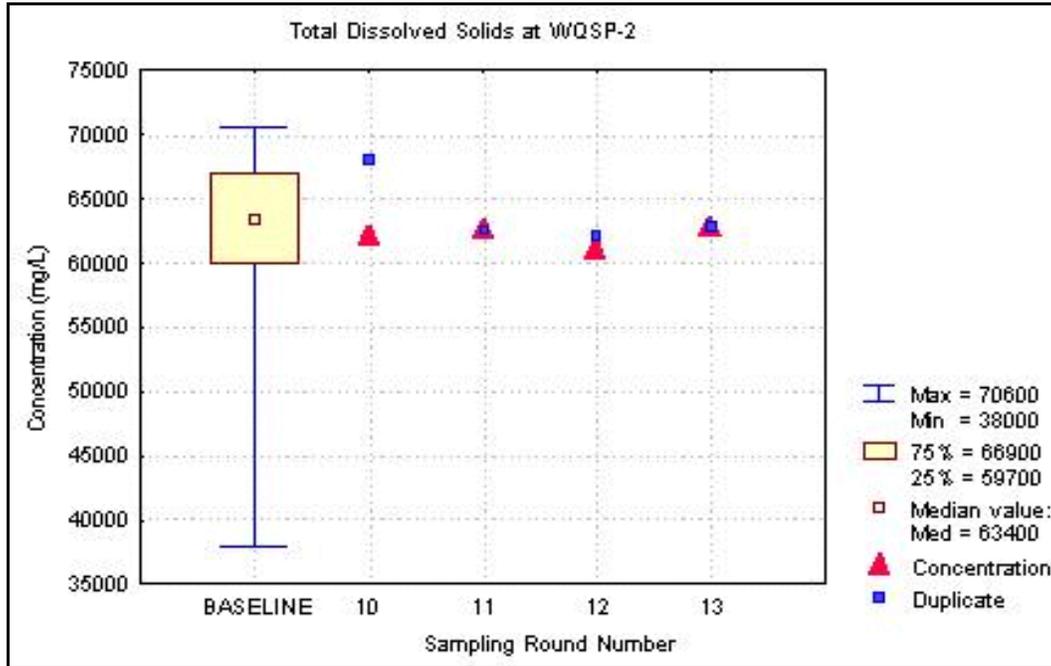


Figure F.34 - Time Trend Plot for Total Dissolved Solids at WQSP-2

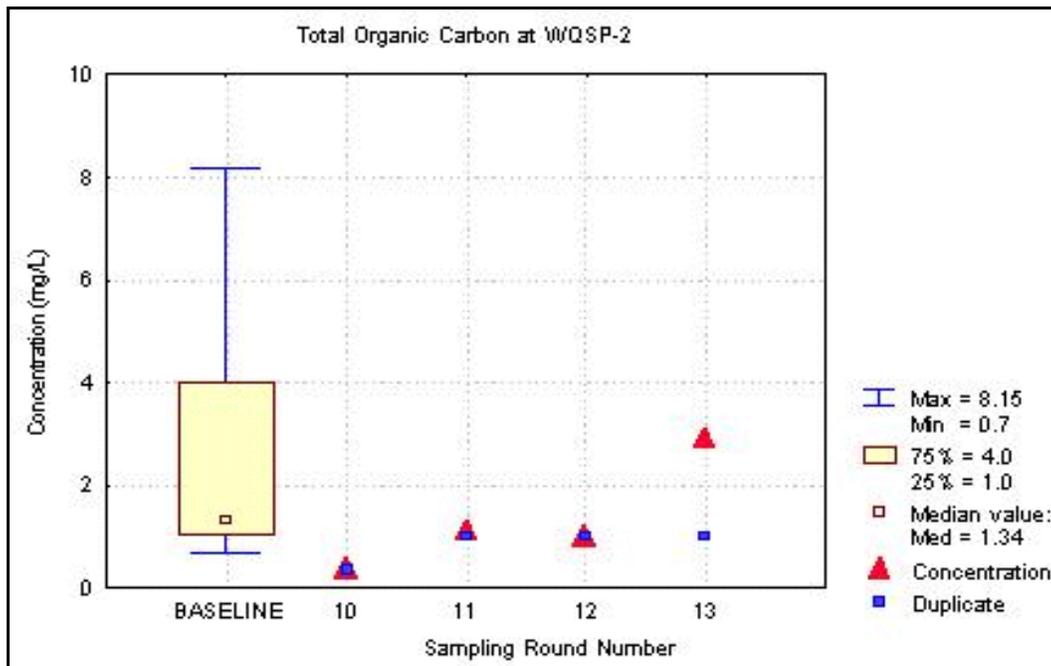


Figure F.35 - Time Trend Plot for Total Organic Carbon at WQSP-2

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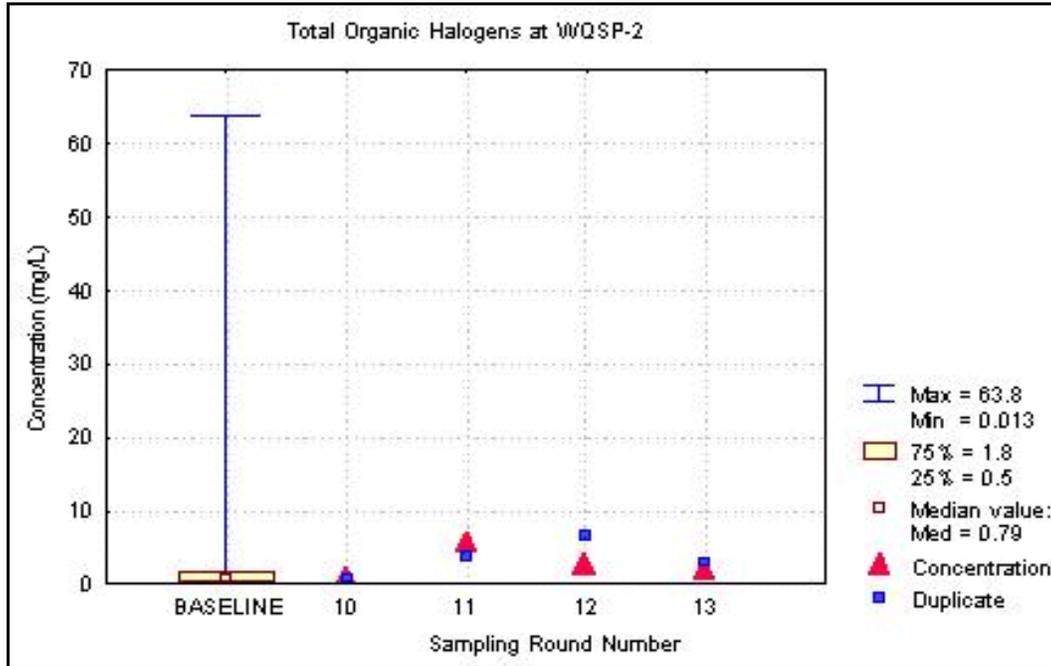


Figure F.36 - Time Trend Plot for Total Organic Halogens at WQSP-2

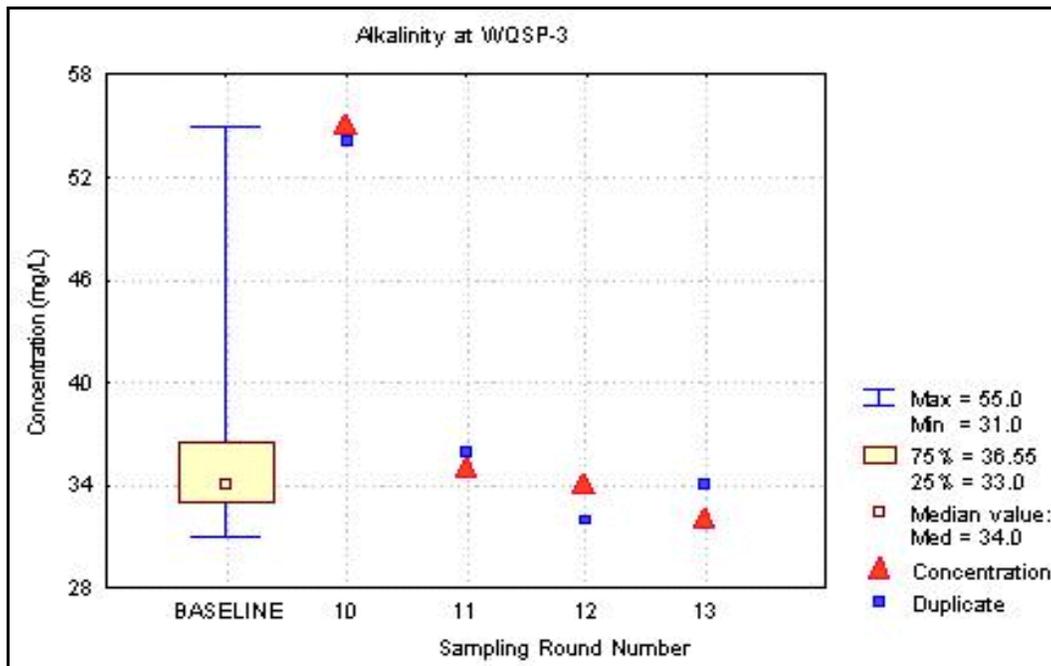


Figure F.37 - Time Trend Plot for Alkalinity at WQSP-2

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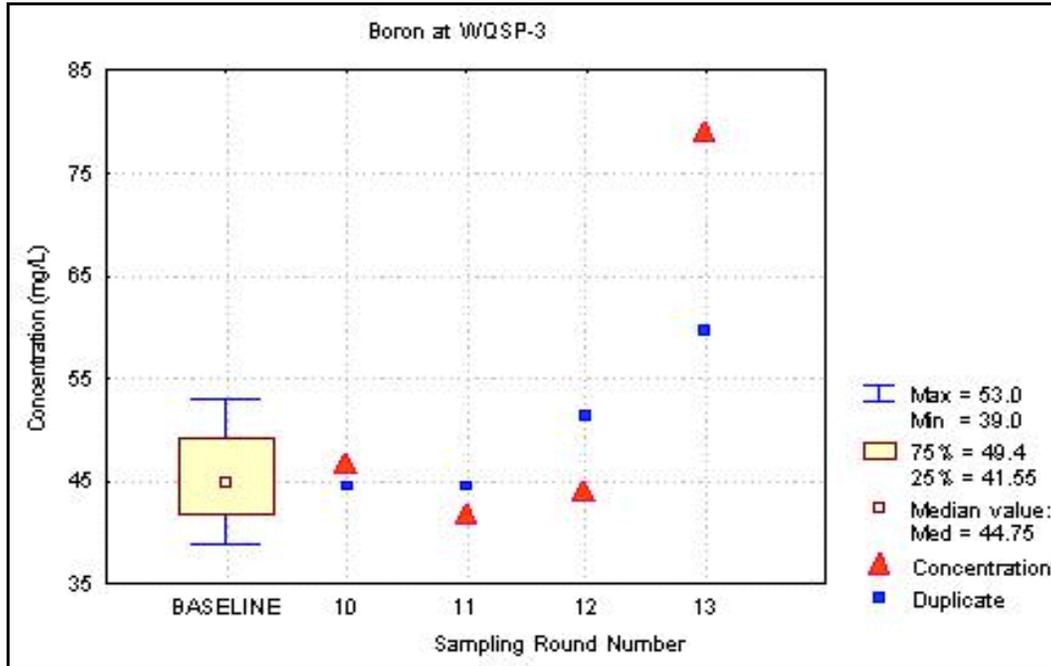


Figure F.38 - Time Trend Plot for Boron at WQSP-3

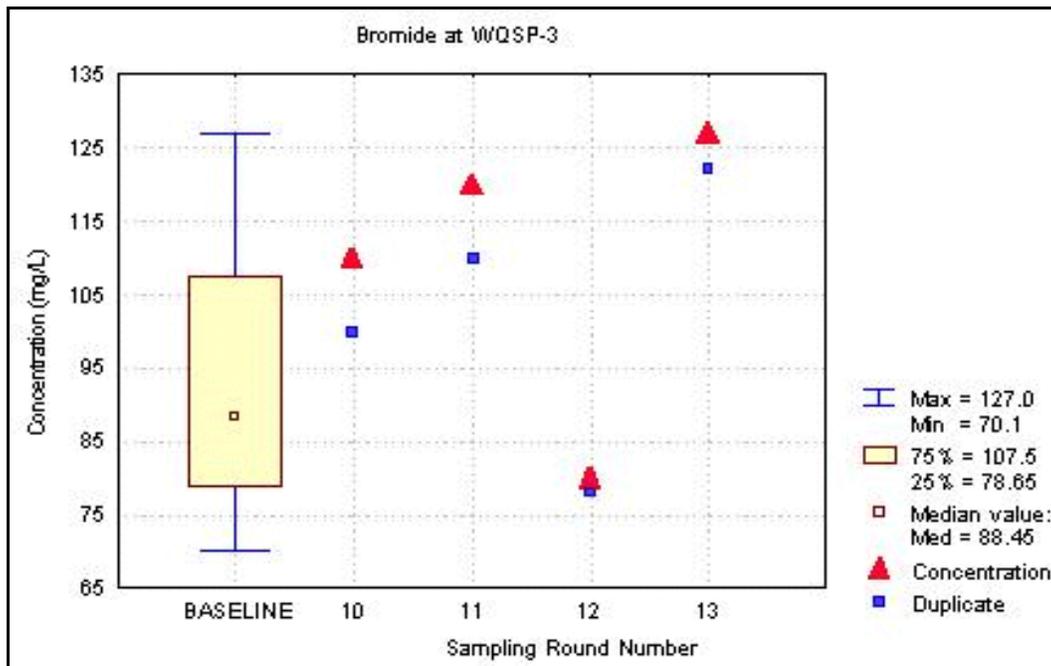


Figure F.39 - Time Trend Plot for Bromide at WQSP-3

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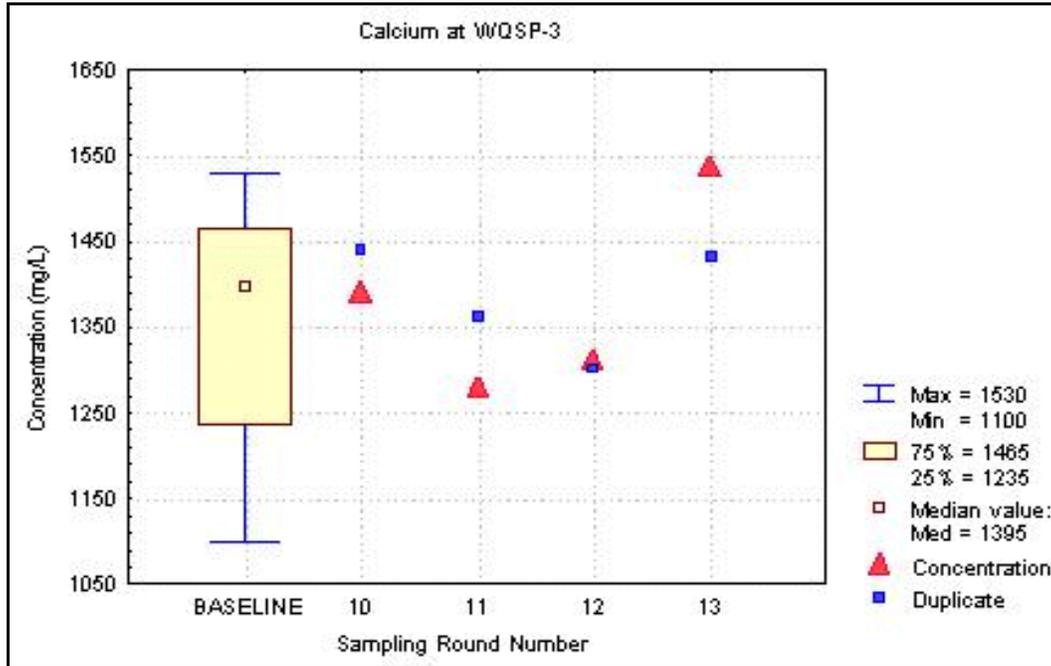


Figure F.40 - Time Trend Plot for Calcium at WQSP-3

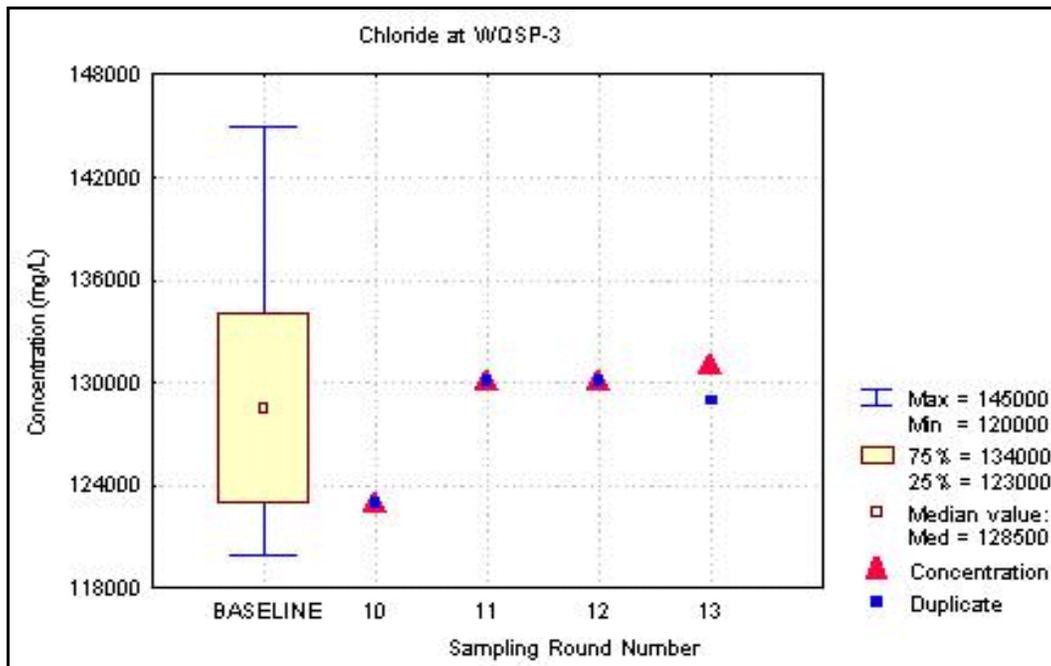


Figure F.41 - Time Trend Plot for Chloride at WQSP-3

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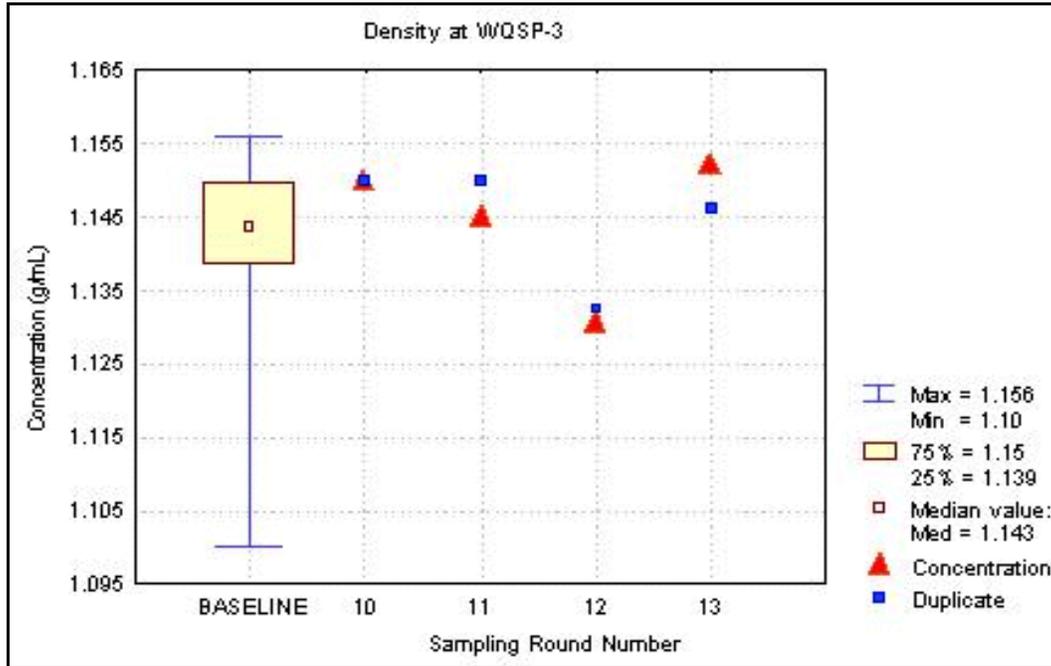


Figure F.42 - Time Trend Plot for Density at WQSP-3

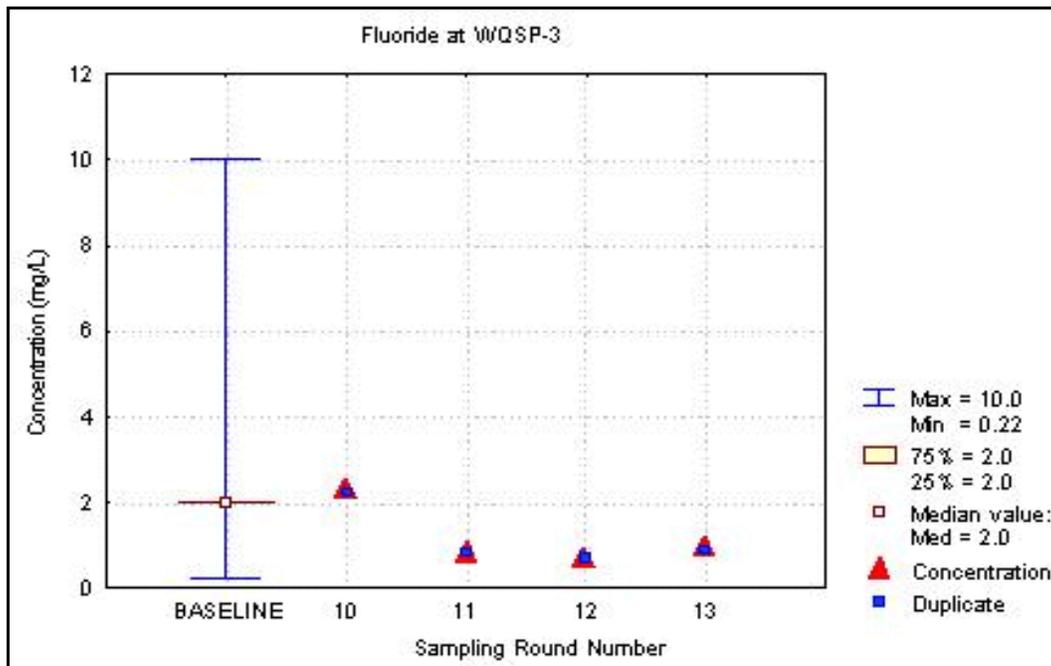


Figure F.43 - Time Trend Plot for Fluoride at WQSP-3

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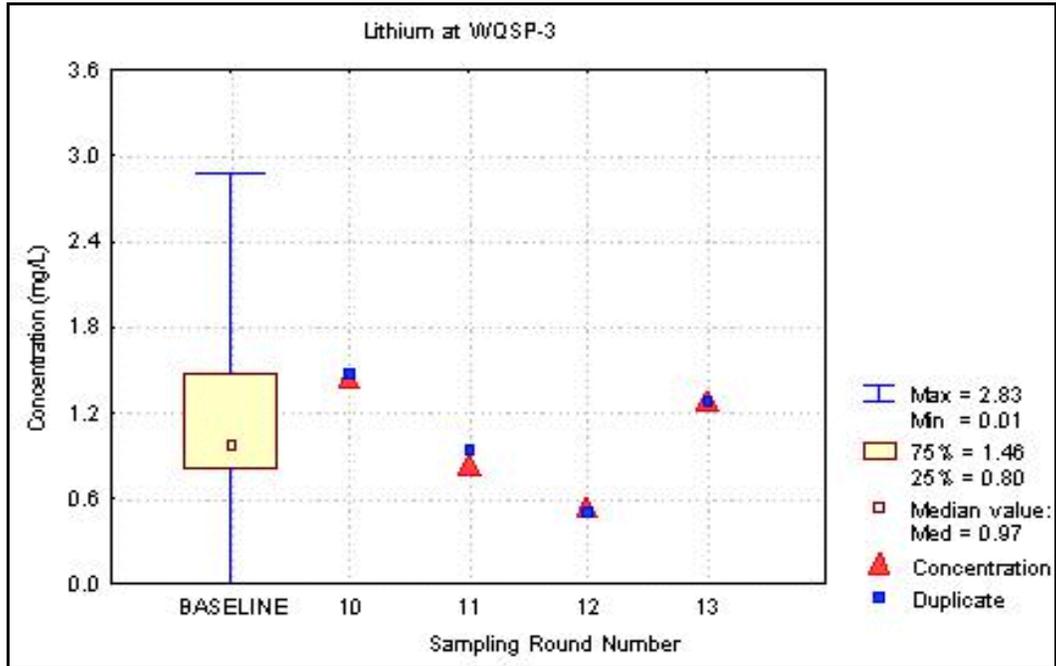


Figure F.44 - Time Trend Plot for Lithium at WQSP-3

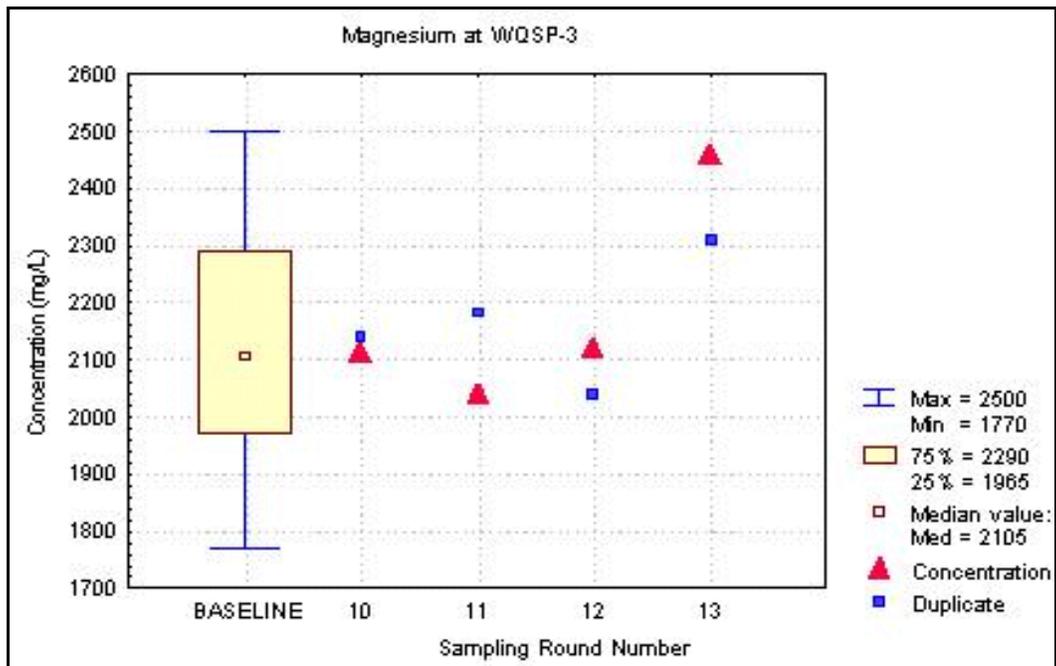


Figure F.45 - Time Trend Plot for Magnesium at WQSP-3

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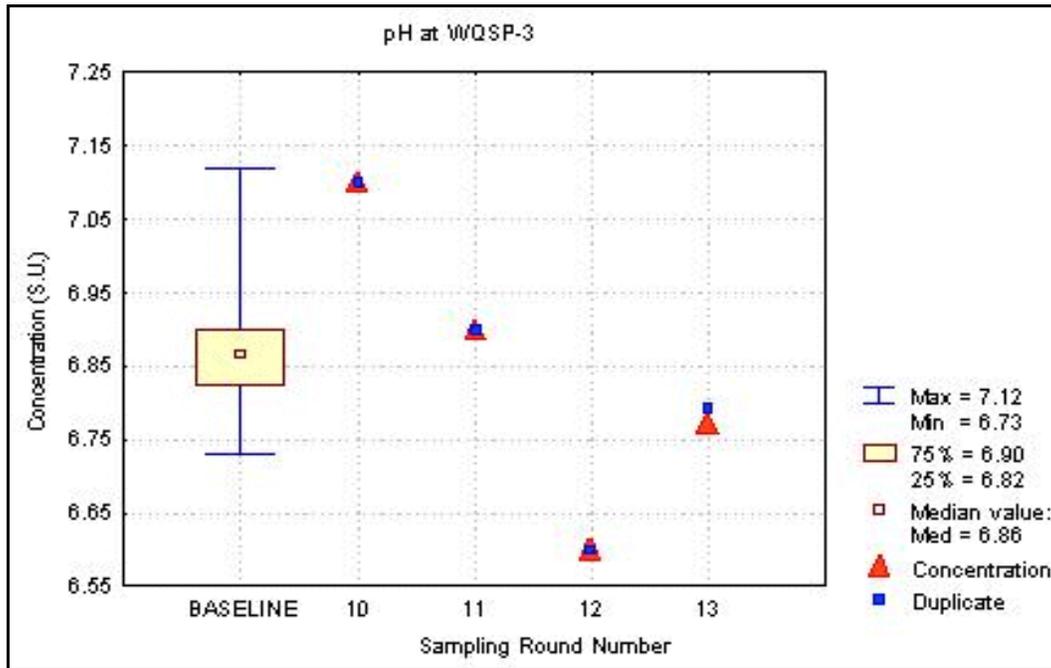


Figure F.46 - Time Trend Plot for pH at WQSP-3

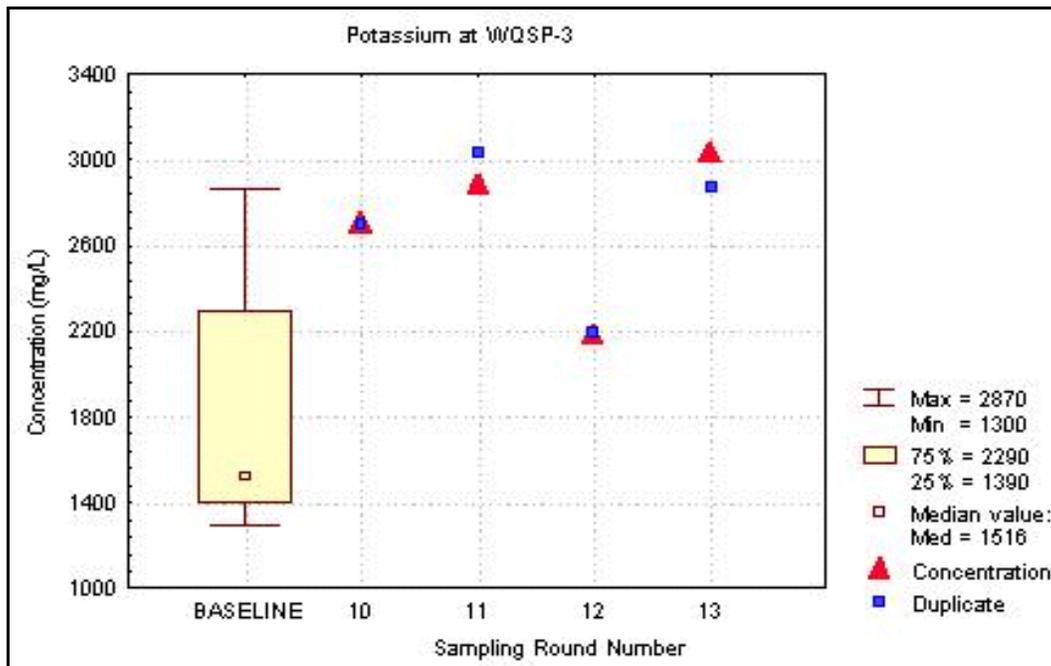


Figure F.47 - Time Trend Plot for Potassium at WQSP-3

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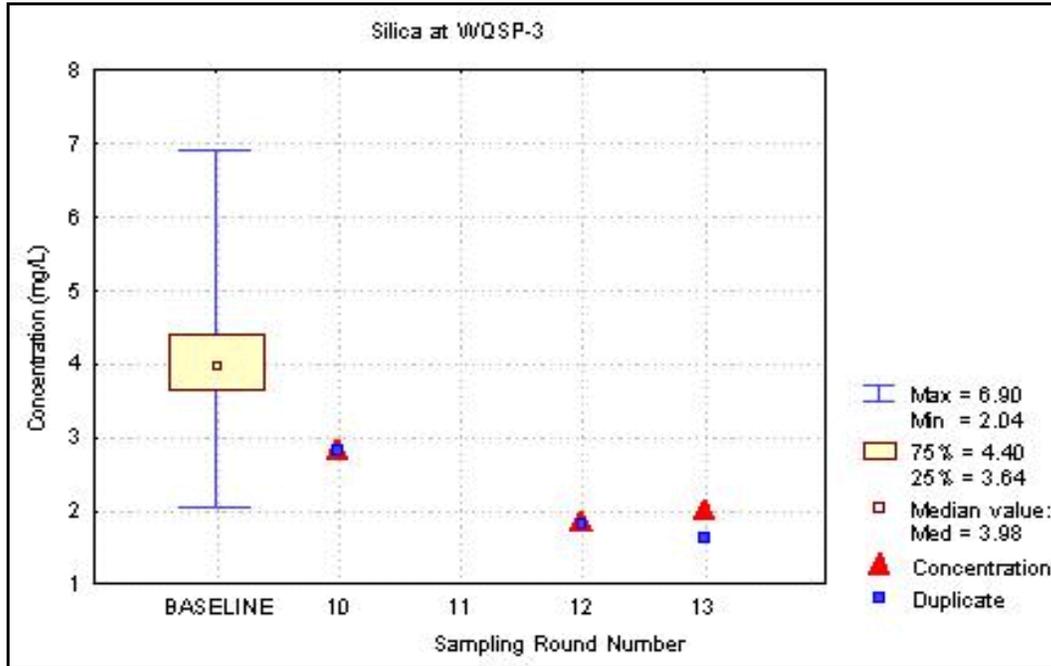


Figure F.48 - Time Trend Plot for Silica at WQSP-3

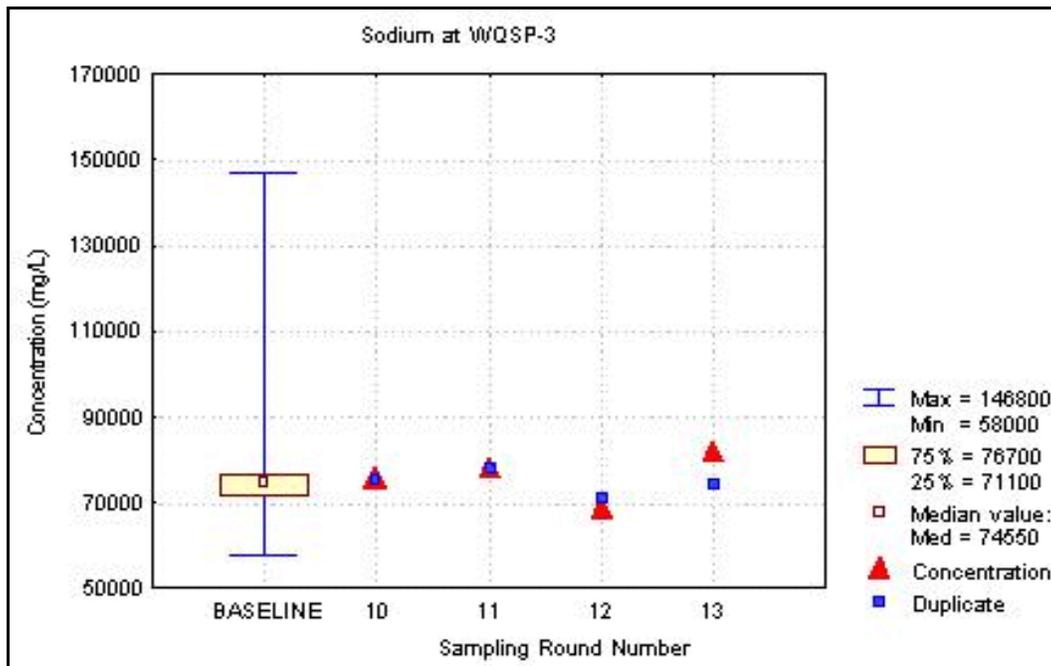


Figure F.49 - Time Trend Plot for Sodium at WQSP-3

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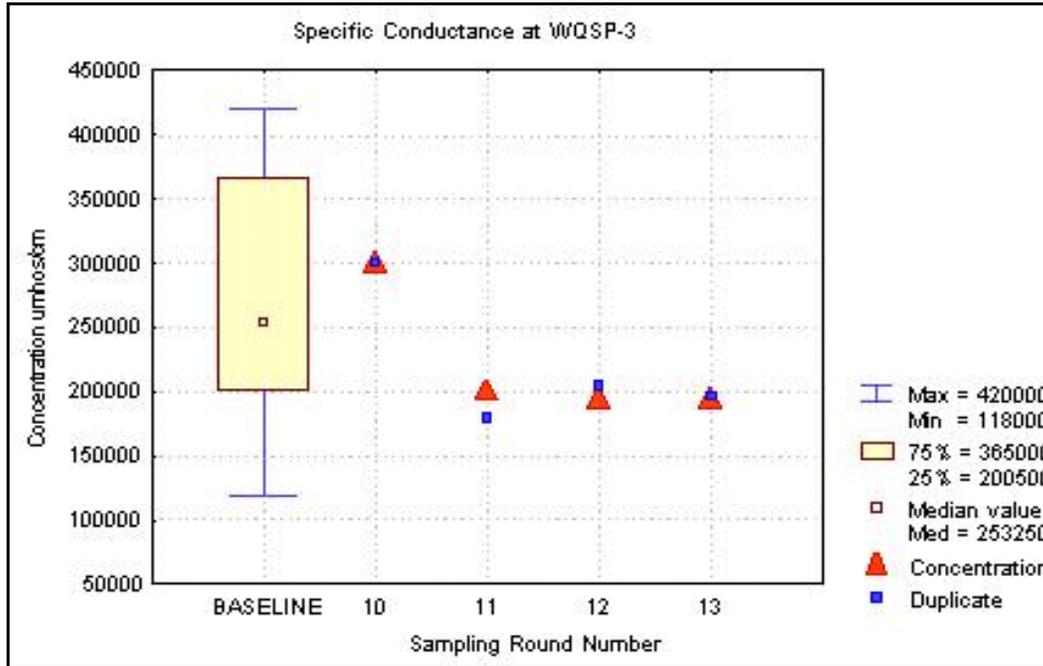


Figure F.50 - Time Trend Plot for Specific Conductance at WQSP-3

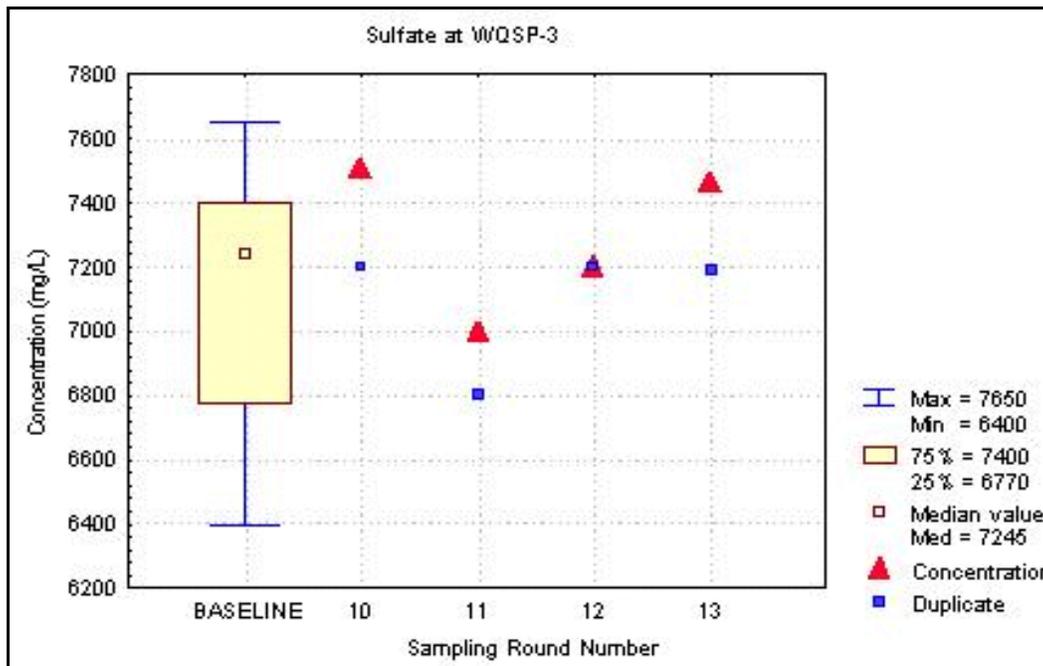


Figure F.51 - Time Trend Plot for Sulfate at WQSP-3

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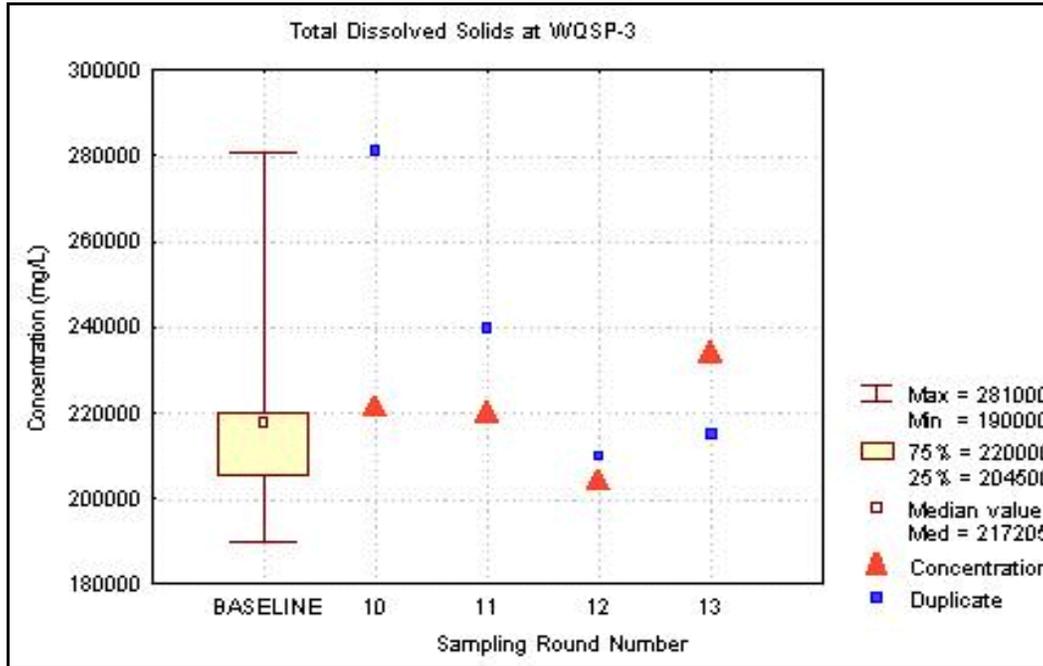


Figure F.52 - Time Trend Plot for Total Dissolved Solids at WQSP-3

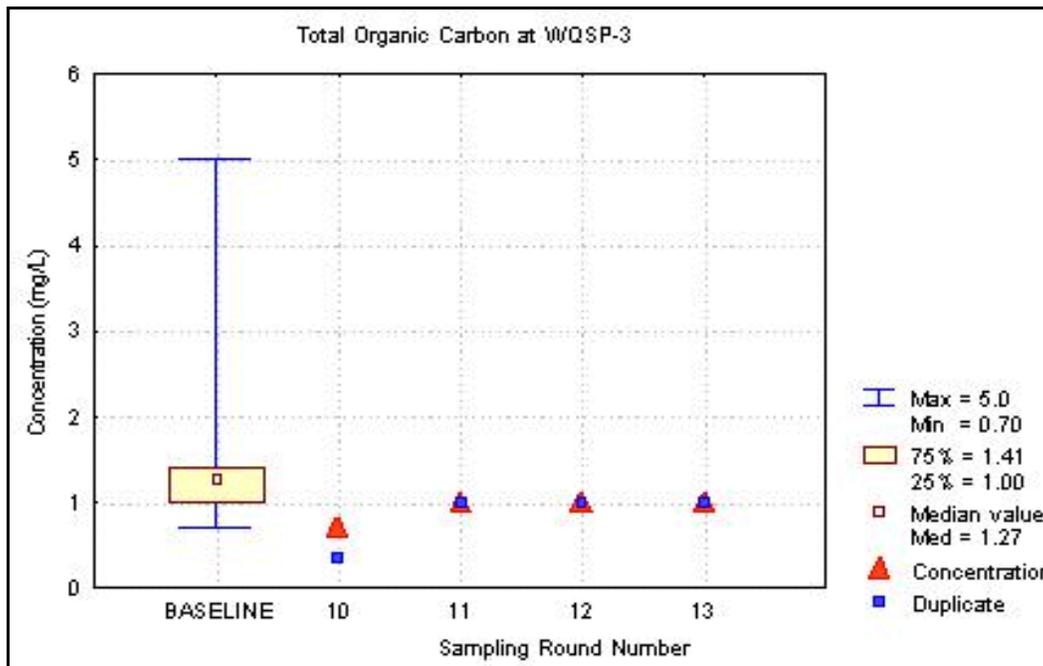


Figure F.53 - Time Trend Plot for Total Organic Carbon at WQSP-3

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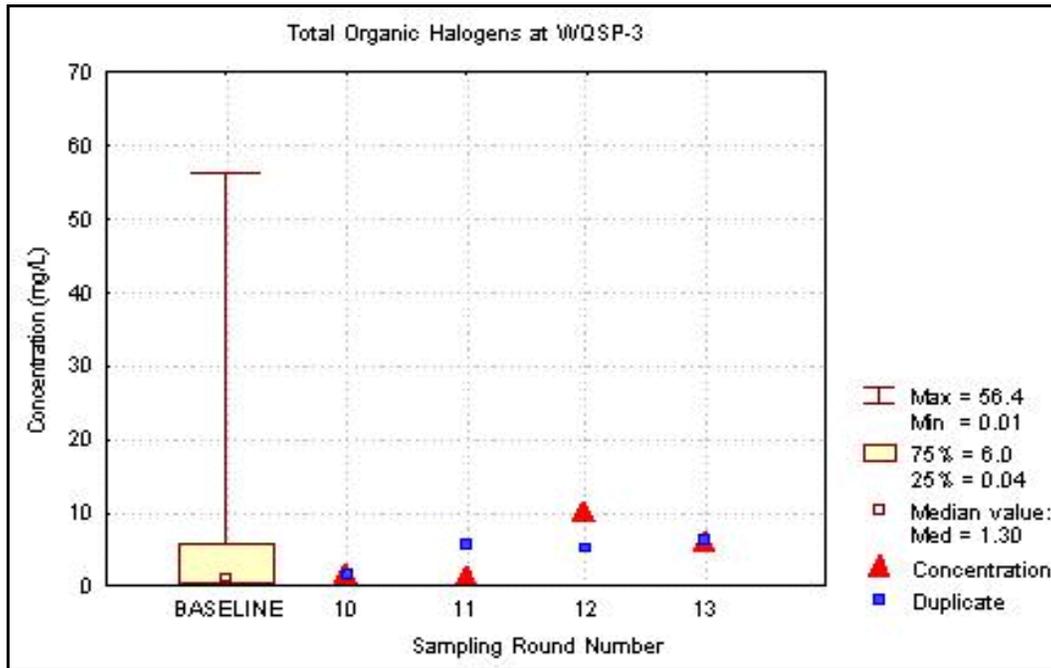


Figure F.54 - Time Trend Plot for Total Organic Halogens at WQSP-3

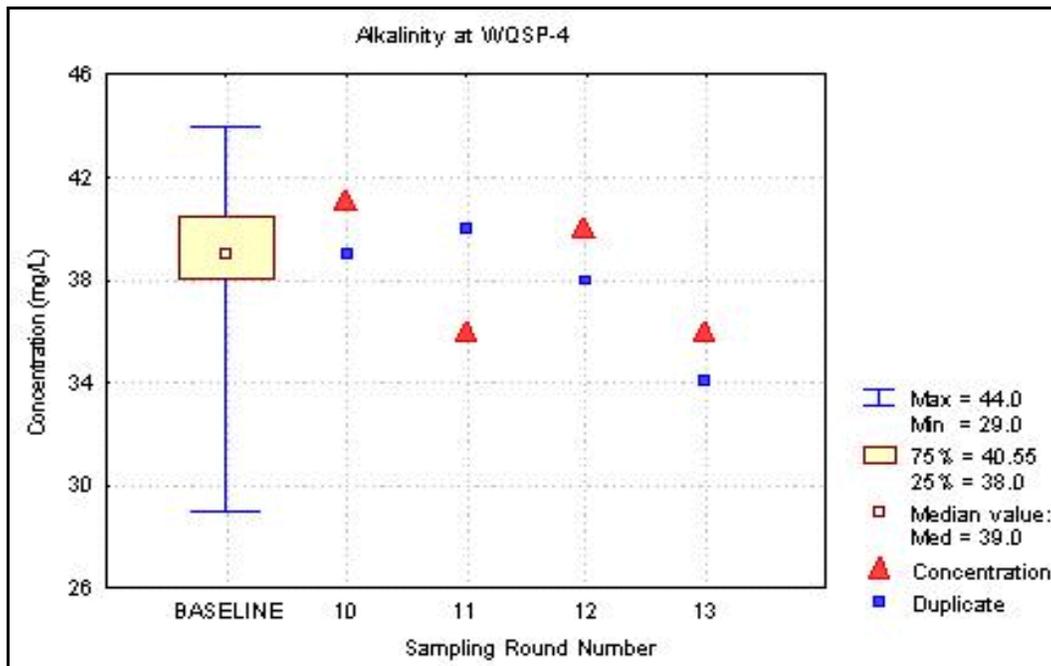


Figure F.55 - Time Trend Plot for Alkalinity at WQSP-4

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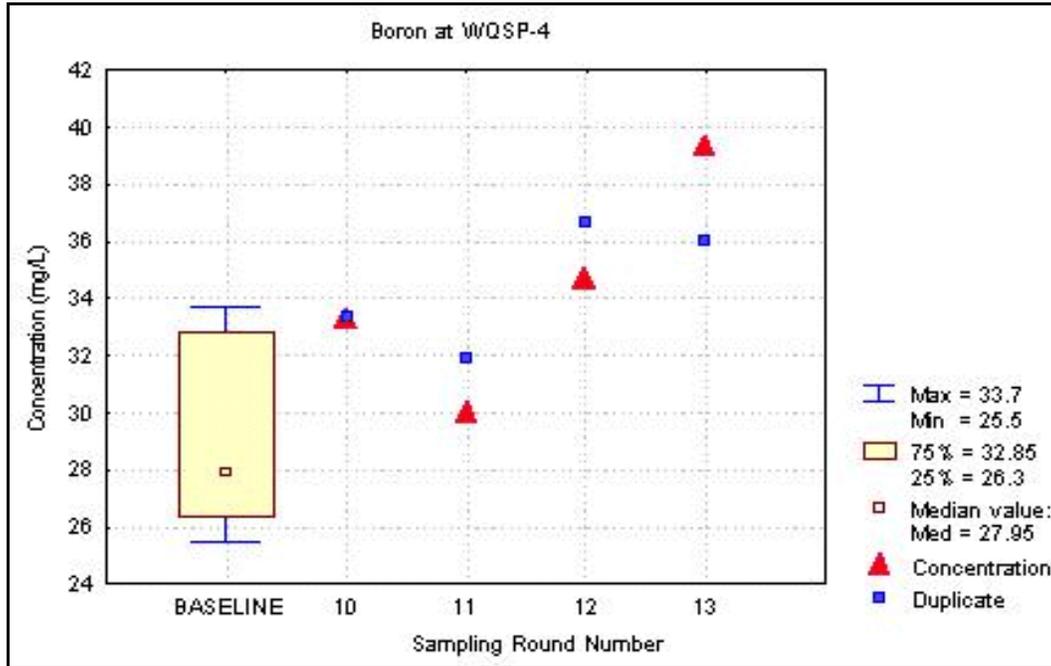


Figure F.56 - Time Trend Plot for Boron at WQSP-4

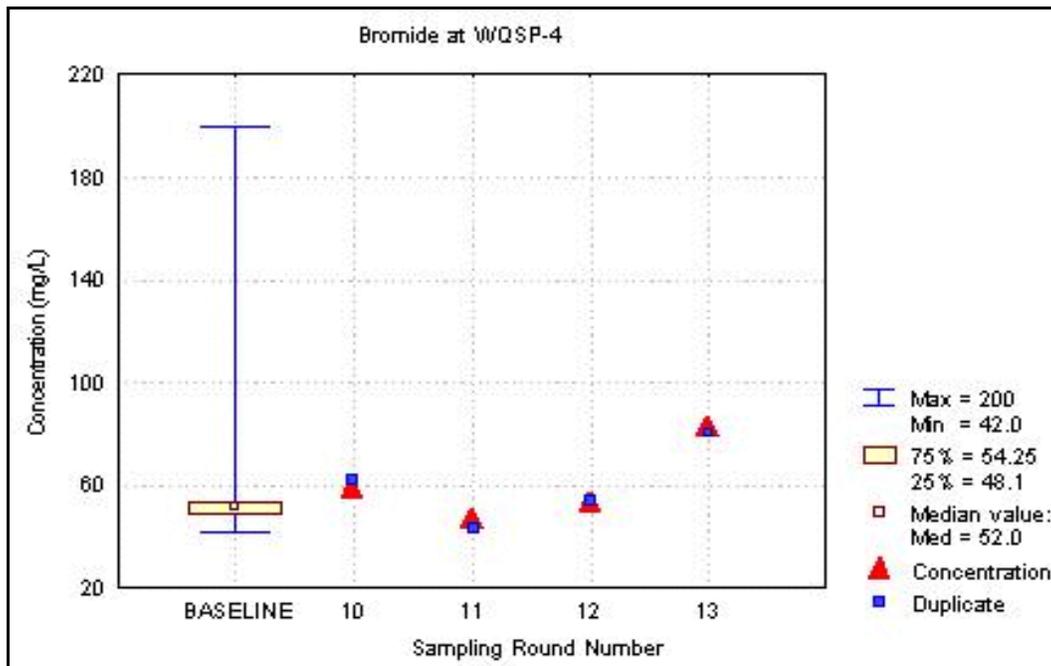


Figure F.57 - Time Trend Plot for Bromide at WQSP-4

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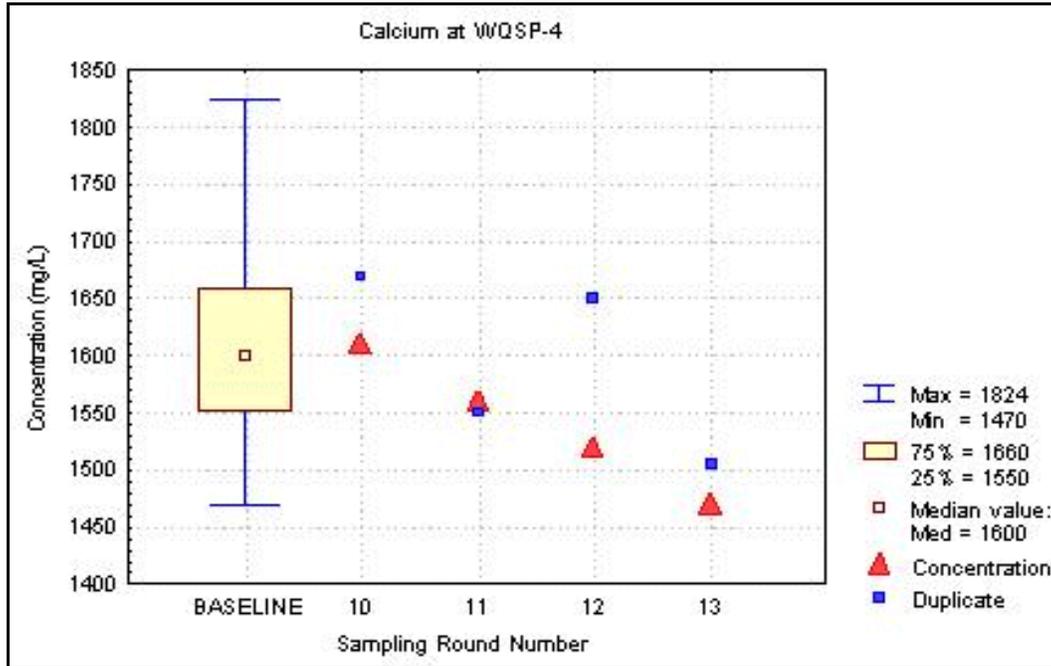


Figure F.58 - Time Trend Plot for Calcium at WQSP-4

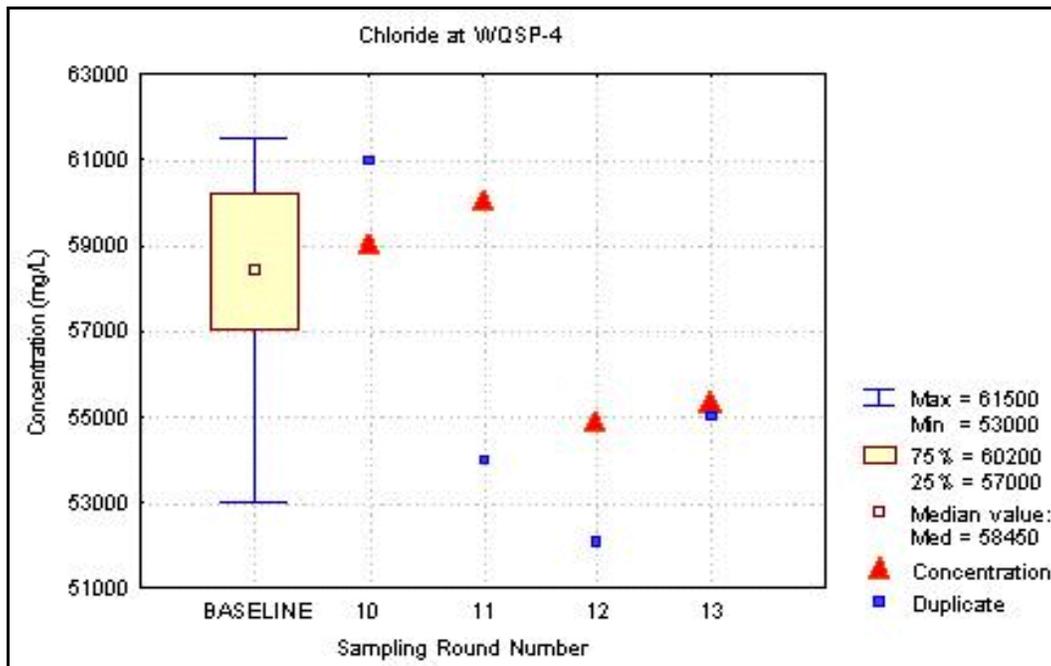


Figure F.59 - Time Trend Plot for Chloride at WQSP-4

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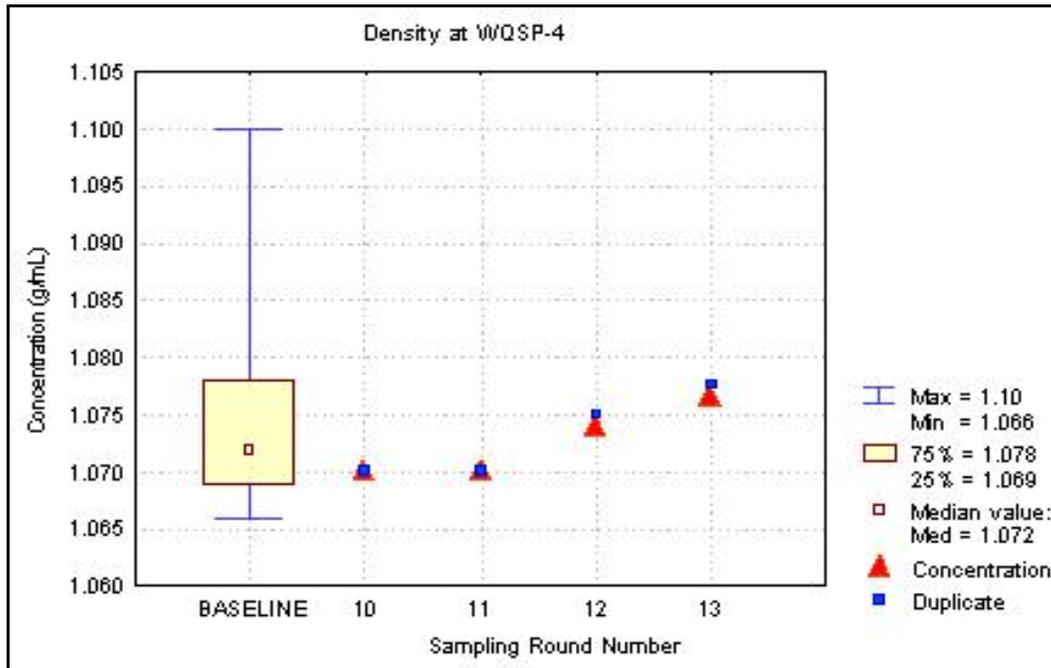


Figure F.60 - Time Trend Plot for Density at WQSP-4

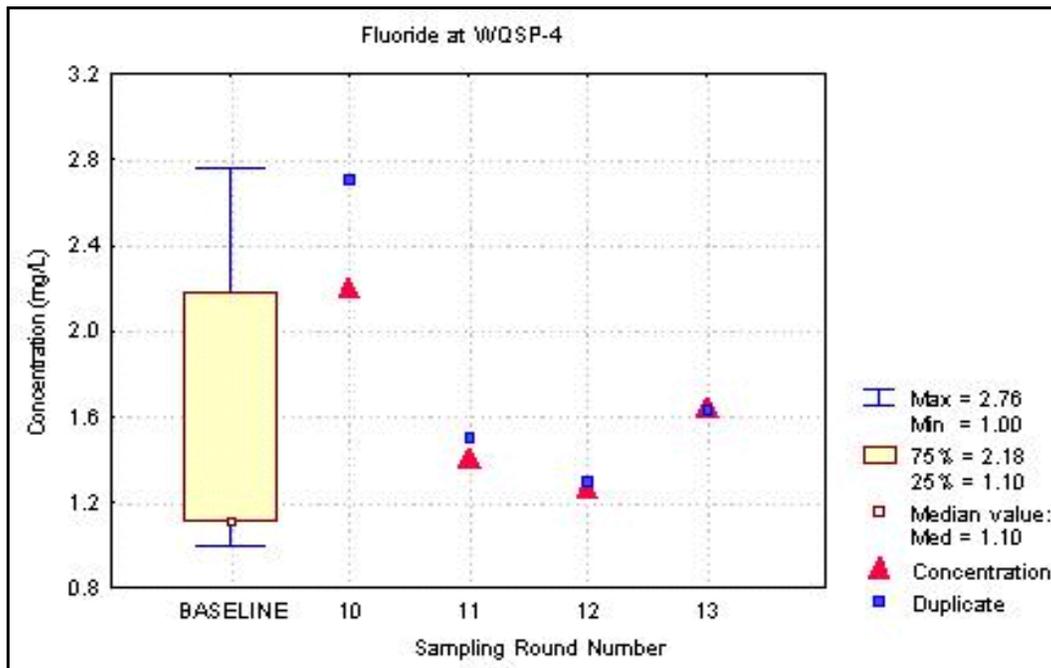


Figure F.61 - Time Trend Plot for Fluoride at WQSP-4

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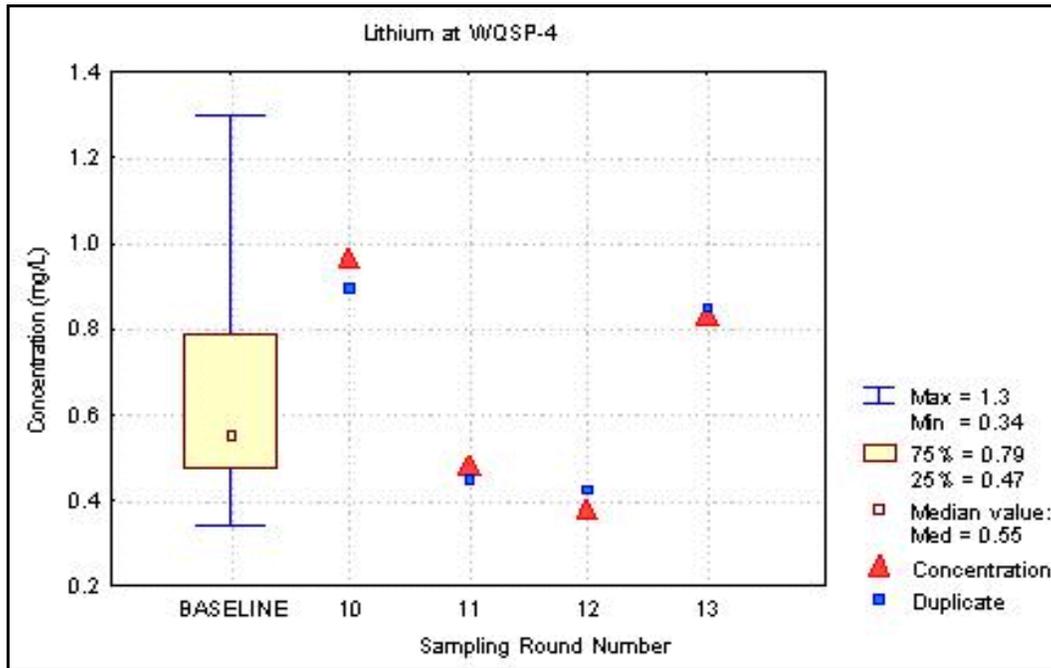


Figure F.62 - Time Trend Plot for Lithium at WQSP-4

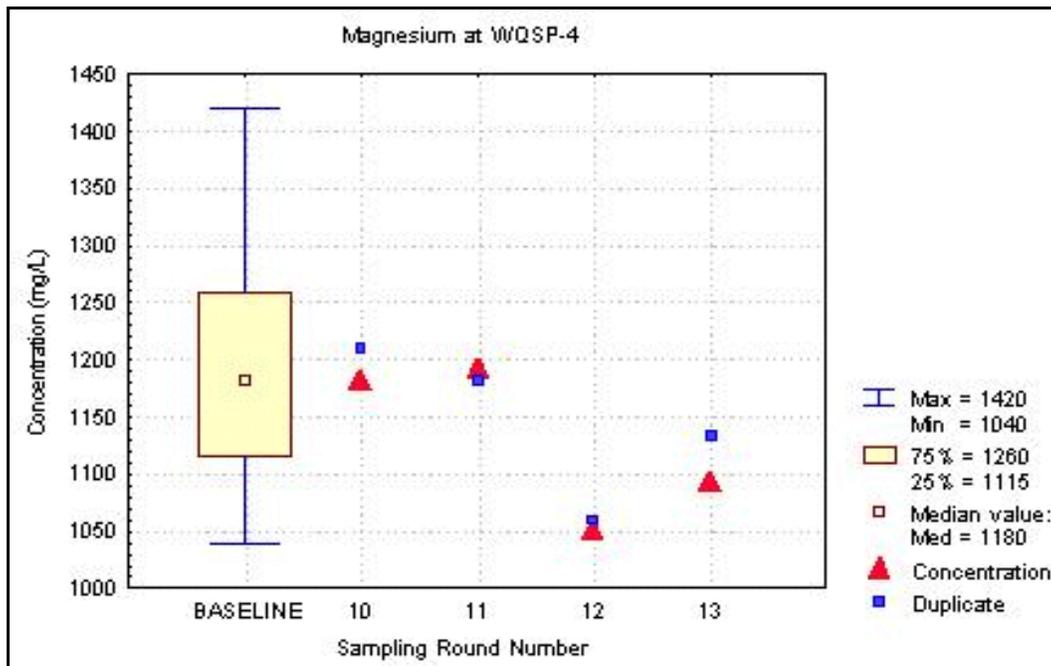


Figure F.63 - Time Trend Plot for Magnesium at WQSP-4

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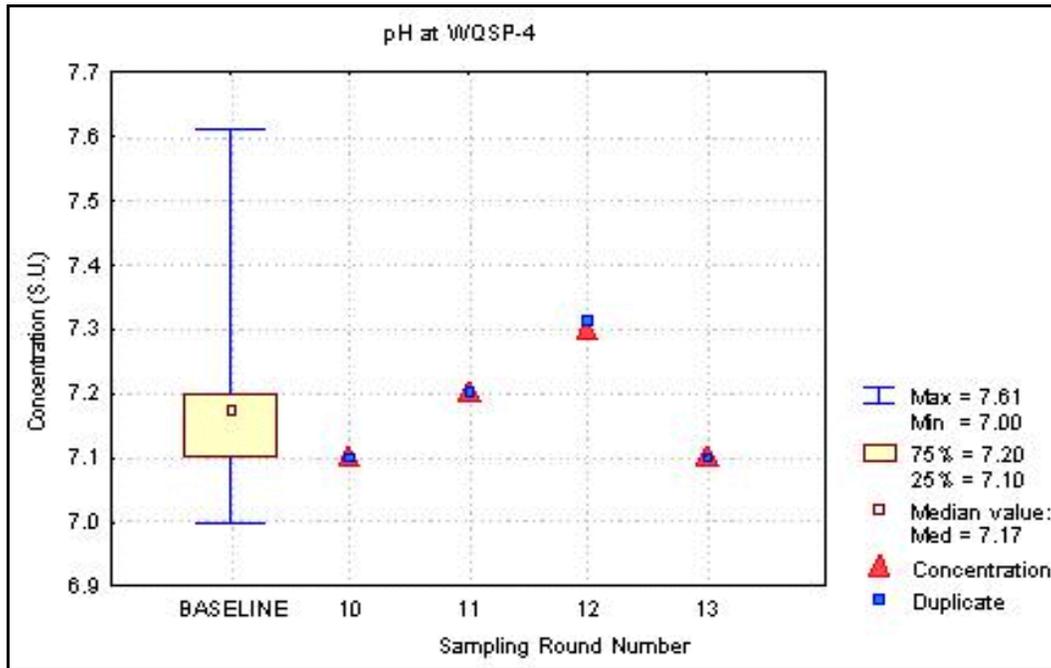


Figure F.64 - Time Trend Plot for pH at WQSP-4

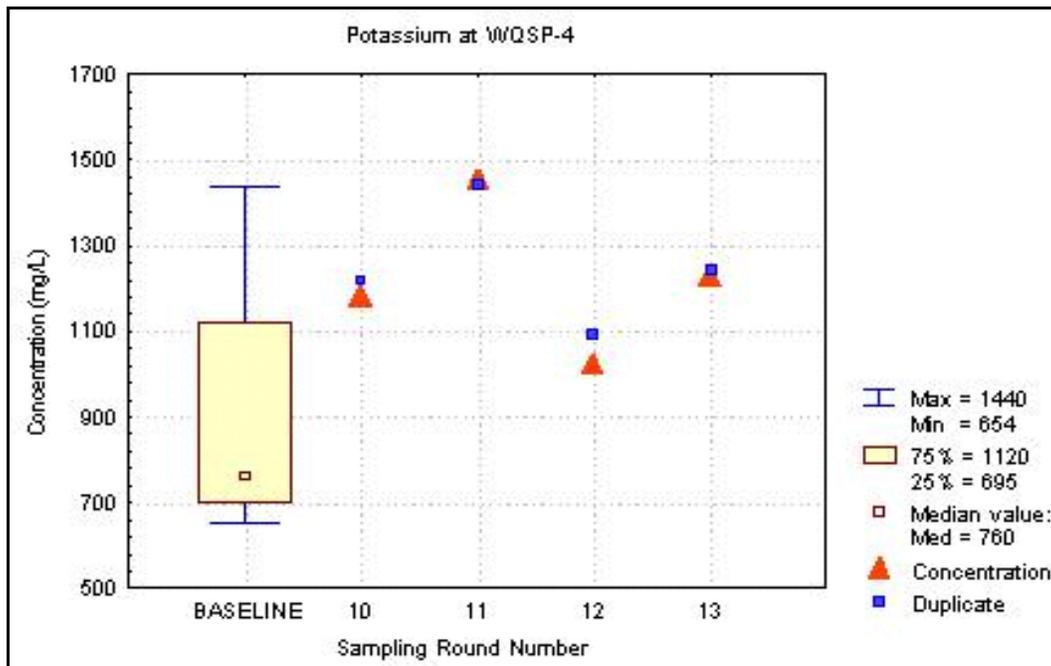


Figure F.65 - Time Trend Plot for Potassium at WQSP-4

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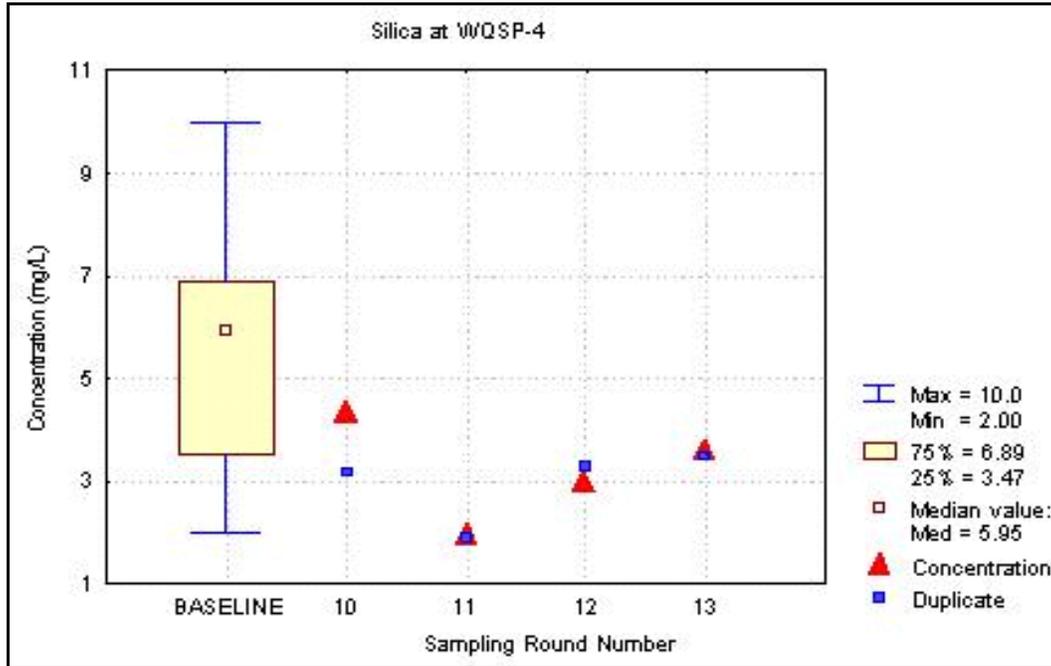


Figure F.66 - Time Trend Plot for Silica at WQSP-4

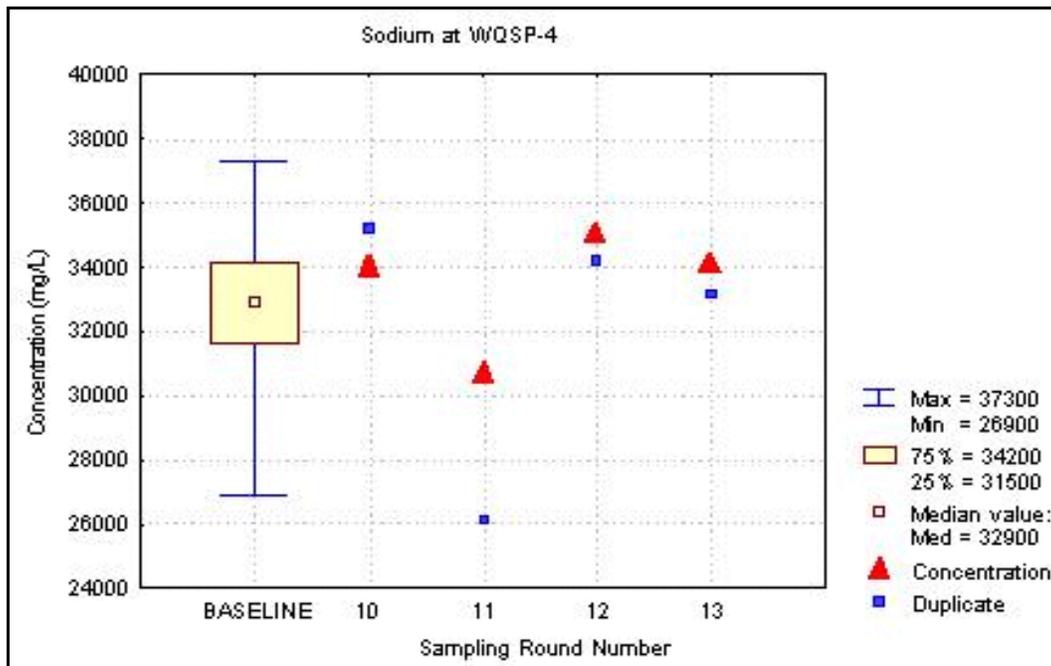


Figure F.67 - Time Trend Plot for Sodium at WQSP-4

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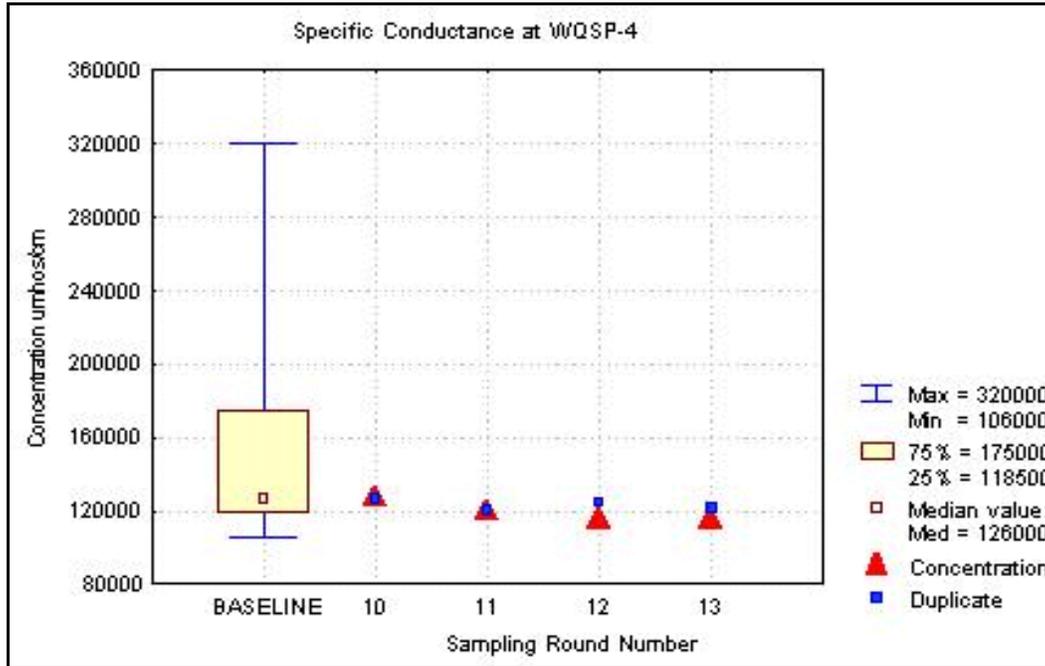


Figure F.68 - Time Trend Plot for Specific Conductance at WQSP-4

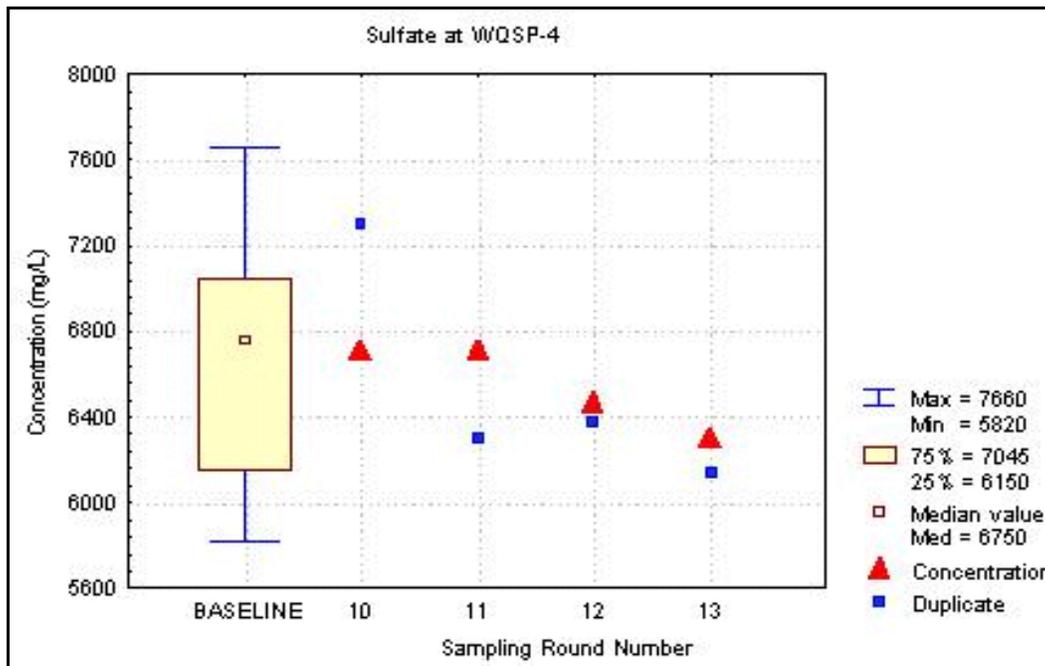


Figure F.69 - Time Trend Plot for Sulfate at WQSP-4

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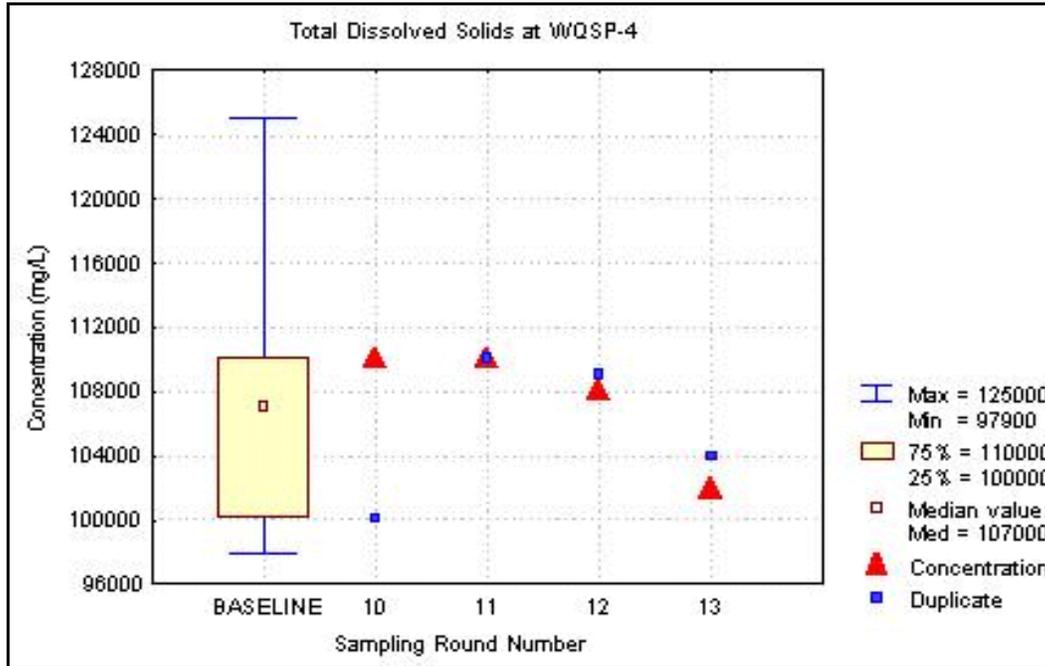


Figure F.70 - Time Trend Plot for Total Dissolved Solids at WQSP-4

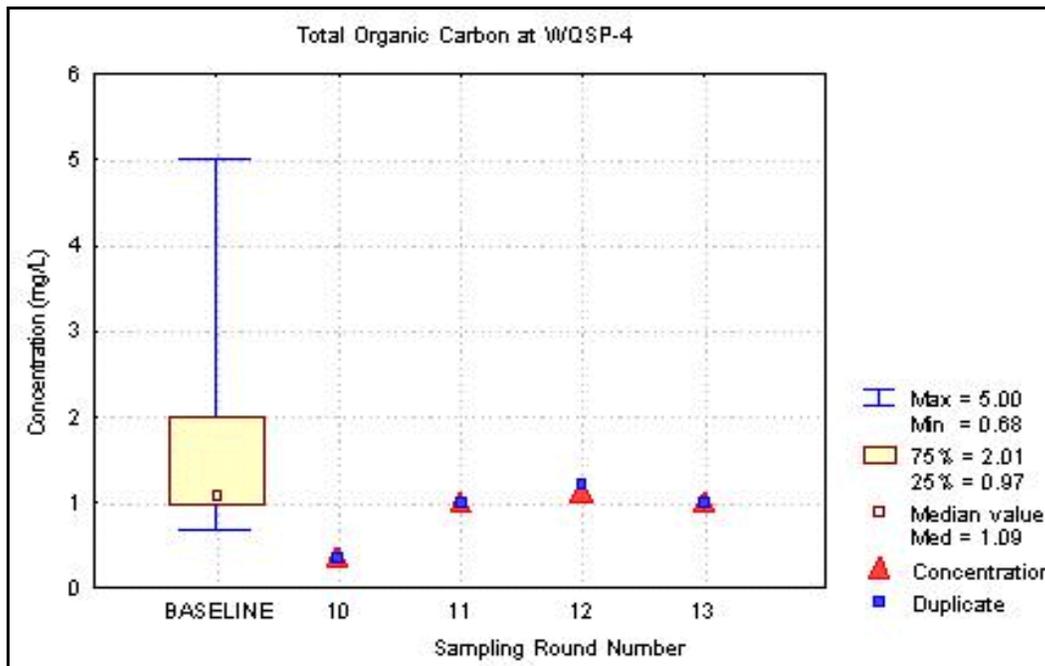


Figure F.71 - Time Trend Plot for Total Organic Carbon at WQSP-4

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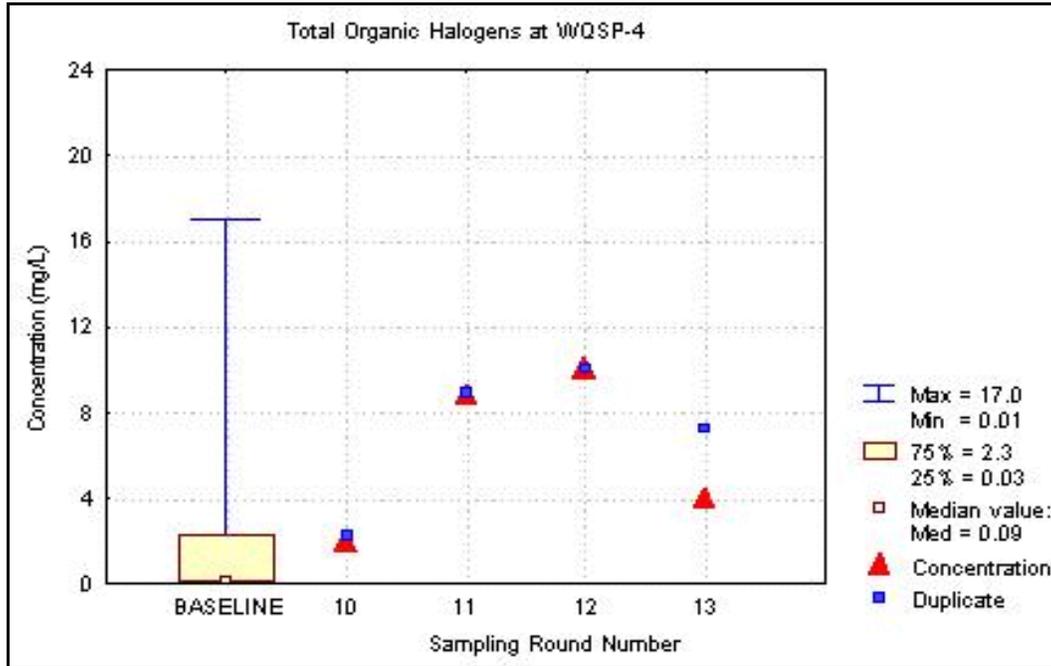


Figure F.72 - Time Trend Plot for Total Organic Halogens at WQSP-4

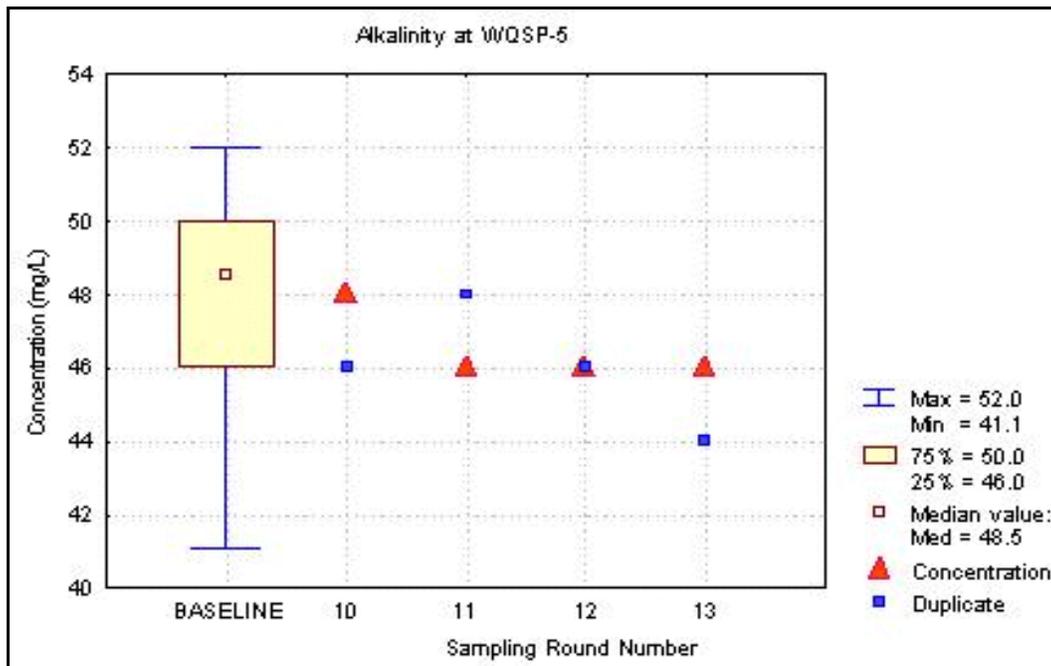


Figure F.73 - Alkalinity at WQSP-5

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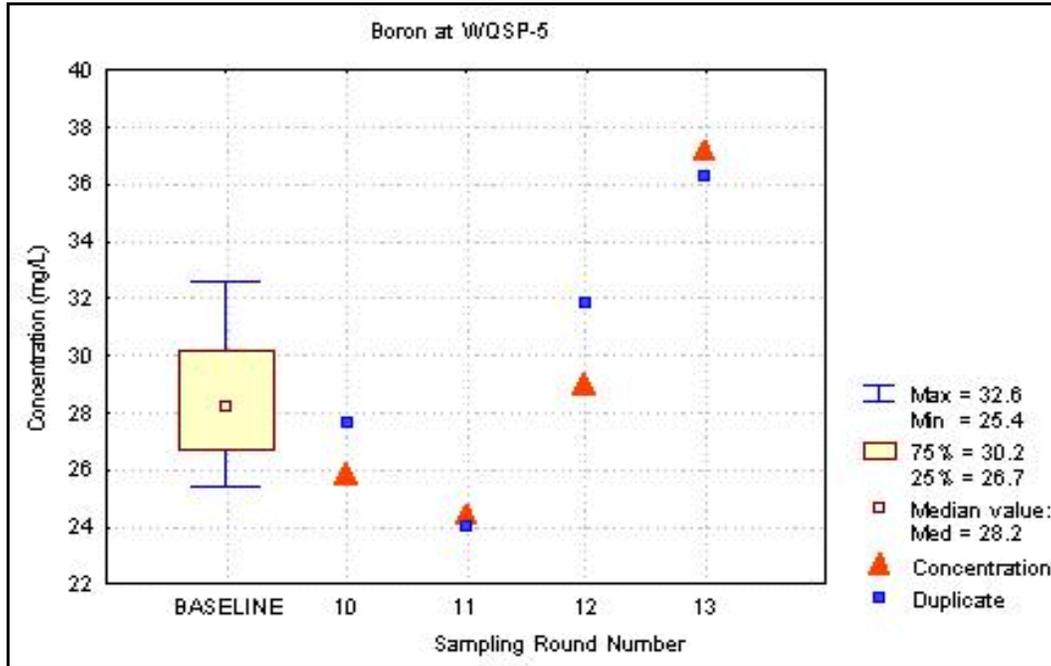


Figure F.74 - Time Trend Plot for Boron at WQSP-5

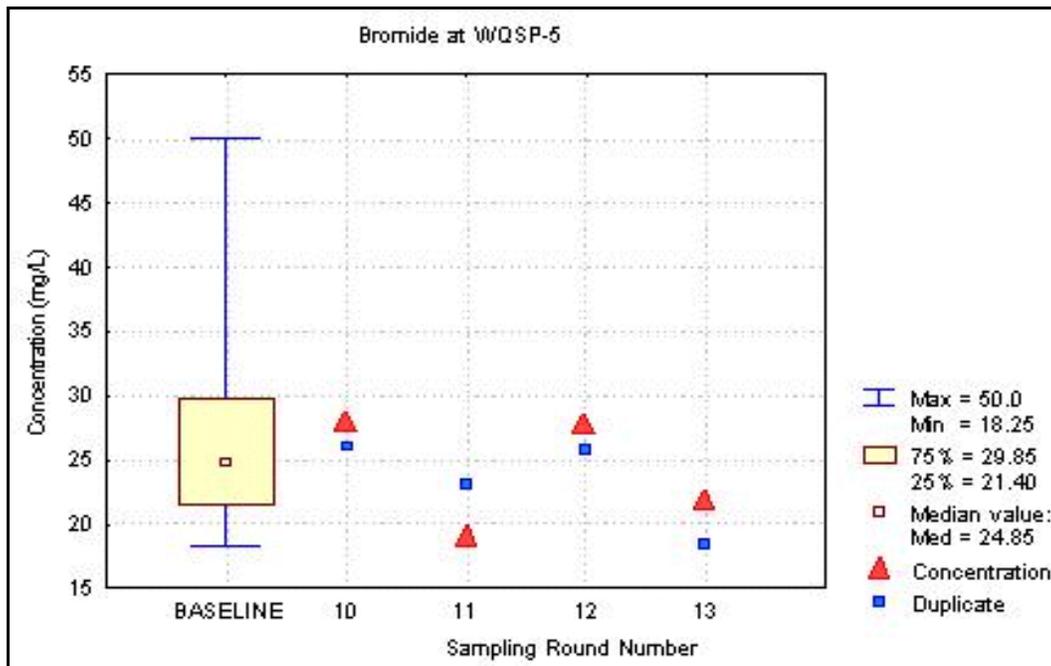


Figure F.75 - Time Trend Plot for Bromide at WQSP-5

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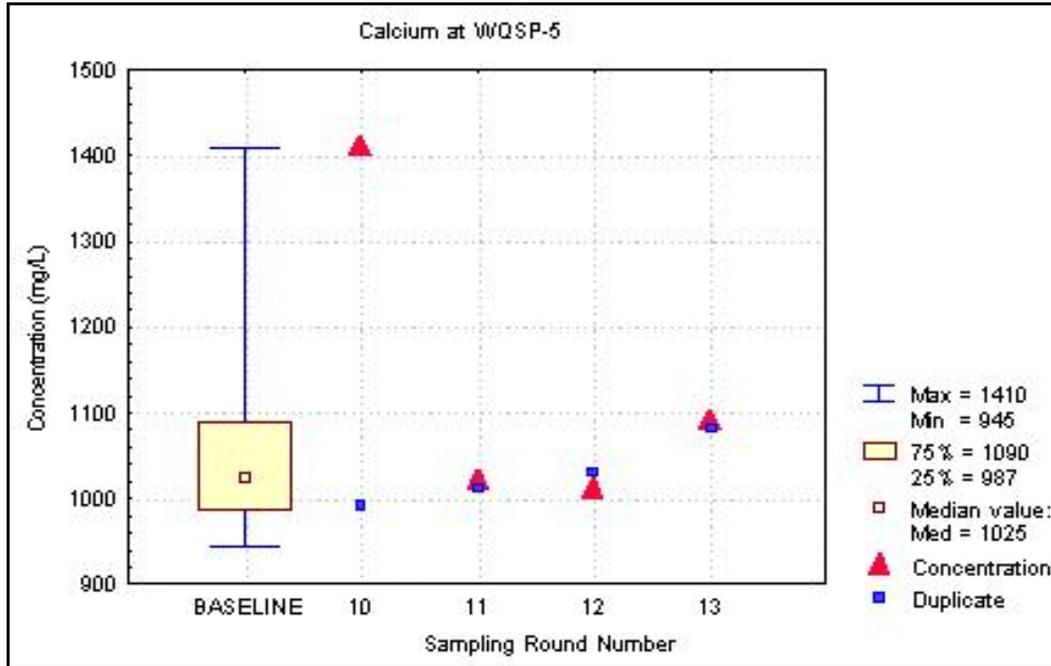


Figure F.76 - Time Trend Plot for Calcium at WQSP-5

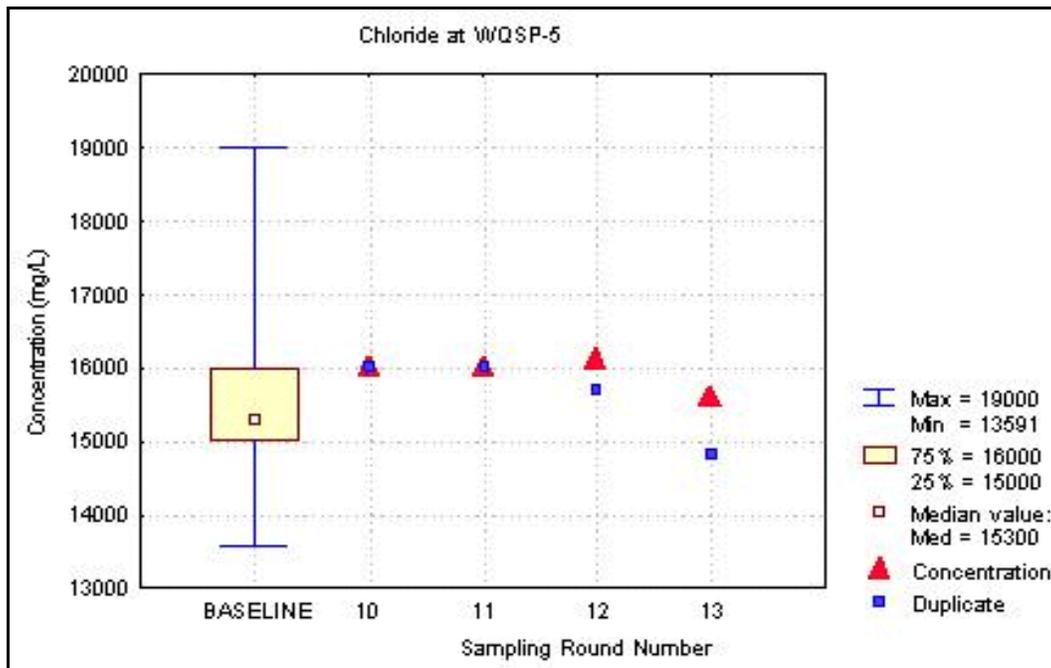


Figure F.77 - Time Trend Plot for Chloride at WQSP-5

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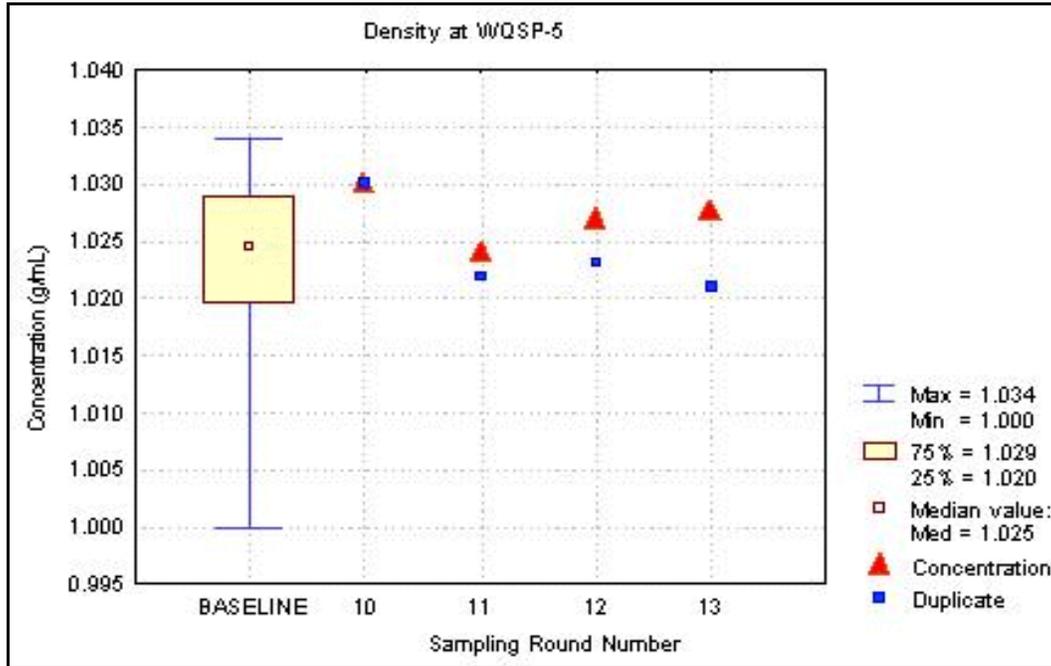


Figure F.78 - Time Trend Plot for Density at WQSP-5

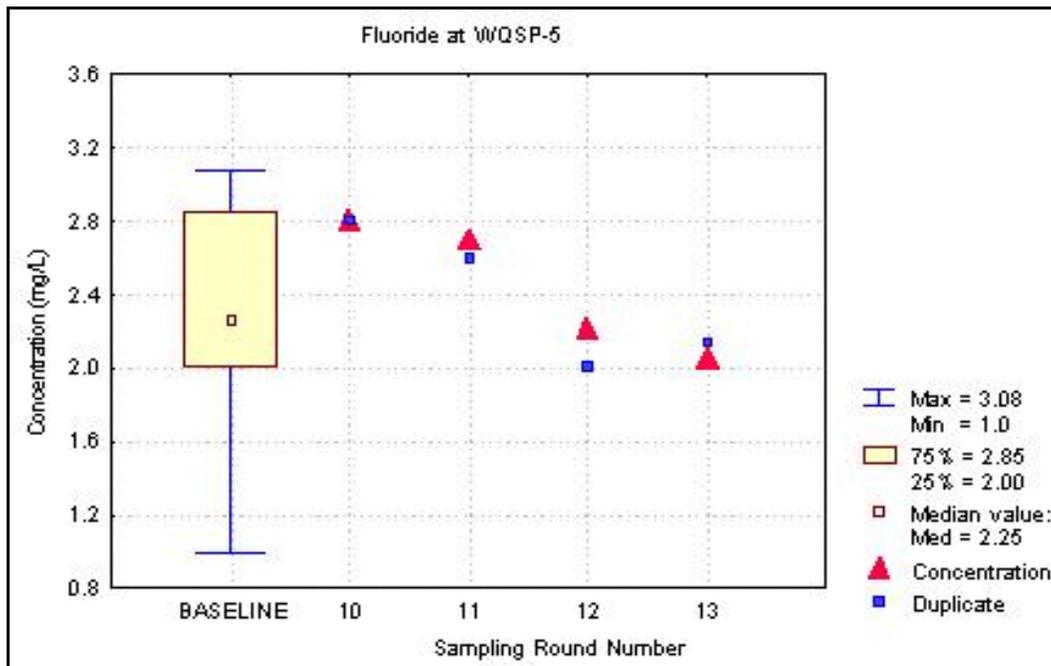


Figure F.79 - Time Trend Plot for Fluoride at WQSP-5

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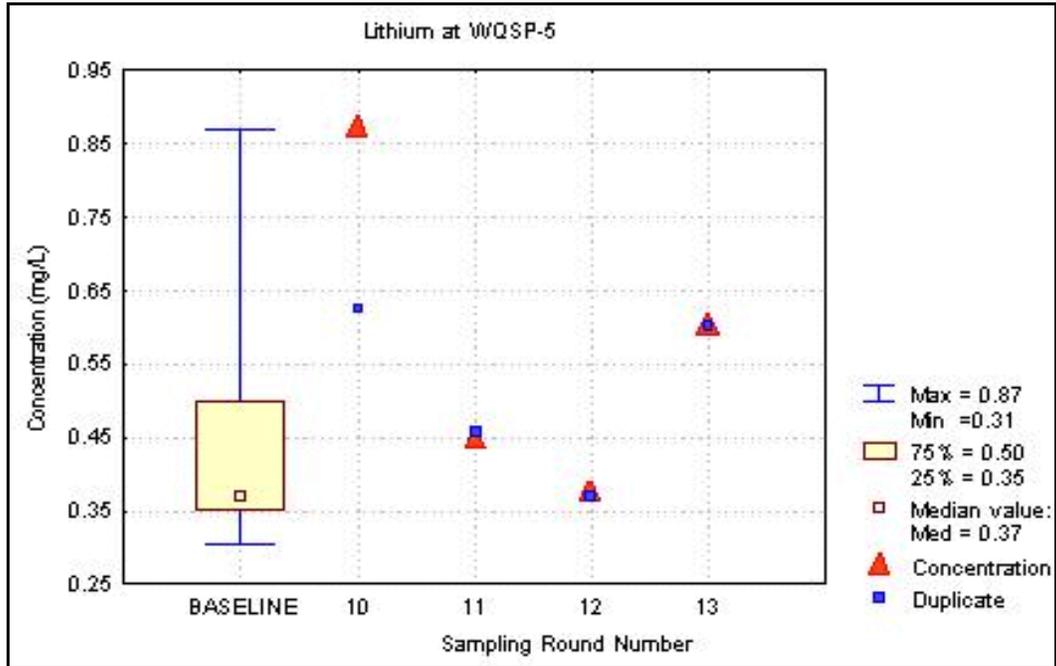


Figure F.80 - Time Trend Plot for Lithium at WQSP-5

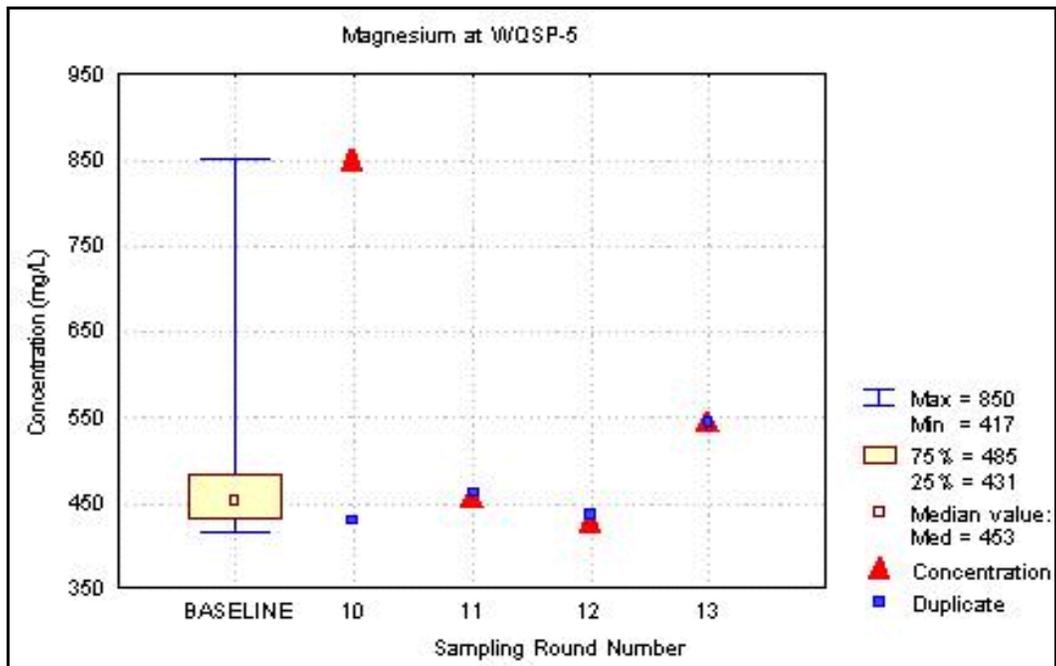


Figure F.81 - Time Trend Plot for Magnesium at WQSP-5

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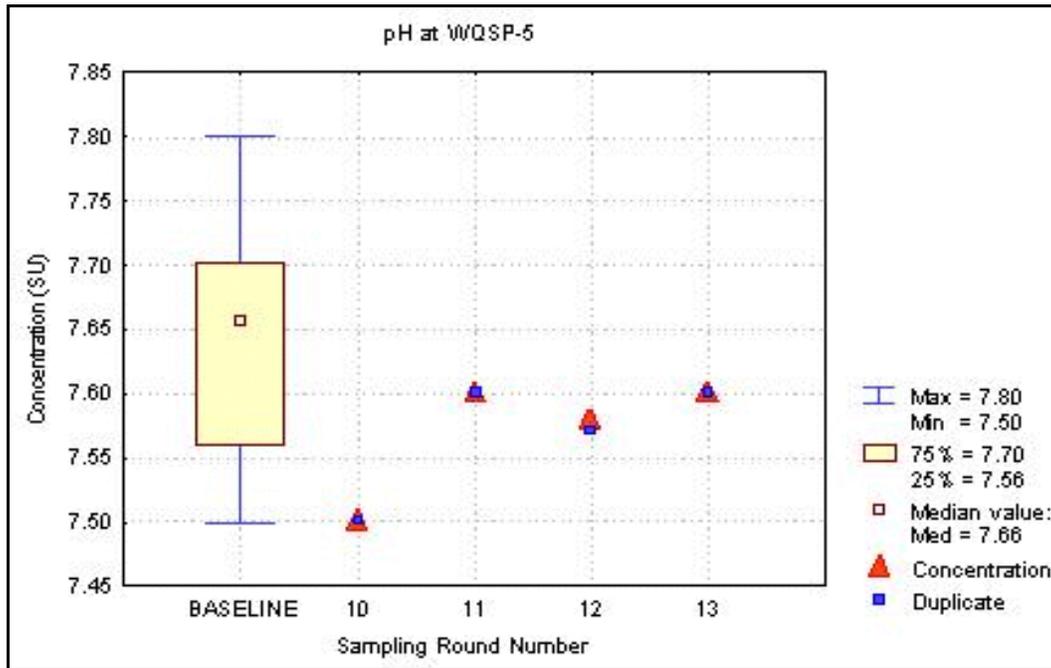


Figure F.82 - Time Trend Plot for pH at WQSP-5

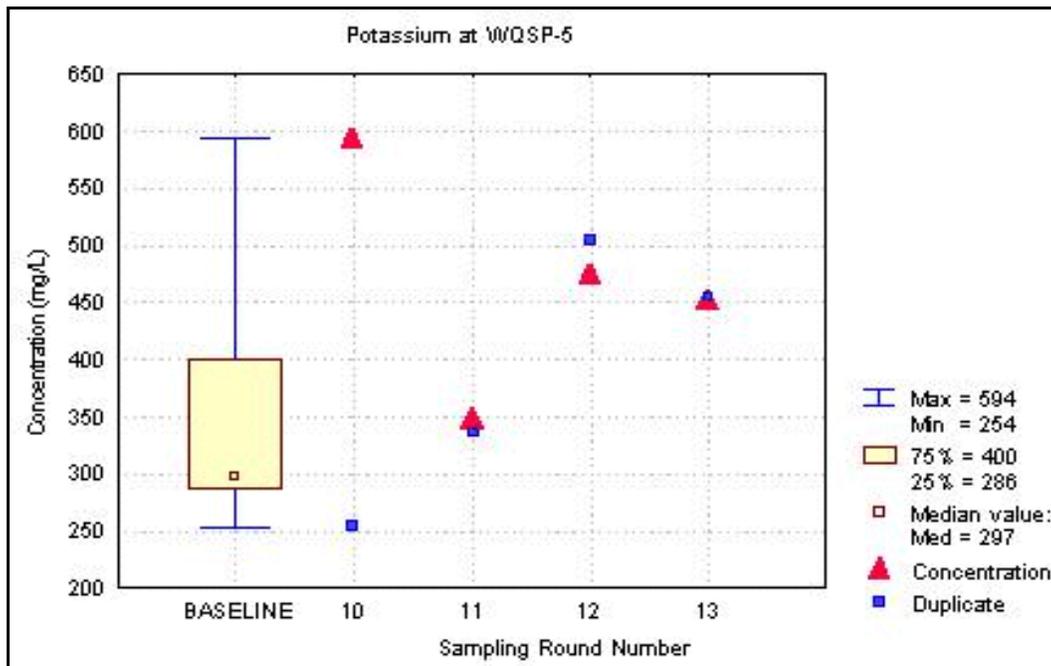


Figure F.83 - Time Trend Plot for Potassium at WQSP-5

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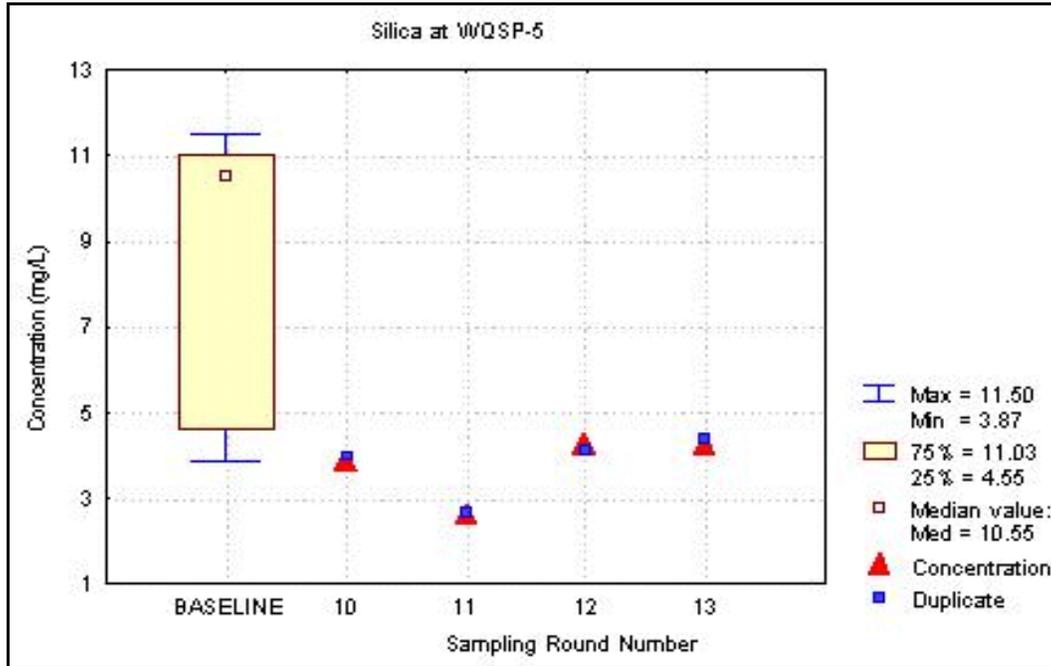


Figure F.84 - Time Trend Plot for Silica at WQSP-5

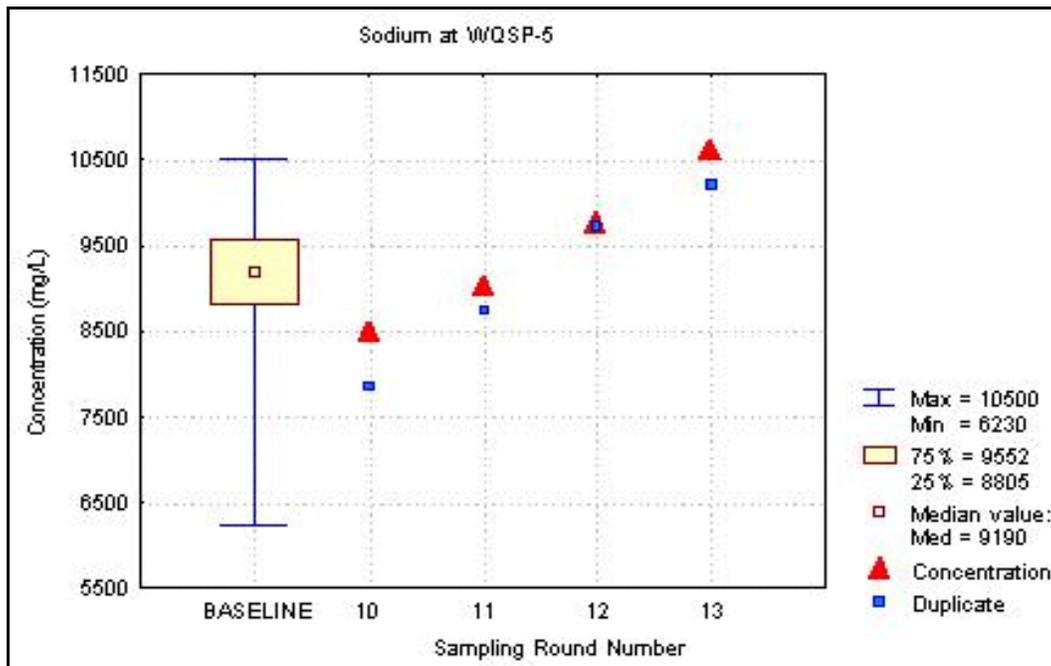


Figure F.85 - Time Trend Plot for Sodium at WQSP-5

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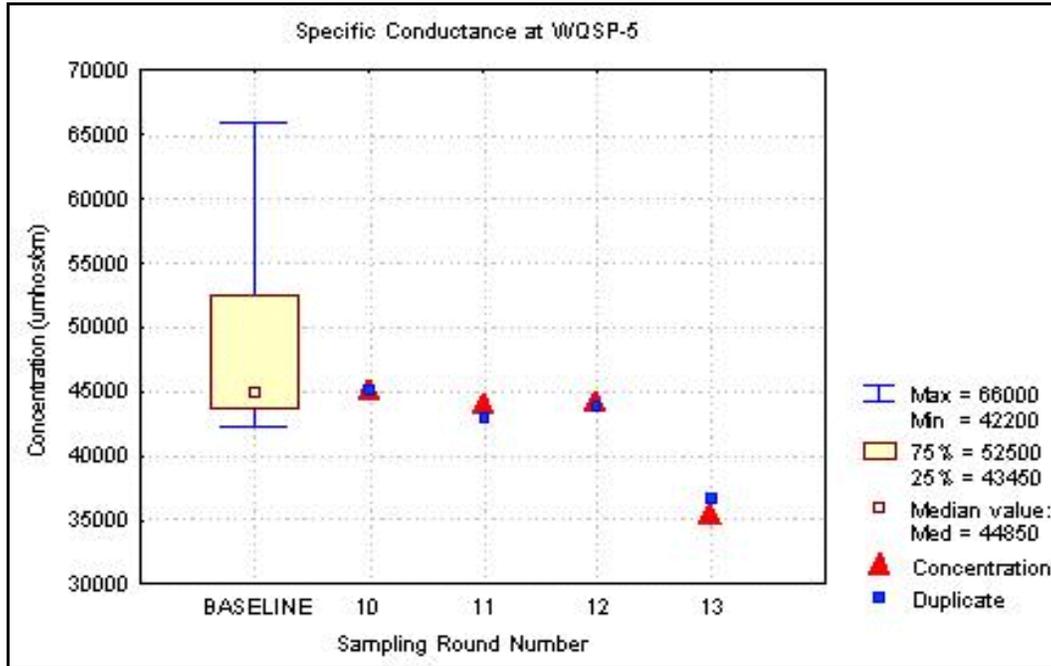


Figure F.86 - Time Trend Plot for Specific Conductance at WQSP-5

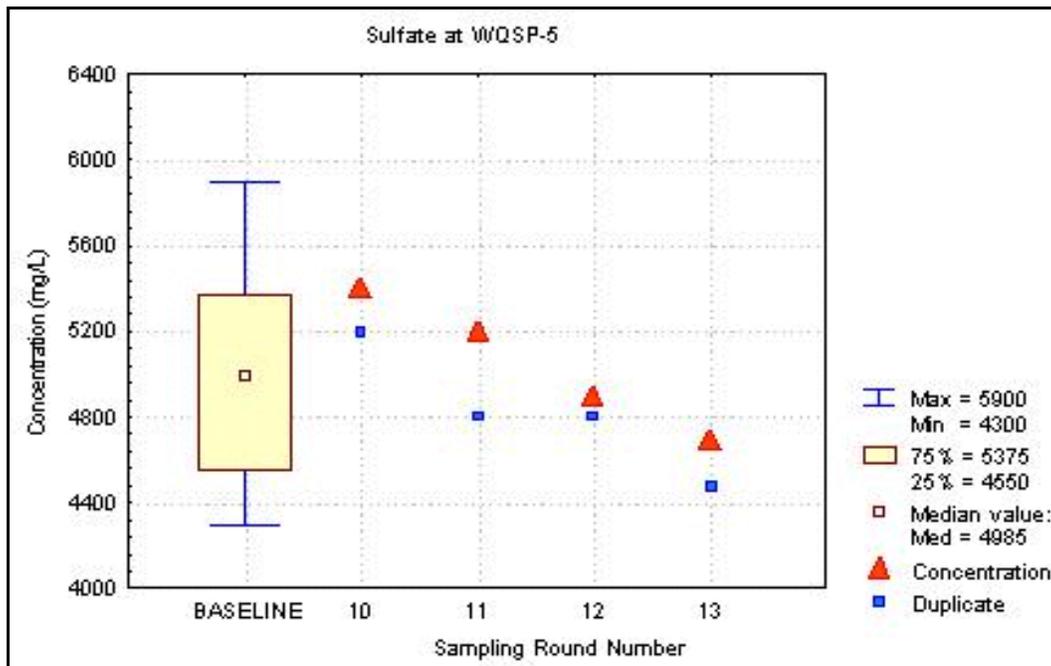


Figure F.87 - Time Trend Plot for Sulfate at WQSP-5

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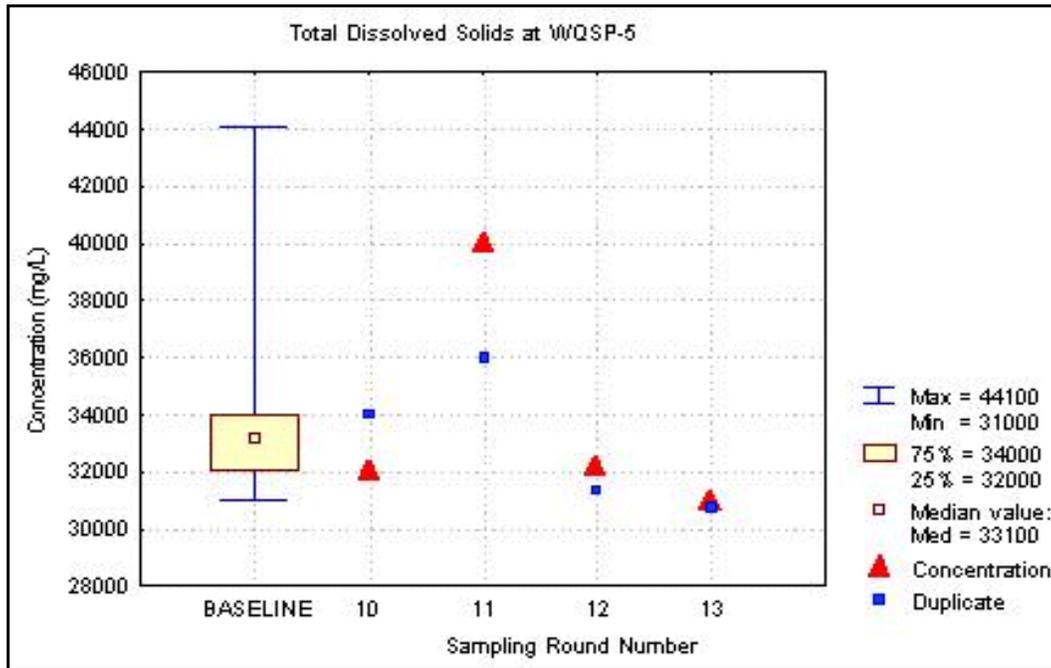


Figure F.88 - Time Trend Plot for Total Dissolved Solids at WQSP-5

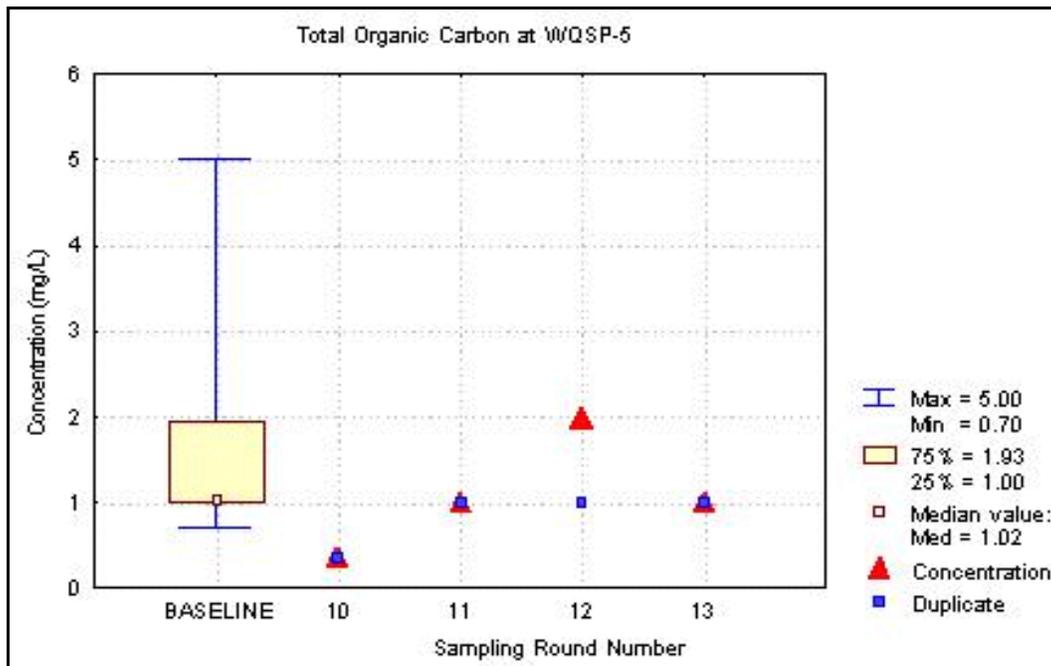


Figure F.89 - Time Trend Plot for Total Organic Carbon at WQSP-5

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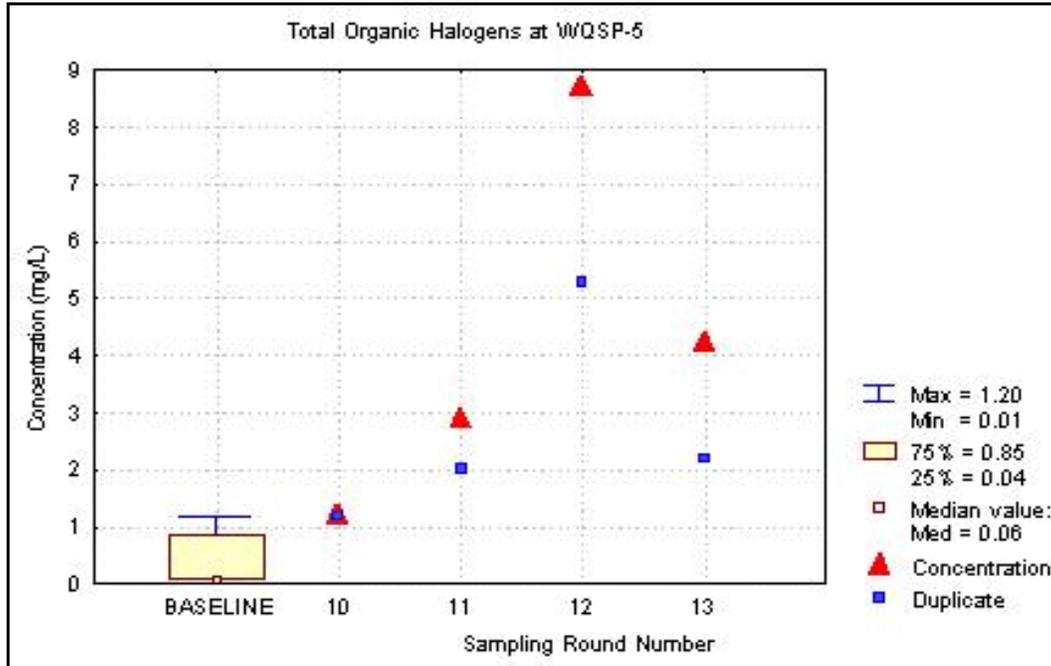


Figure F.90 - Time Trend Plot for Total Organic Halogens at WQSP-5

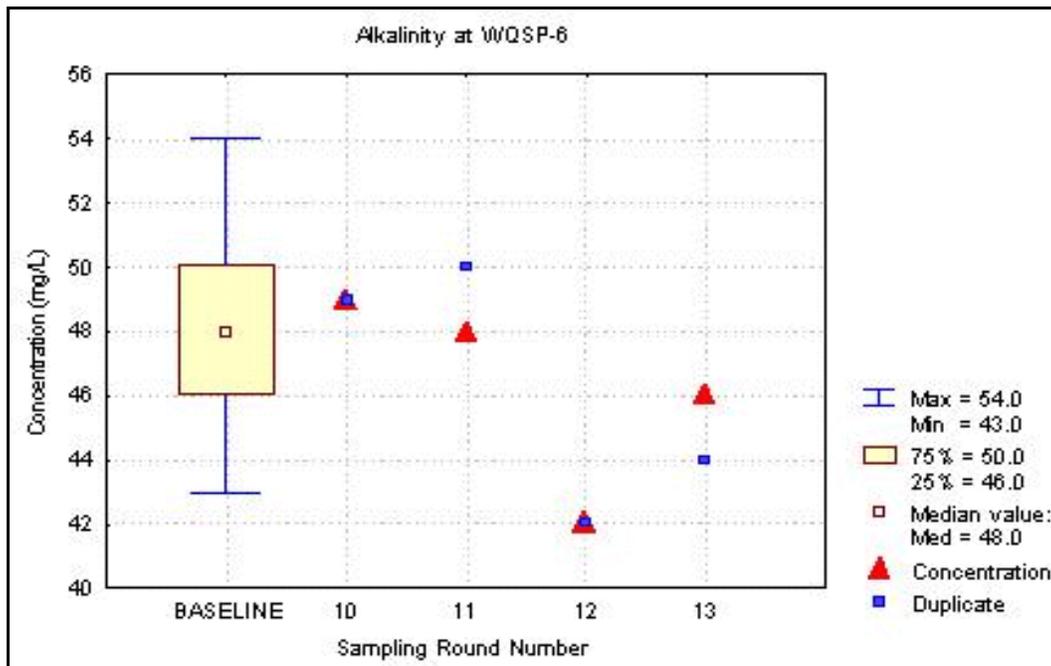


Figure F.91 - Time Trend Plot for Alkalinity at WQSP-6

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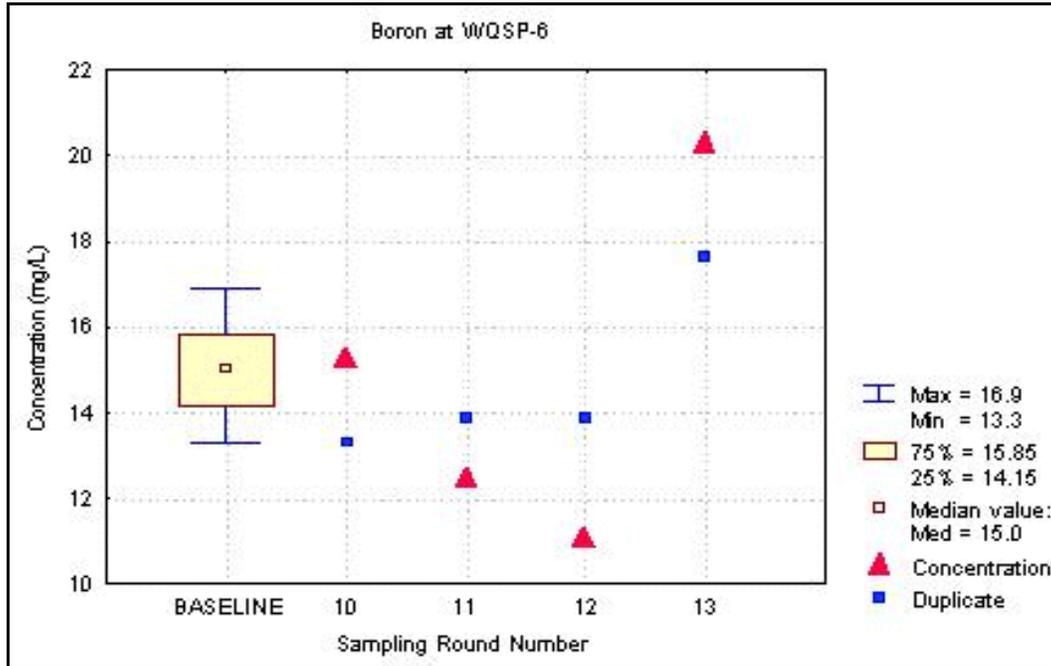


Figure F.92 - Time Trend Plot for Boron at WQSP-6

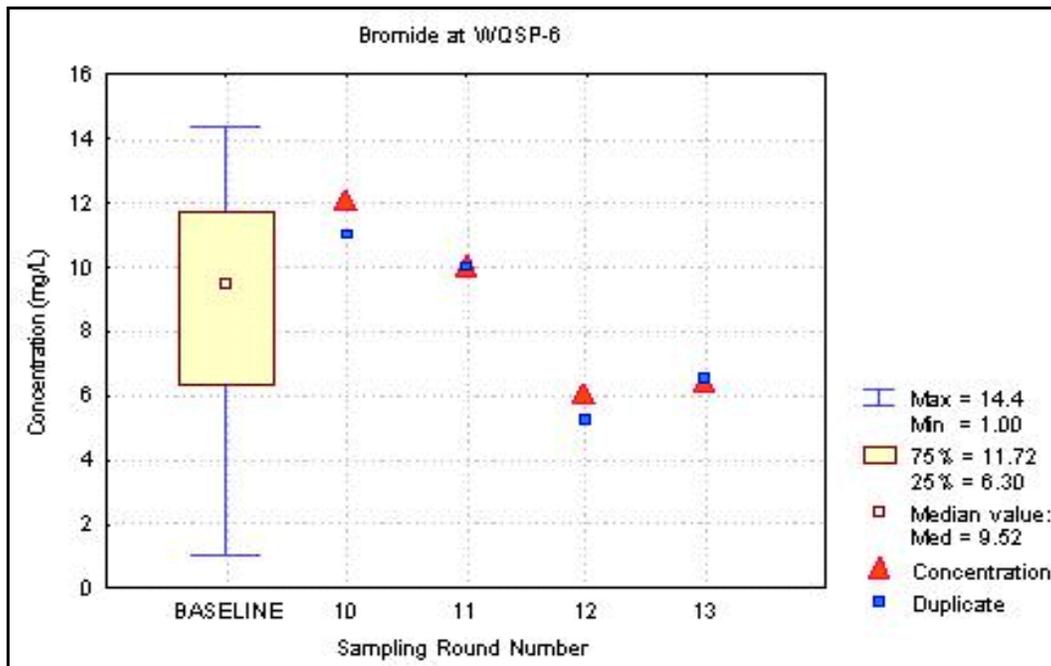


Figure F.93 - Time Trend Plot for Bromide at WQSP-6

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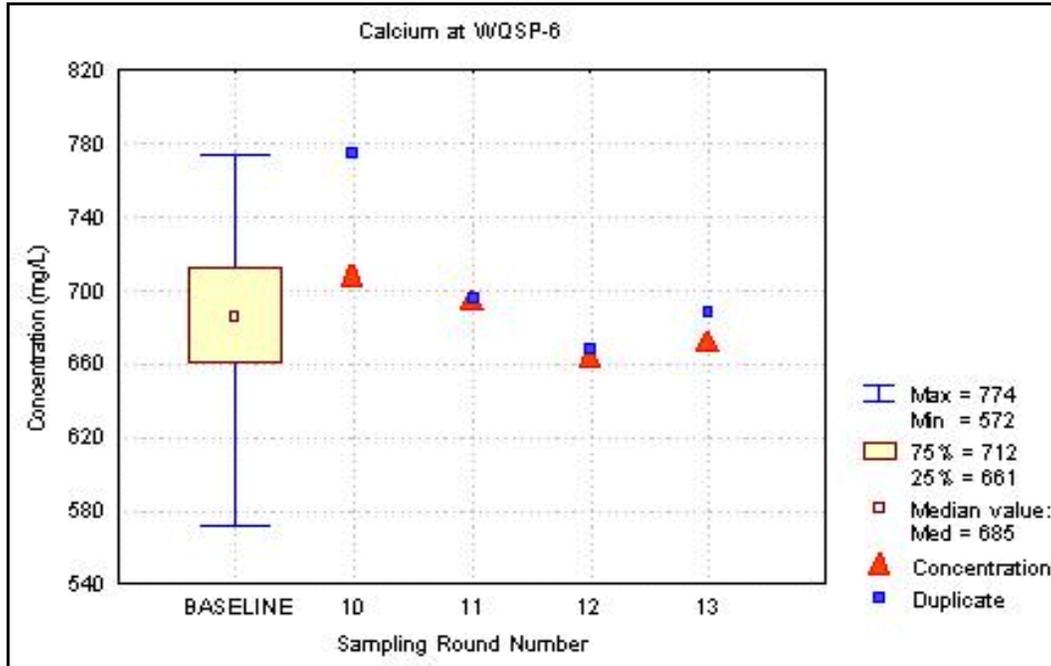


Figure F.94 - Time Trend Plot for Calcium at WQSP-6

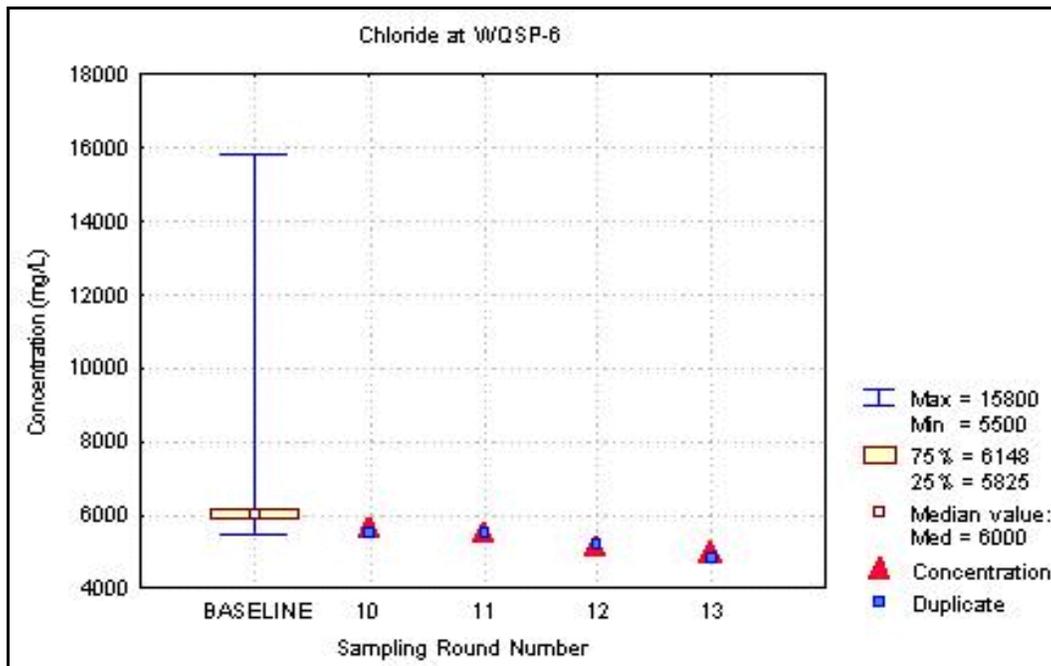


Figure F.95 - Time Trend Plot for Chloride at WQSP-6

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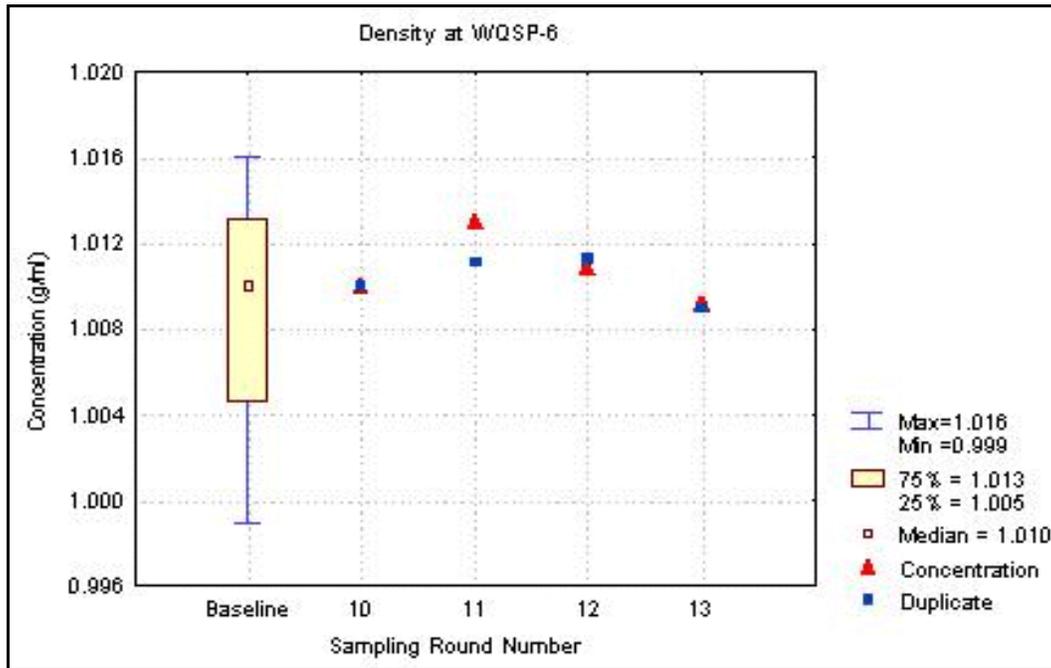


Figure F.96 - Time Trend Plot for Density at WQSP-6

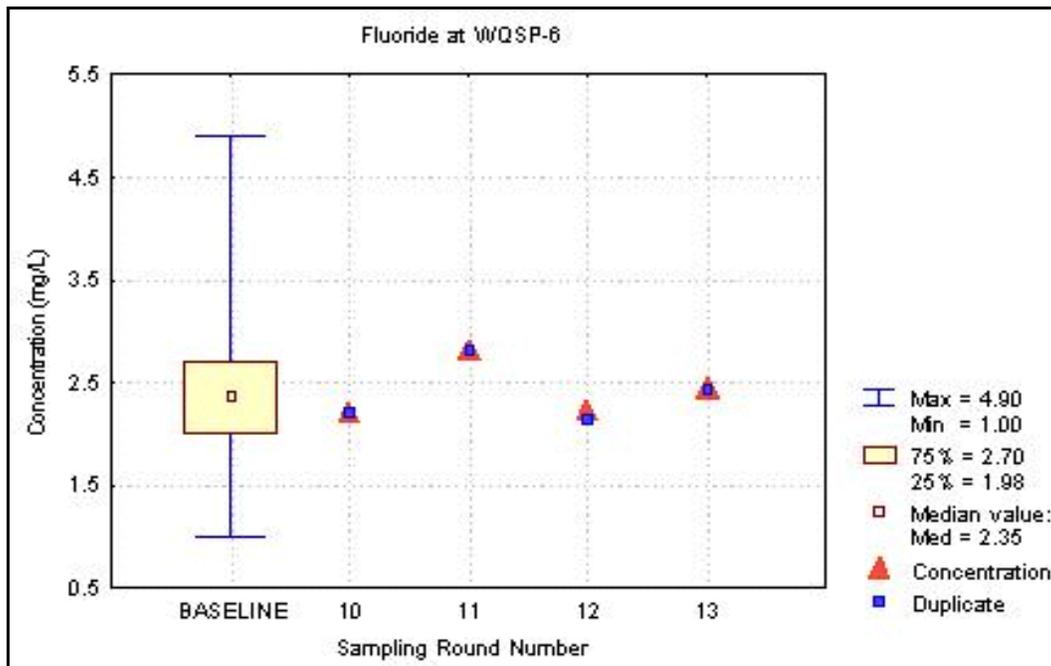


Figure F.97 - Time Trend Plot for Fluoride at WQSP-6

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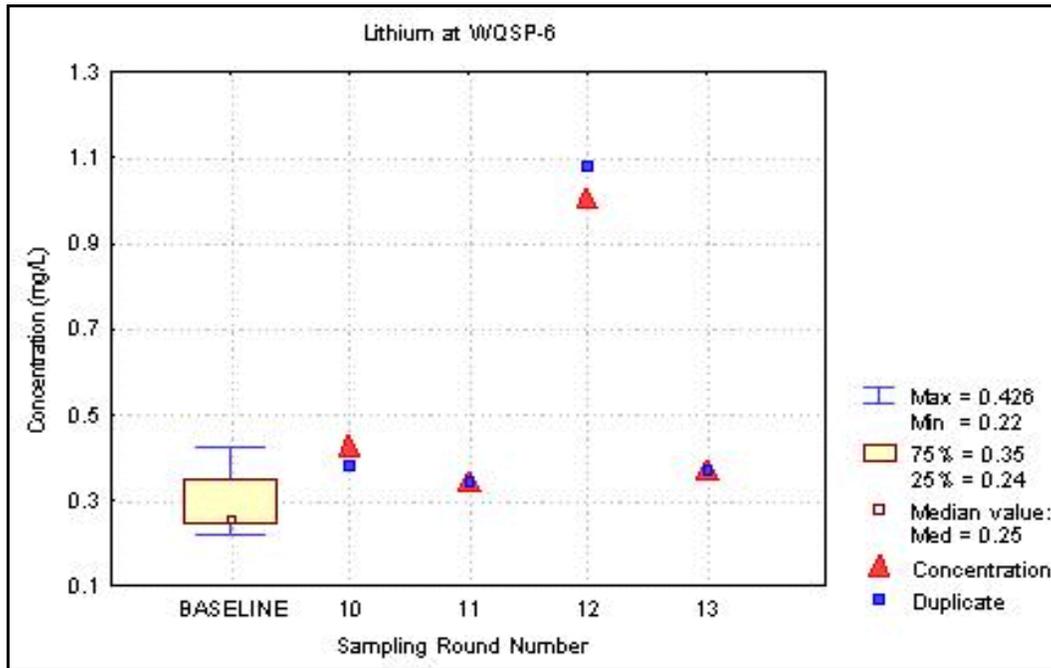


Figure F.98 - Time Trend Plot for Lithium at WQSP-6

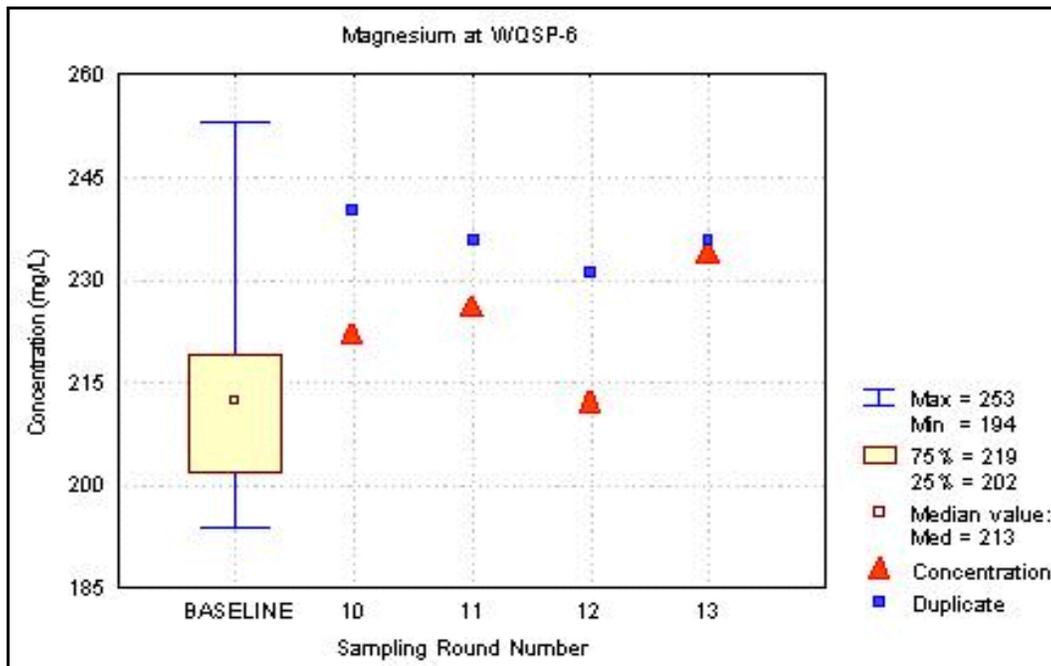


Figure F.99 - Time Trend Plot for Magnesium at WQSP-6

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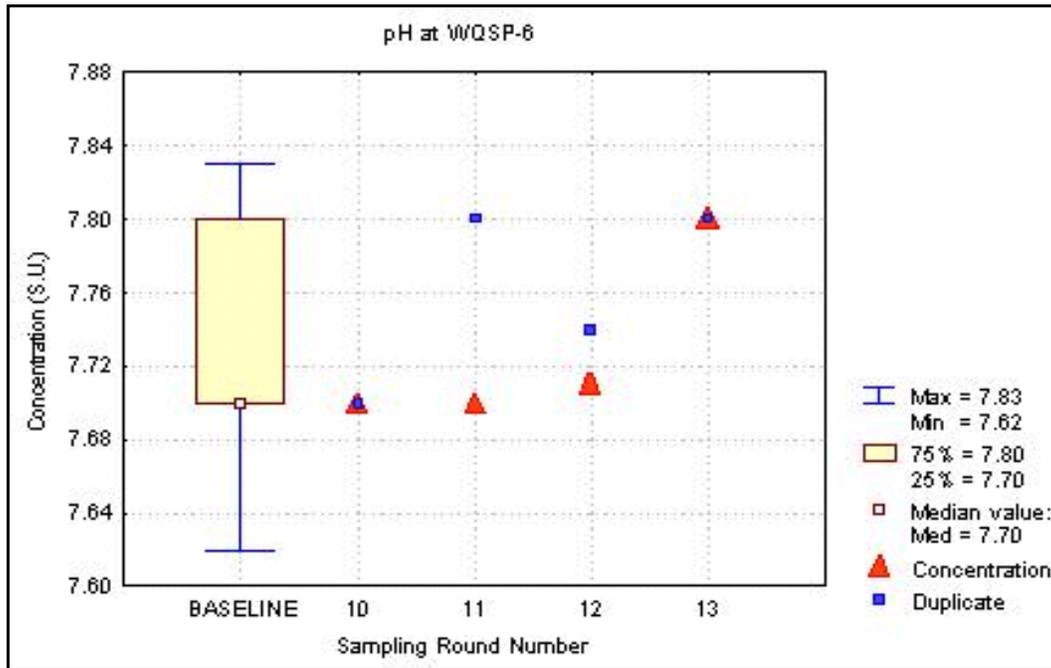


Figure F.100 - Time Trend Plot for pH at WQSP-6

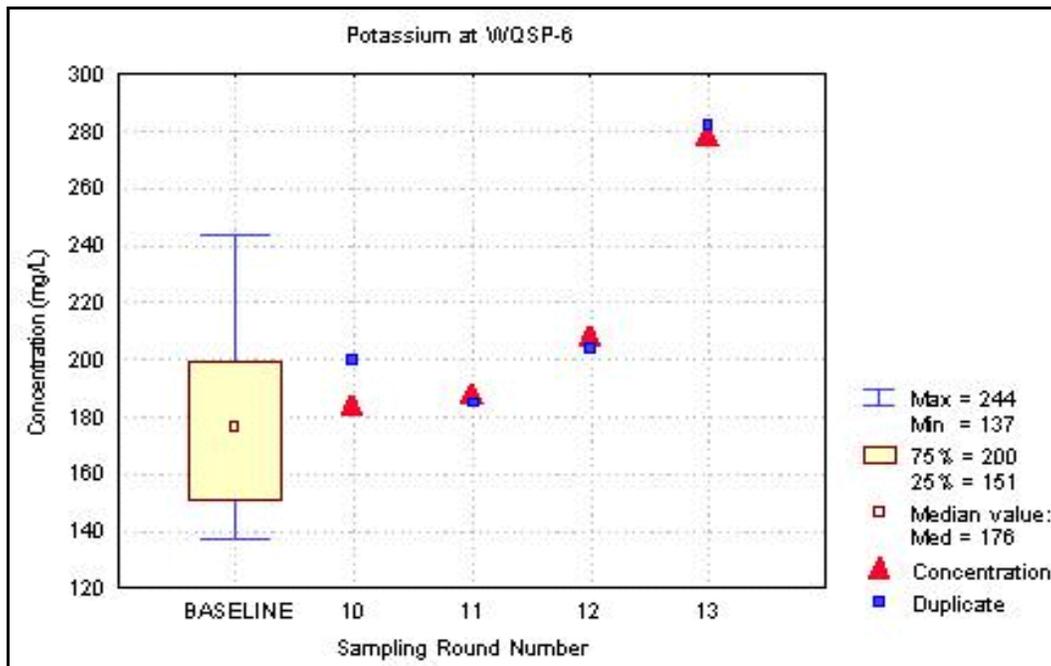


Figure F.101 - Time Trend Plot for Potassium at WQSP-6

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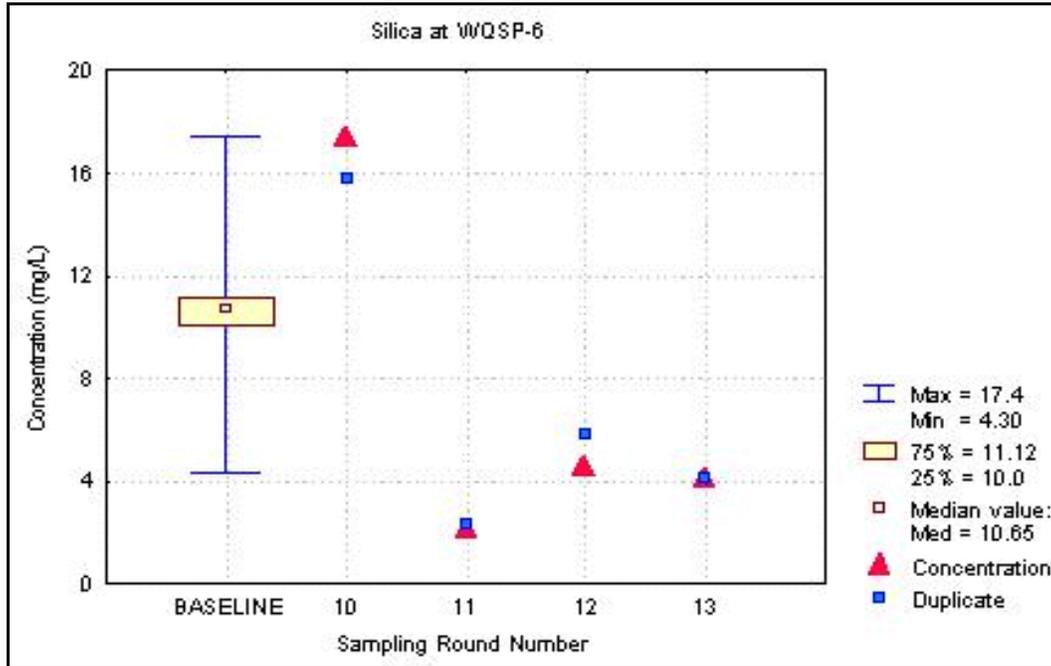


Figure F.102 - Time Trend Plot for Silica at WQSP-6

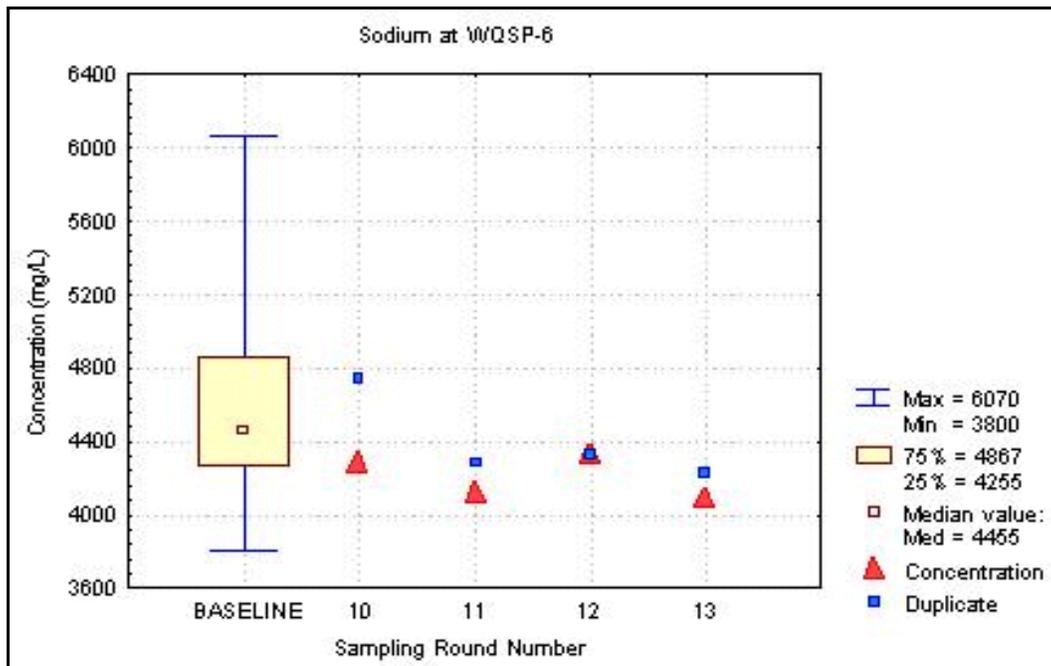


Figure F.103 - Time Trend Plot for Sodium at WQSP-6

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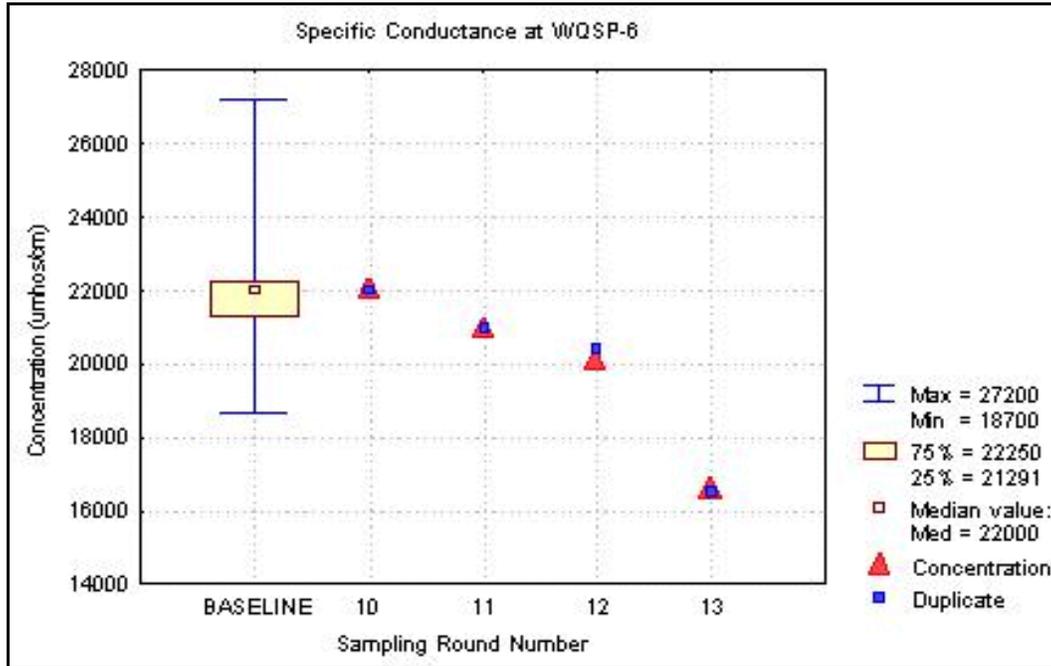


Figure F.104 - Time Trend for Specific Conductance at WQSP-6

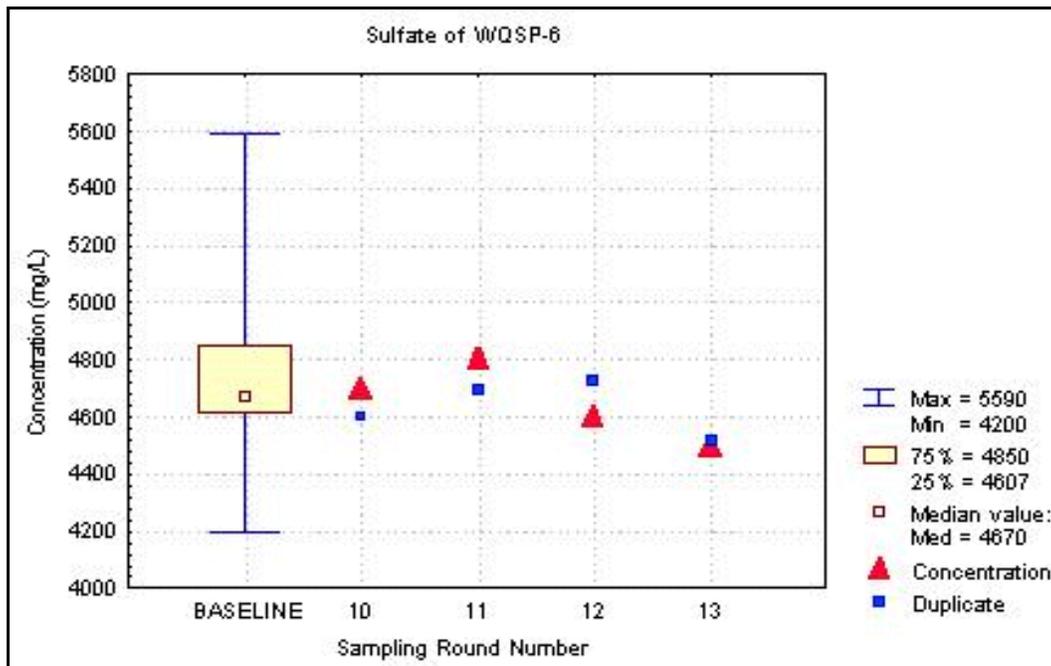


Figure F.105 - Time Trend Plot for Sulfate at WQSP-6

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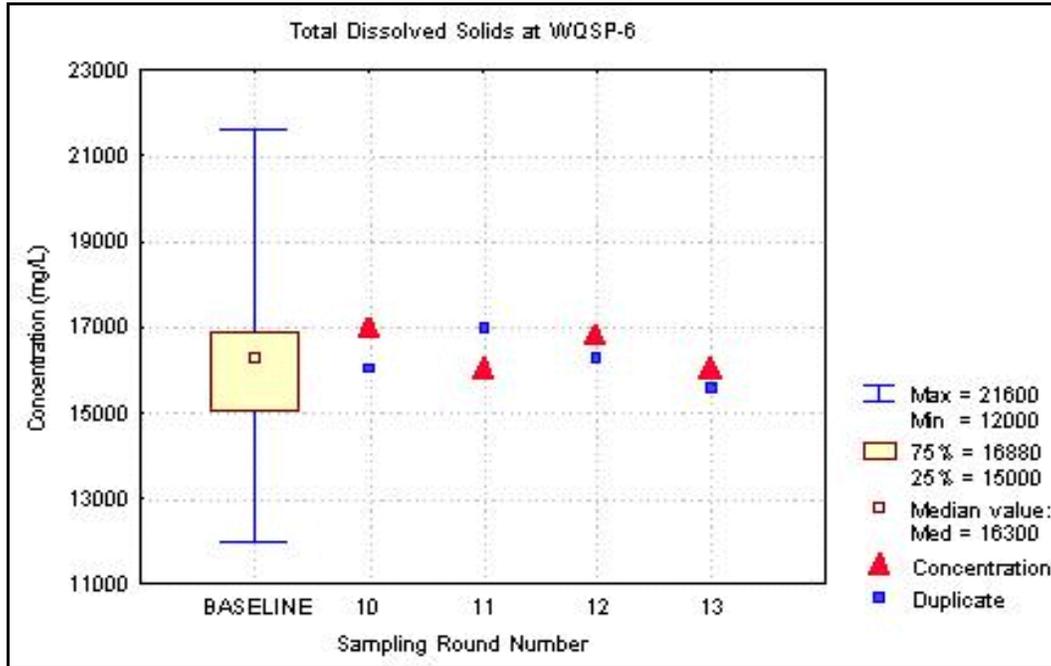


Figure F.106 - Time Trend Plot for Total Dissolved Solids at WQSP-6

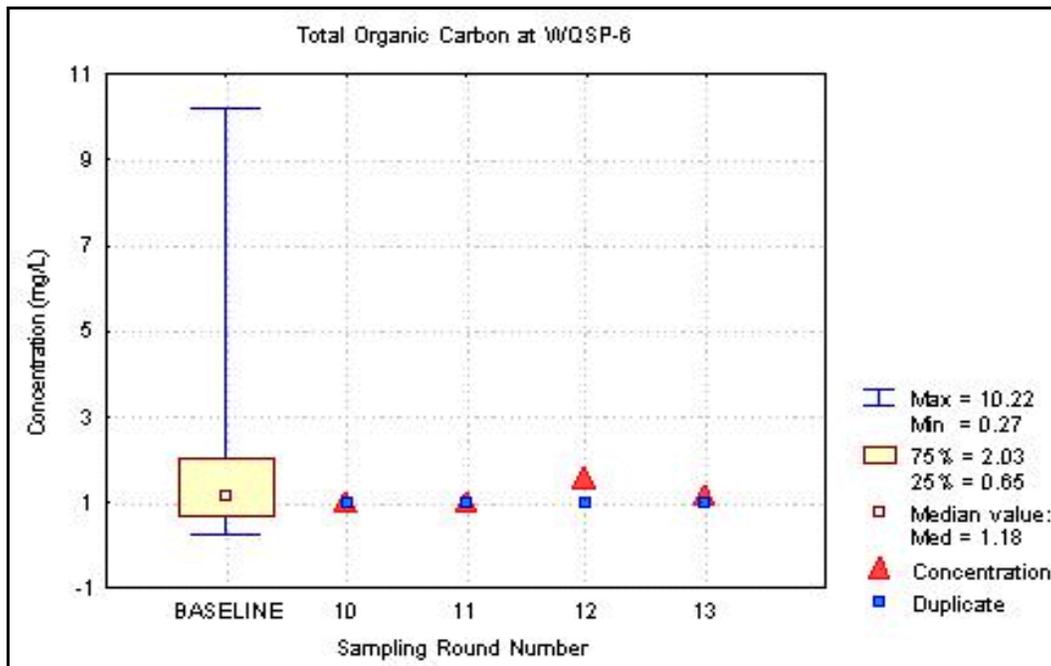


Figure F.107 - Time Trend Plot for Total Organic Carbon at WQSP-6

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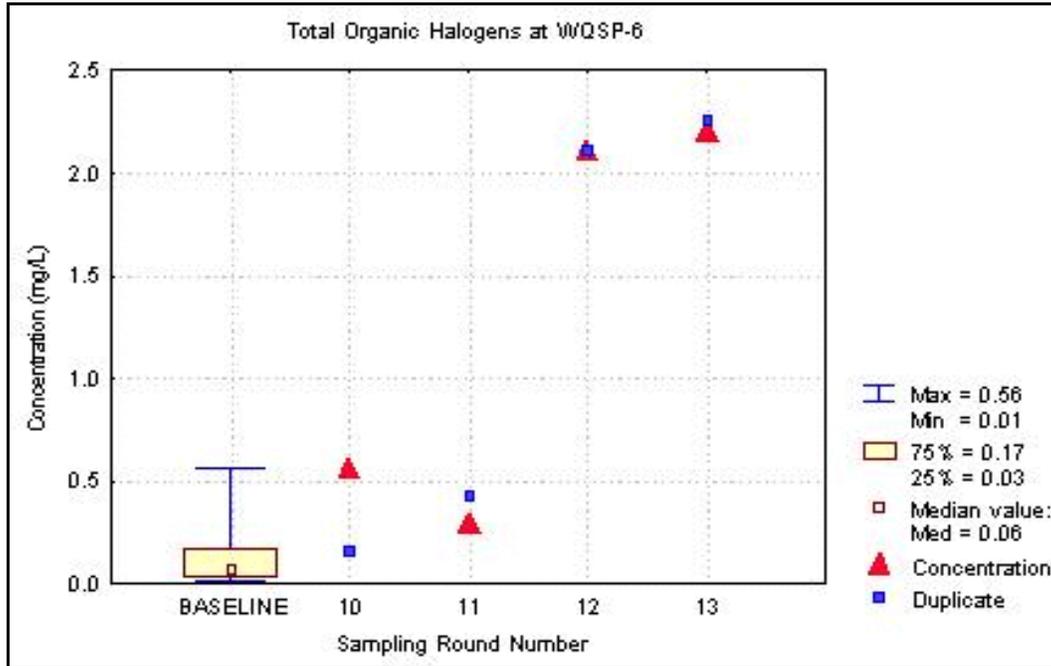


Figure F.108 - Time Trend Plot for Total Organic Halogens at WQSP-6

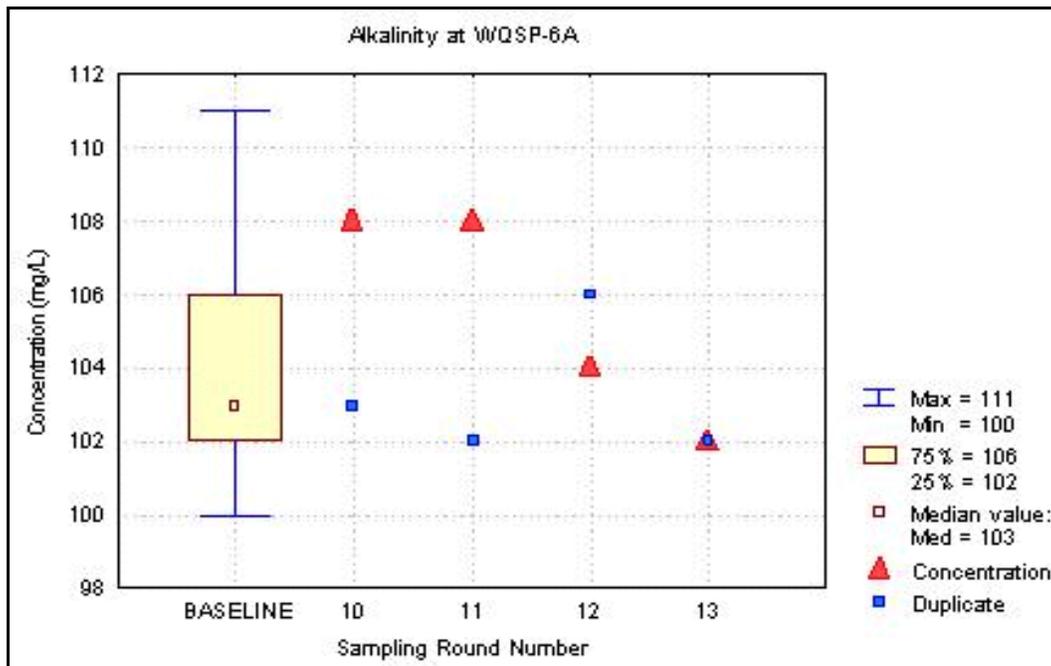


Figure F.109 - Time Trend Plot for Alkalinity at WQSP-6A

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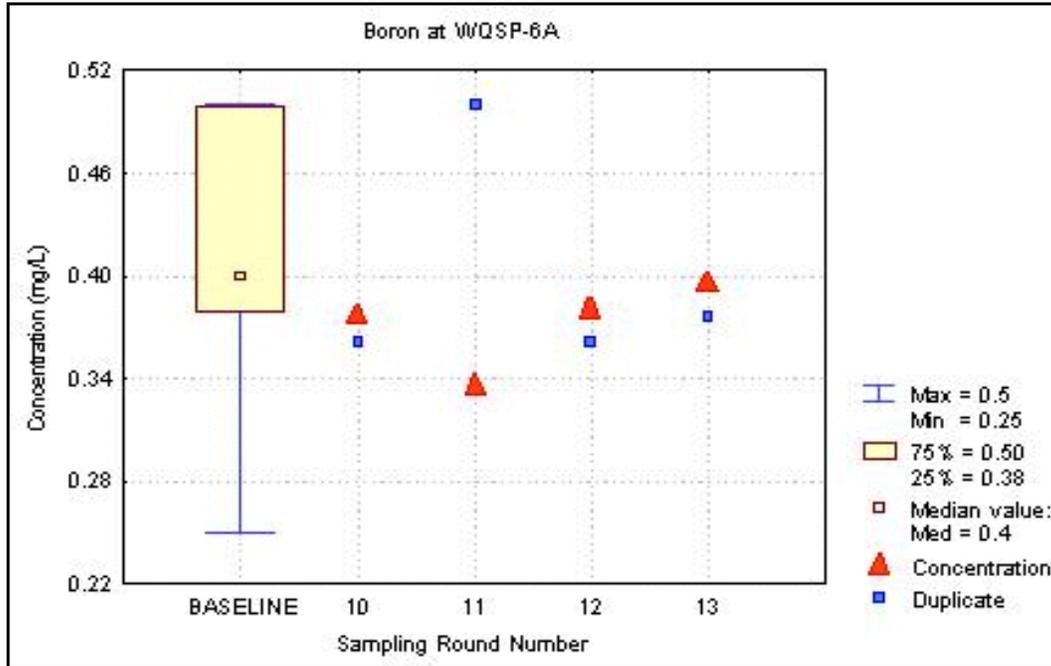


Figure F.110 - Time Trend Plot for Boron at WQSP-6A

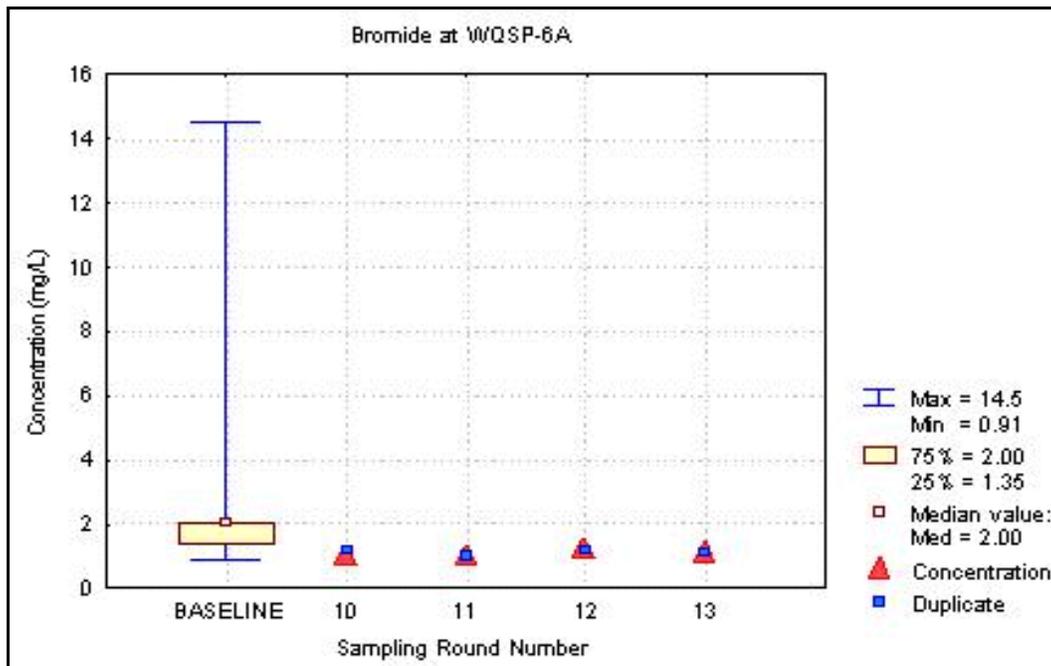


Figure F.111 - Time Trend Plot for Bromide at WQSP-6A

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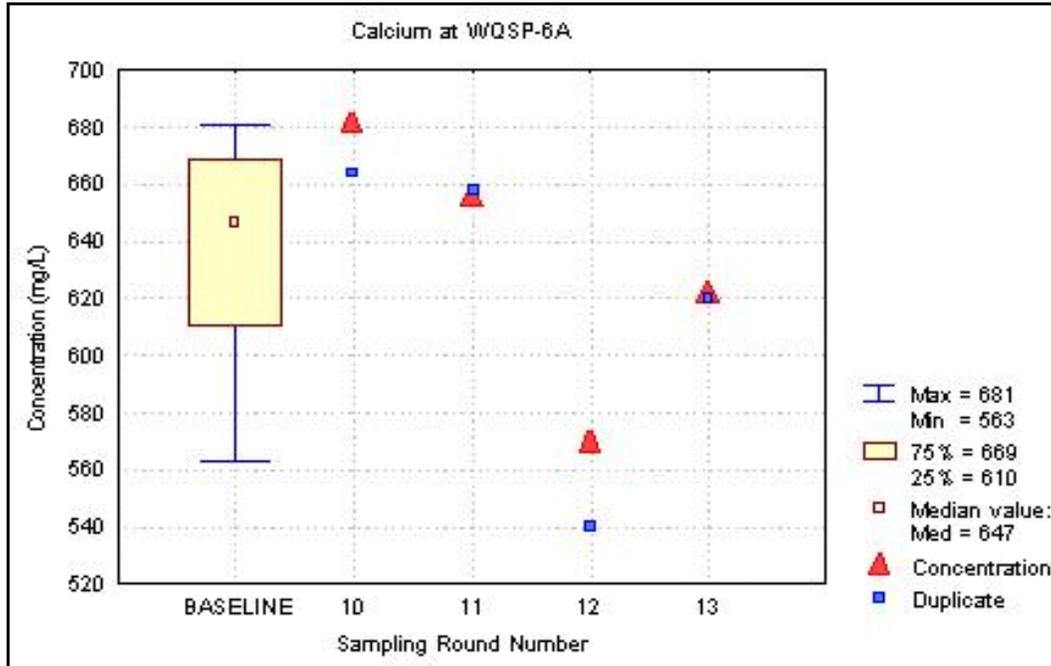


Figure F.112 - Time Trend Plot for Calcium at WQSP-6A

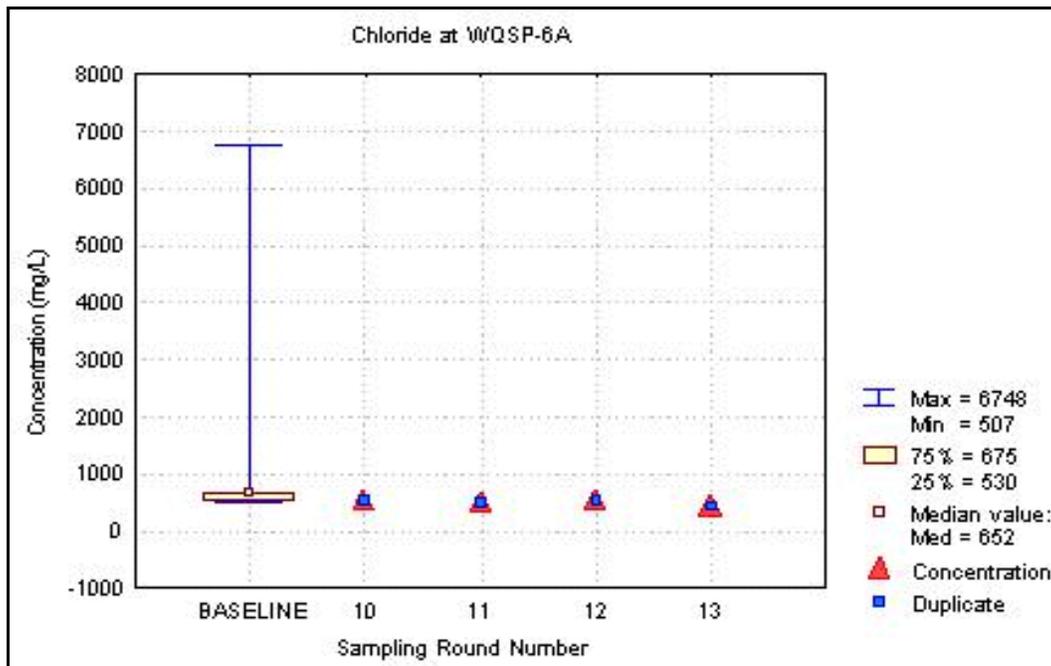


Figure F.113 - Time Trend Plot for Chloride at WQSP-6A

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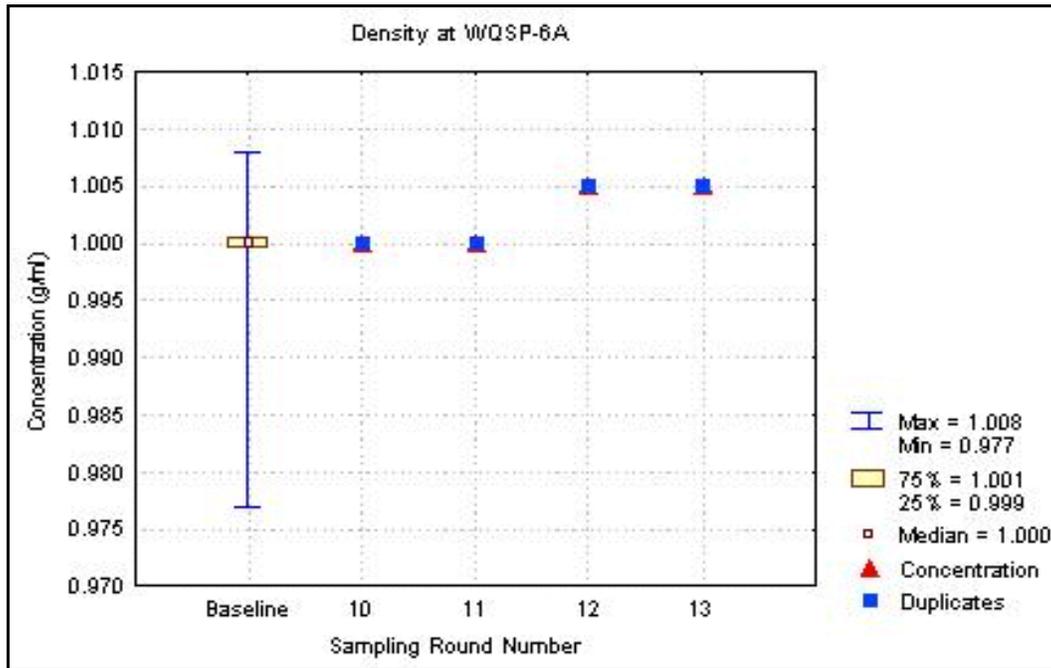


Figure F.114 - Time Trend Plot for Density at WQSP-6A

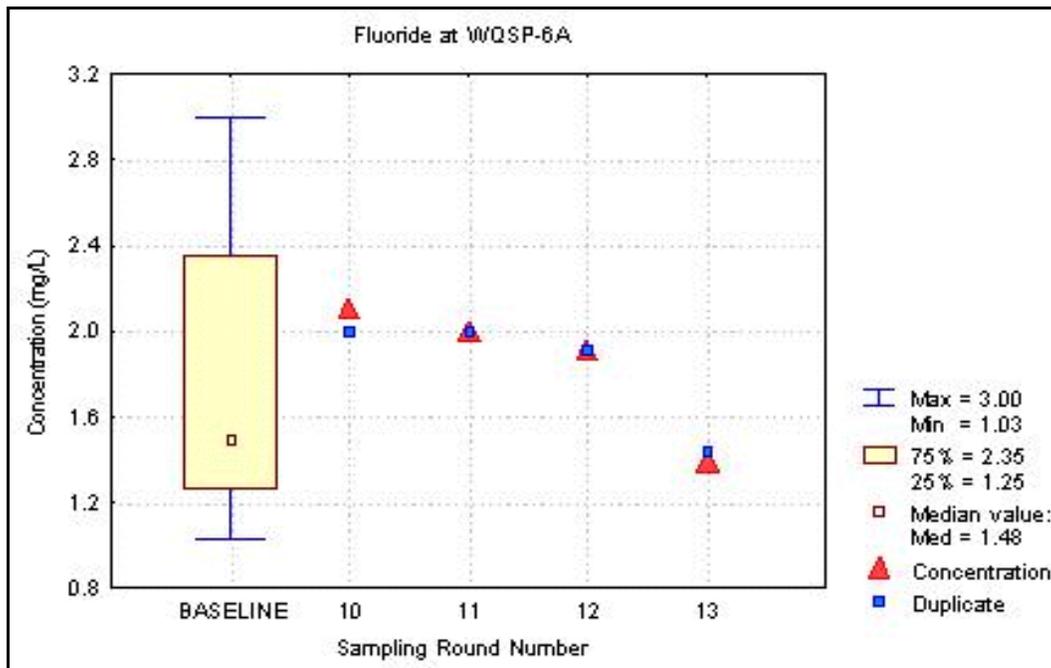


Figure F.115 - Time Trend Plot for Fluoride at WQSP-6A

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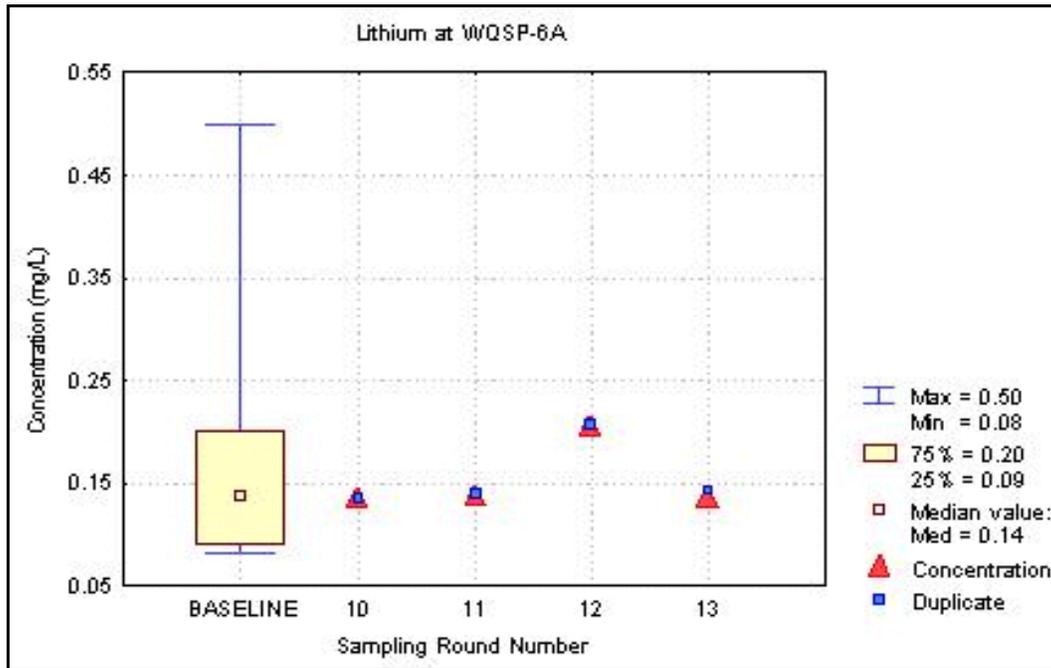


Figure F.116 - Time Trend Plot for Lithium at WQSP-6A

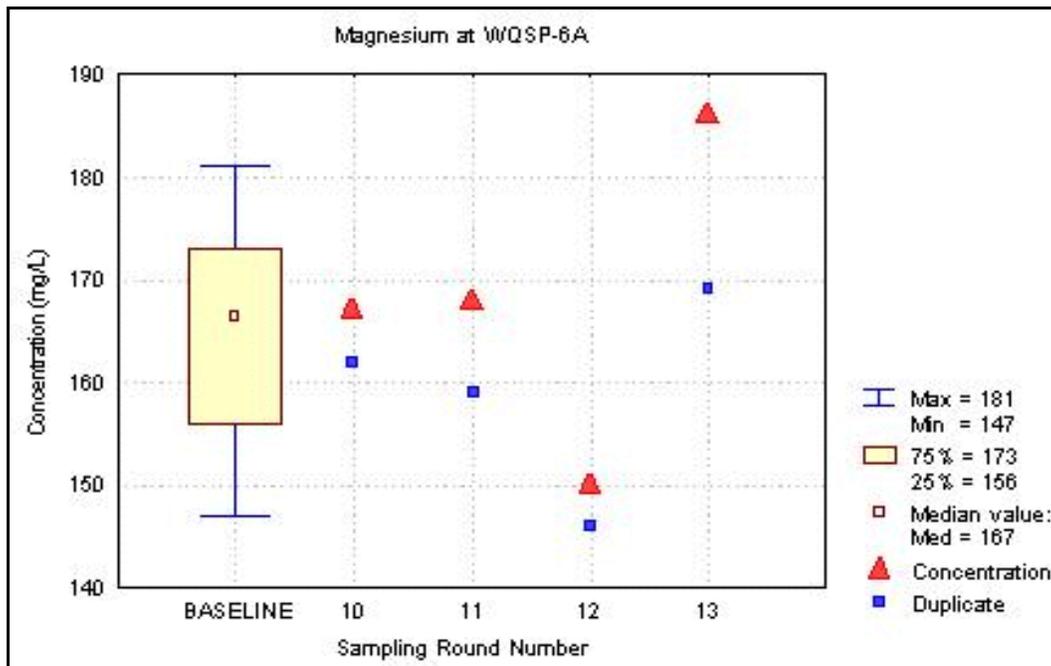


Figure F.117 - Time Trend Plot for Magnesium at WQSP-6A

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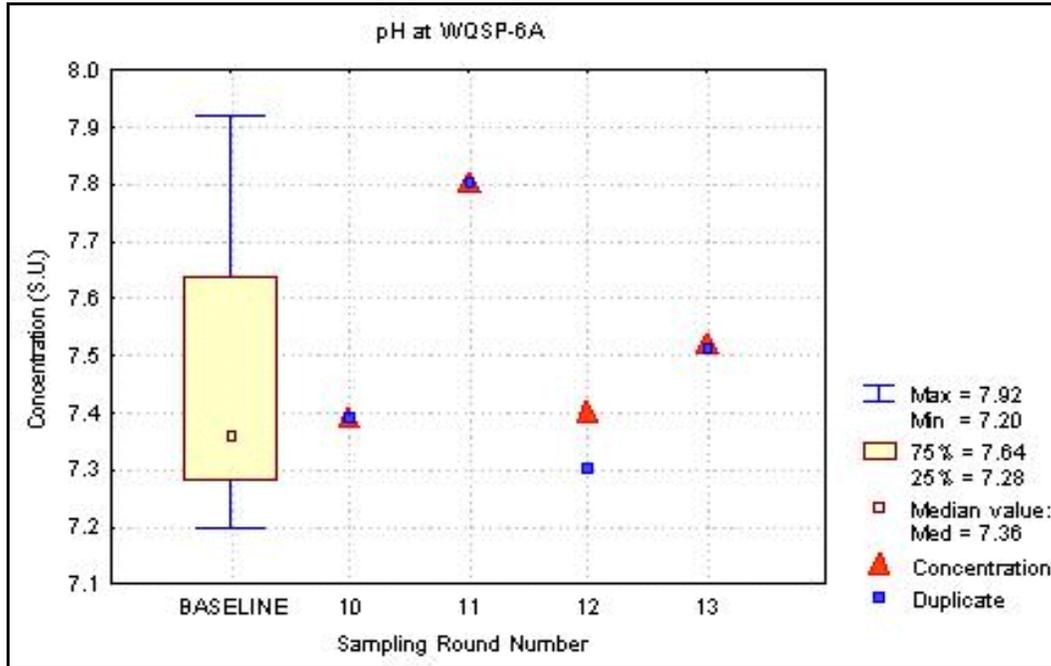


Figure F.118 - Time Trend Plot for pH at WQSP-6A

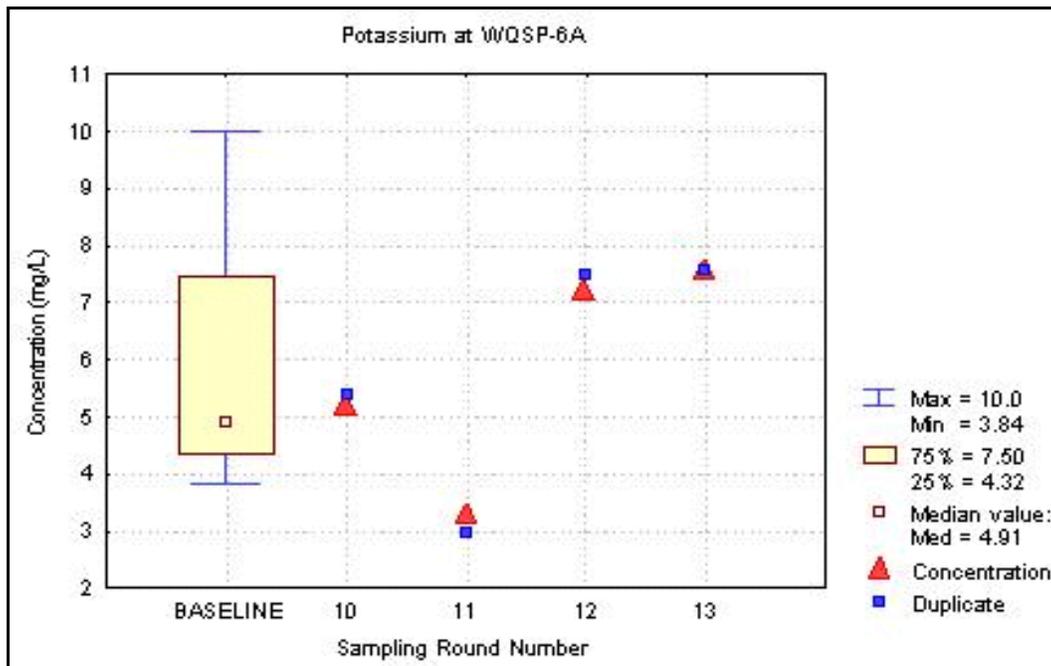


Figure F.119 - Time Trend Plot for Potassium at WQSP-6A

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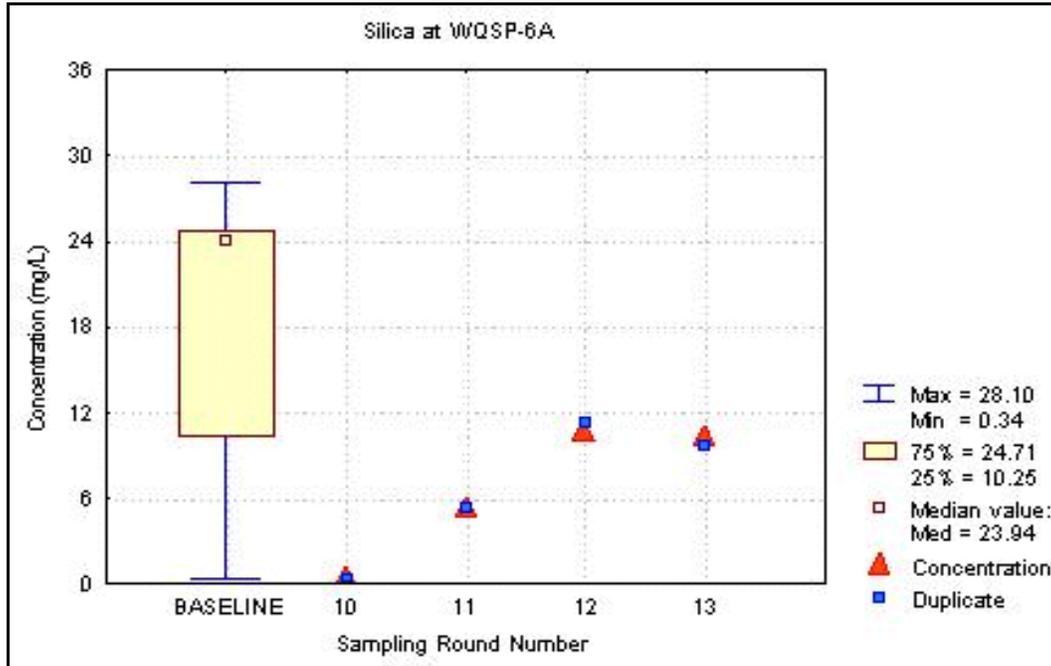


Figure F.120 - Time Trend Plot for Silica at WQSP-6A

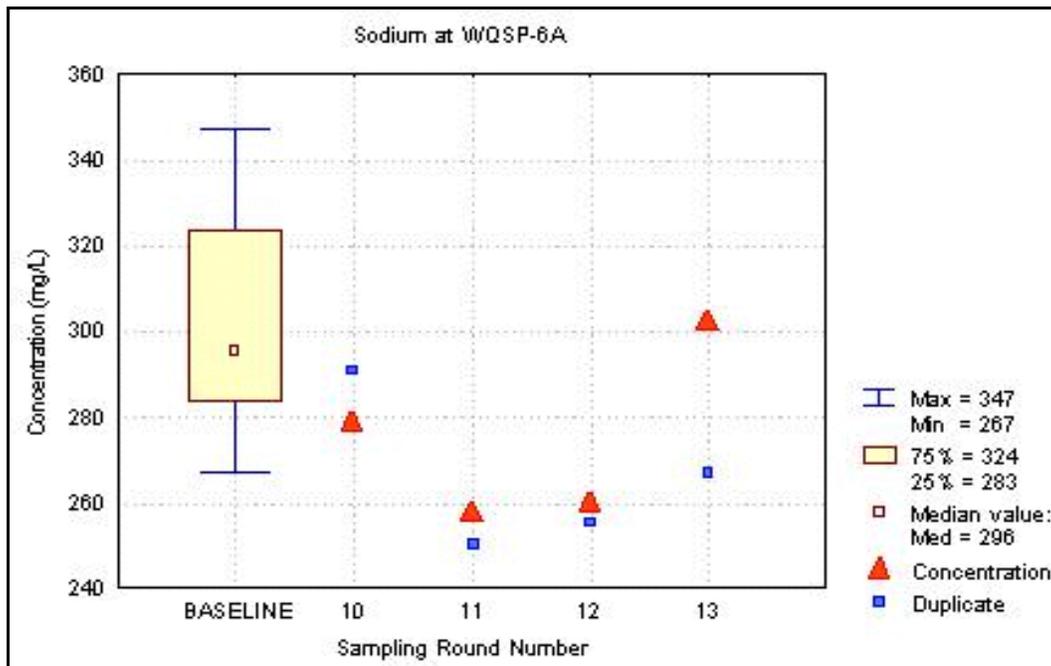


Figure F.121 - Time Trend Plot for Sodium at WQSP-6A

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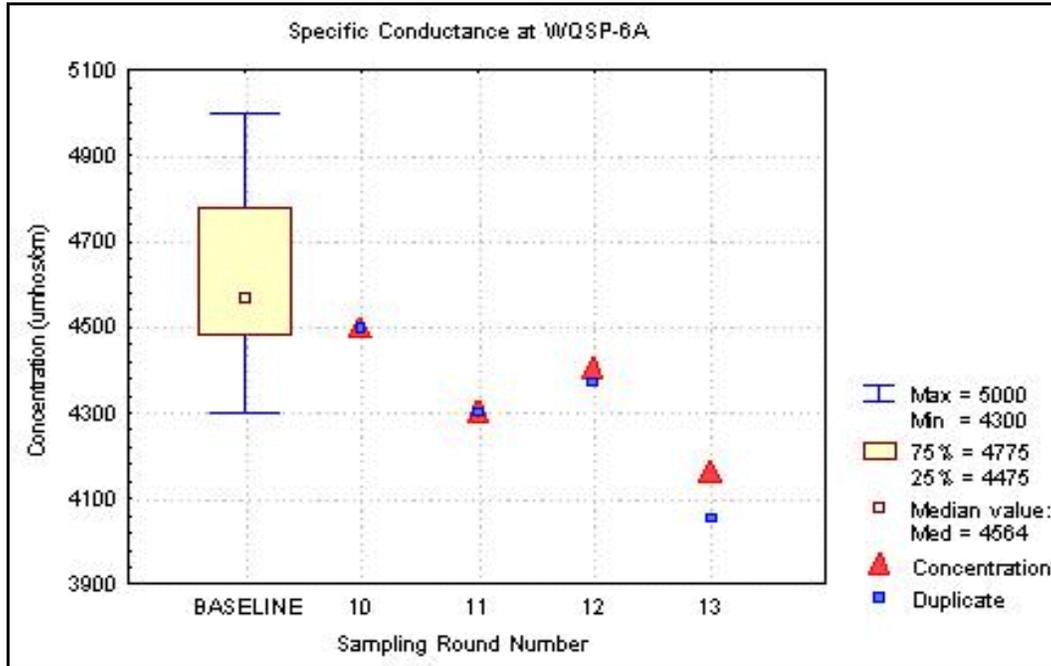


Figure F.122 - Time Trend Plot for Specific Conductance at WQSP-6A

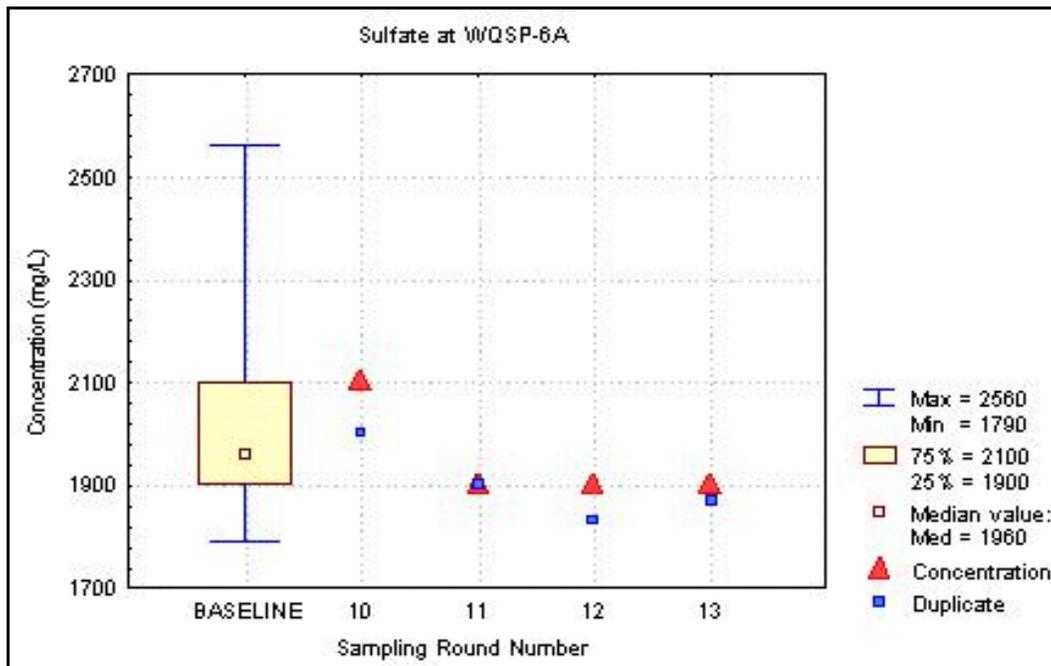


Figure F.123 - Time Trend Plot for Sulfate at WQSP-6A

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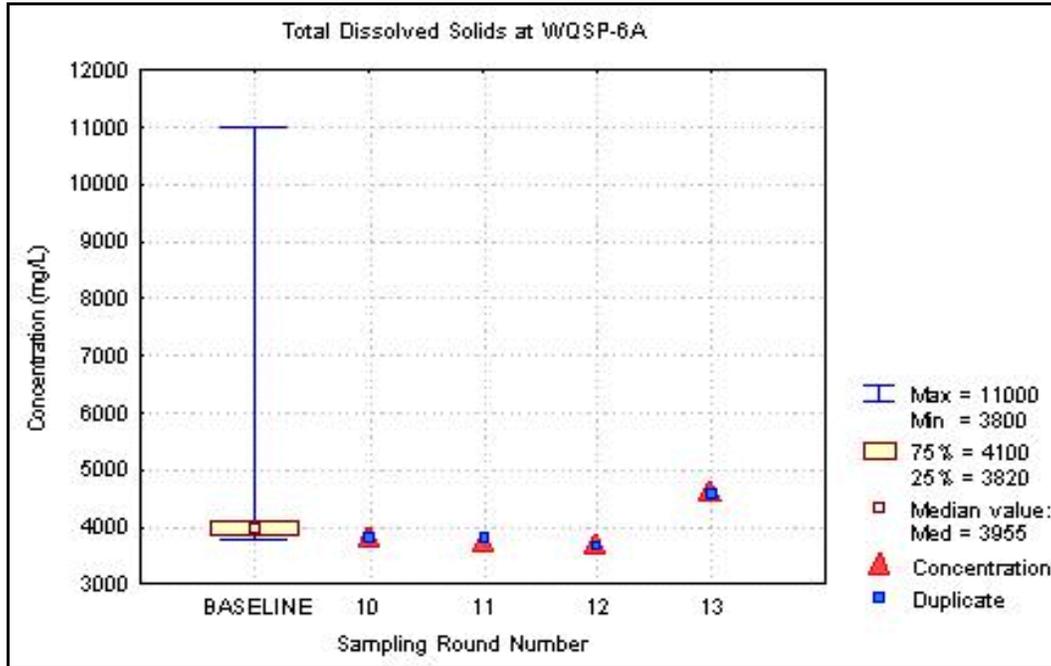


Figure F.124 - Time Trend Plot for Total Dissolved Solids at WQSP-6A

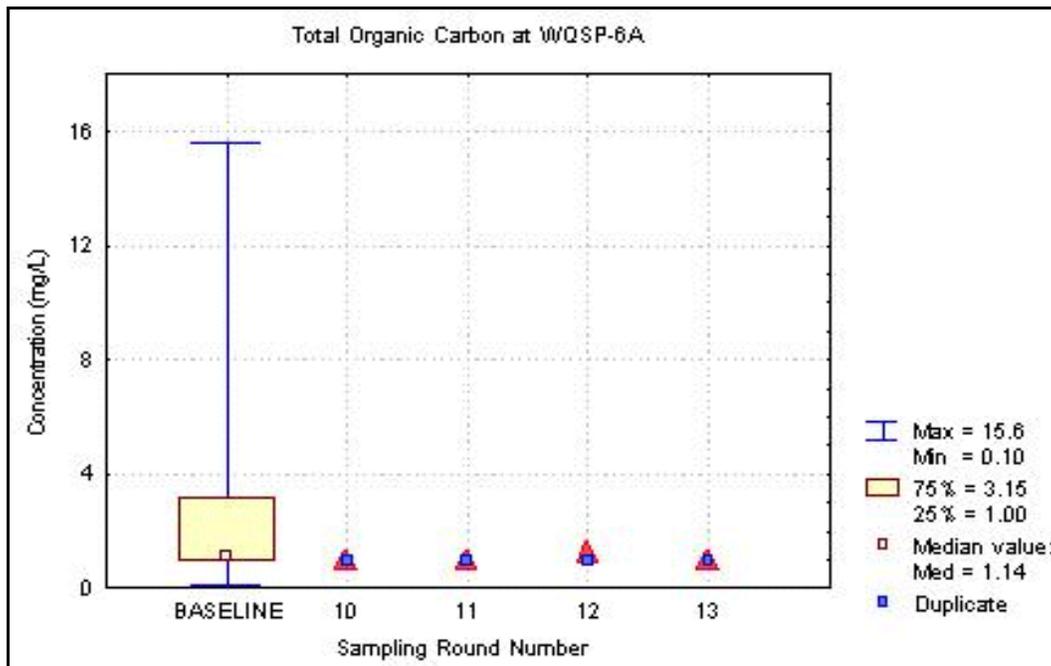


Figure F.125 - Time Trend Plot for Total Organic Carbon at WQSP-6A

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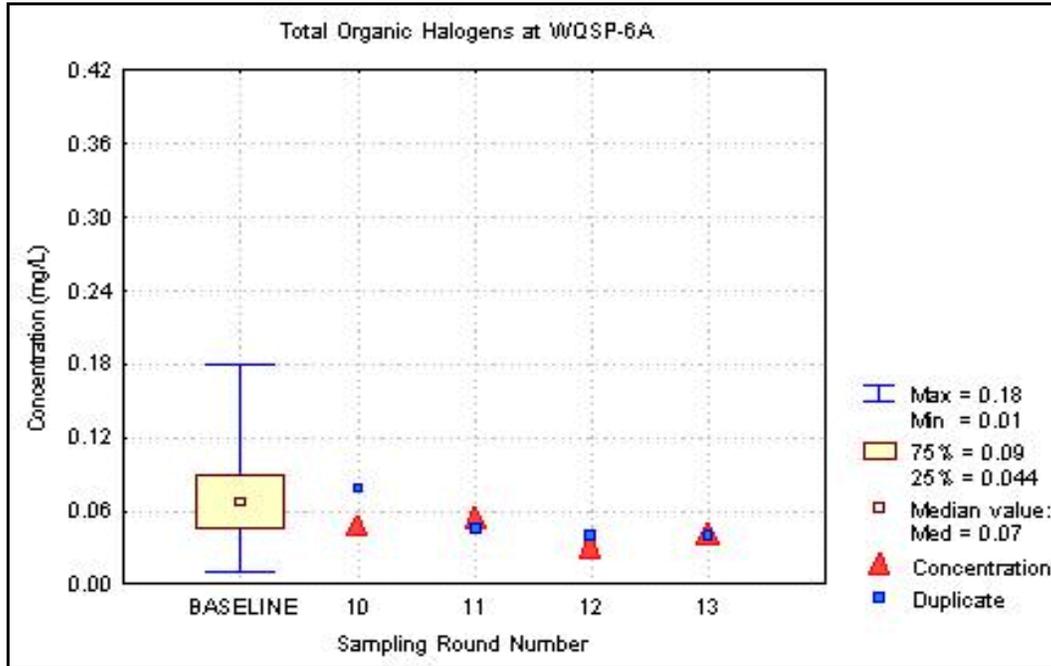


Figure F.126 - Time Trend Plot for Total Organic Halogens at WQSP-6A

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**Appendix G
Air Sampling Data: Concentrations of Radionuclides**

Table G.1 - Radionuclide Concentrations (Bq/m³) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	²⁴¹ Am			²³⁸ Pu			²³⁹⁺²⁴⁰ Pu		
		[RN] ^a	2xTPU ^b	MDC ^c	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
CBD	1	0.00×10 ⁰	0.00×10 ⁰	3.89×10 ⁻⁸	1.12×10 ⁻⁸	5.70×10 ⁻⁸	1.35×10 ⁻⁷	0.00×10 ⁰	0.00×10 ⁰	4.51×10 ⁻⁸
CBD	2	1.51×10 ⁻⁸	3.03×10 ⁻⁸	4.11×10 ⁻⁸	4.40×10 ⁻⁸	5.14×10 ⁻⁸	3.96×10 ⁻⁸	0.00×10 ⁰	0.00×10 ⁰	3.96×10 ⁻⁸
CBD	3	4.55×10 ⁻⁸	5.29×10 ⁻⁸	4.11×10 ⁻⁸	1.76×10 ⁻⁸	6.11×10 ⁻⁸	1.29×10 ⁻⁷	3.50×10 ⁻⁸	5.00×10 ⁻⁸	4.74×10 ⁻⁸
CBD	4	6.03×10 ⁻⁸	6.11×10 ⁻⁸	4.07×10 ⁻⁸	2.21×10 ⁻⁸	1.17×10 ⁻⁷	2.37×10 ⁻⁷	0.00×10 ⁰	0.00×10 ⁰	5.96×10 ⁻⁸
MLR	1	1.47×10 ⁻⁸	2.95×10 ⁻⁸	4.00×10 ⁻⁸	3.32×10 ⁻⁸	4.74×10 ⁻⁸	4.48×10 ⁻⁸	2.21×10 ⁻⁸	5.18×10 ⁻⁸	1.08×10 ⁻⁷
MLR	2	0.00×10 ⁰	0.00×10 ⁰	1.53×10 ⁻⁷	-3.36×10 ⁻⁸	6.73×10 ⁻⁸	1.81×10 ⁻⁷	1.68×10 ⁻⁸	3.36×10 ⁻⁸	4.55×10 ⁻⁸
MLR	3	1.78×10 ⁻⁸	7.99×10 ⁻⁸	1.66×10 ⁻⁷	4.85×10 ⁻⁸	8.58×10 ⁻⁸	1.50×10 ⁻⁷	3.22×10 ⁻⁸	6.48×10 ⁻⁸	1.19×10 ⁻⁷
MLR	4	1.81×10 ⁻⁸	3.62×10 ⁻⁸	4.88×10 ⁻⁸	8.07×10 ⁻⁸	1.21×10 ⁻⁷	1.97×10 ⁻⁷	0.00×10 ⁰	0.00×10 ⁰	7.25×10 ⁻⁸
SEC	1	1.44×10 ⁻⁸	2.87×10 ⁻⁸	3.89×10 ⁻⁸	-4.63×10 ⁻⁹	3.81×10 ⁻⁸	1.12×10 ⁻⁷	1.39×10 ⁻⁸	2.79×10 ⁻⁸	3.77×10 ⁻⁸
SEC	2	4.22×10 ⁻⁸	4.88×10 ⁻⁸	3.81×10 ⁻⁸	-2.60×10 ⁻⁸	3.70×10 ⁻⁸	1.21×10 ⁻⁷	5.22×10 ⁻⁸	5.25×10 ⁻⁸	3.52×10 ⁻⁸
SEC	3	-1.43×10 ⁻⁸	6.40×10 ⁻⁸	1.54×10 ⁻⁷	1.39×10 ⁻⁸	4.81×10 ⁻⁸	1.02×10 ⁻⁷	1.38×10 ⁻⁸	2.77×10 ⁻⁸	3.74×10 ⁻⁸
SEC	4	5.25×10 ⁻⁸	6.14×10 ⁻⁸	4.74×10 ⁻⁸	0.00×10 ⁰	0.00×10 ⁰	2.08×10 ⁻⁷	-2.82×10 ⁻⁸	5.66×10 ⁻⁸	2.08×10 ⁻⁷
SMR	1	-9.99×10 ⁻⁹	2.00×10 ⁻⁸	9.73×10 ⁻⁸	1.15×10 ⁻⁸	5.85×10 ⁻⁸	1.39×10 ⁻⁷	2.29×10 ⁻⁸	5.40×10 ⁻⁸	1.12×10 ⁻⁷
SMR	2	1.62×10 ⁻⁸	3.26×10 ⁻⁸	4.40×10 ⁻⁸	0.00×10 ⁰	0.00×10 ⁰	5.07×10 ⁻⁸	3.74×10 ⁻⁸	5.33×10 ⁻⁸	5.07×10 ⁻⁸
SMR	3	4.07×10 ⁻⁸	7.18×10 ⁻⁸	1.26×10 ⁻⁷	1.39×10 ⁻⁸	4.81×10 ⁻⁸	1.02×10 ⁻⁷	-1.39×10 ⁻⁸	2.78×10 ⁻⁸	1.02×10 ⁻⁷
SMR	4	0.00×10 ⁰	0.00×10 ⁰	5.70×10 ⁻⁸	2.07×10 ⁻⁷	2.23×10 ⁻⁷	3.05×10 ⁻⁷	0.00×10 ⁰	0.00×10 ⁰	1.12×10 ⁻⁷
WEE	1	5.74×10 ⁻⁸	5.81×10 ⁻⁸	3.89×10 ⁻⁸	-1.05×10 ⁻⁸	2.11×10 ⁻⁸	1.02×10 ⁻⁷	1.57×10 ⁻⁸	3.16×10 ⁻⁸	4.26×10 ⁻⁸
WEE	2	-1.45×10 ⁻⁸	5.00×10 ⁻⁸	1.34×10 ⁻⁷	5.62×10 ⁻⁸	8.03×10 ⁻⁸	1.31×10 ⁻⁷	1.41×10 ⁻⁸	2.82×10 ⁻⁸	3.81×10 ⁻⁸
WEE	3	1.66×10 ⁻⁸	1.10×10 ⁻⁷	2.17×10 ⁻⁷	-3.07×10 ⁻⁸	7.55×10 ⁻⁸	1.84×10 ⁻⁷	3.06×10 ⁻⁸	4.33×10 ⁻⁸	4.14×10 ⁻⁸
WEE	4	4.81×10 ⁻⁸	7.22×10 ⁻⁸	1.18×10 ⁻⁷	5.92×10 ⁻⁸	1.46×10 ⁻⁷	2.75×10 ⁻⁷	-2.96×10 ⁻⁸	5.96×10 ⁻⁸	2.18×10 ⁻⁷
WFF	1	1.95×10 ⁻⁸	4.59×10 ⁻⁸	9.55×10 ⁻⁸	3.89×10 ⁻⁸	6.18×10 ⁻⁸	1.08×10 ⁻⁷	1.65×10 ⁻⁸	3.32×10 ⁻⁸	4.48×10 ⁻⁸
WFF	2	1.65×10 ⁻⁸	5.74×10 ⁻⁸	1.22×10 ⁻⁷	-1.74×10 ⁻⁸	3.48×10 ⁻⁸	1.28×10 ⁻⁷	5.18×10 ⁻⁸	6.03×10 ⁻⁸	4.70×10 ⁻⁸

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Table G.1 - Radionuclide Concentrations (Bq/m³) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN] ^a	2xTPU ^b	MDC ^c	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC	
WFF	3	-4.26×10 ⁻⁸	6.40×10 ⁻⁸	1.71×10 ⁻⁷	-1.80×10 ⁻⁸	3.61×10 ⁻⁸	1.32×10 ⁻⁷	-1.79×10 ⁻⁸	3.60×10 ⁻⁸	1.32×10 ⁻⁷	
WFF	4	1.59×10 ⁻⁸	3.20×10 ⁻⁸	4.33×10 ⁻⁸	-2.71×10 ⁻⁸	5.44×10 ⁻⁸	7.33×10 ⁻⁸	1.08×10 ⁻⁷	1.34×10 ⁻⁷	1.99×10 ⁻⁷	
WSS	1	5.14×10 ⁻⁹	3.70×10 ⁻⁸	1.00×10 ⁻⁷	0.00×10 ⁰	0.00×10 ⁰	3.92×10 ⁻⁸	0.00×10 ⁰	0.00×10 ⁰	3.92×10 ⁻⁸	
WSS	2	0.00×10 ⁰	0.00×10 ⁰	1.09×10 ⁻⁷	1.64×10 ⁻⁸	5.70×10 ⁻⁸	1.21×10 ⁻⁷	1.64×10 ⁻⁸	3.29×10 ⁻⁸	4.44×10 ⁻⁸	
WSS	3	4.33×10 ⁻⁸	5.03×10 ⁻⁸	3.92×10 ⁻⁸	-1.68×10 ⁻⁸	7.51×10 ⁻⁸	1.80×10 ⁻⁷	1.67×10 ⁻⁸	3.35×10 ⁻⁸	4.51×10 ⁻⁸	
WSS	4	4.59×10 ⁻⁸	5.37×10 ⁻⁸	4.14×10 ⁻⁸	7.99×10 ⁻⁸	1.61×10 ⁻⁷	2.86×10 ⁻⁷	2.66×10 ⁻⁸	5.33×10 ⁻⁸	7.22×10 ⁻⁸	
WAB	1	1.14×10 ⁻⁴	2.29×10 ⁻⁴	3.10×10 ⁻⁴	3.02×10 ⁻⁴	3.52×10 ⁻⁴	2.72×10 ⁻⁴	-1.34×10 ⁻⁴	1.91×10 ⁻⁴	8.14×10 ⁻⁴	
WAB	2	0.00×10 ⁰	0.00×10 ⁰	7.99×10 ⁻⁴	2.83×10 ⁻⁴	4.03×10 ⁻⁴	3.85×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	3.85×10 ⁻⁴	
WAB	3	0.00×10 ⁰	0.00×10 ⁰	8.18×10 ⁻⁴	-1.24×10 ⁻⁴	6.55×10 ⁻⁴	1.48×10 ⁻³	0.00×10 ⁰	0.00×10 ⁰	9.07×10 ⁻⁴	
WAB	4	-1.39×10 ⁻⁴	2.80×10 ⁻⁴	1.02×10 ⁻³	3.70×10 ⁻⁴	5.55×10 ⁻⁴	9.07×10 ⁻⁴	0.00×10 ⁰	0.00×10 ⁰	9.07×10 ⁻⁴	
Minimum		-4.26×10 ⁻⁸	6.40×10 ⁻⁸	3.81×10 ⁻⁸	-3.36×10 ⁻⁸	6.73×10 ⁻⁸	3.92×10 ⁻⁸	-2.96×10 ⁻⁸	5.96×10 ⁻⁸	3.52×10 ⁻⁸	
Maximum		6.03×10 ⁻⁸	6.11×10 ⁻⁸	2.17×10 ⁻⁷	2.07×10 ⁻⁷	2.23×10 ⁻⁷	3.05×10 ⁻⁷	1.08×10 ⁻⁷	1.34×10 ⁻⁷	2.18×10 ⁻⁷	
Mean ^c		1.87×10 ⁻⁸	4.88×10 ⁻⁸	8.58×10 ⁻⁸	2.23×10 ⁻⁸	9.37×10 ⁻⁸	1.43×10 ⁻⁷	1.62×10 ⁻⁸	5.36×10 ⁻⁸	7.84×10 ⁻⁸	
²³⁴U											
CBD	1	2.51×10 ⁻⁶	5.66×10 ⁻⁷	4.11×10 ⁻⁸	5.62×10 ⁻⁸	6.55×10 ⁻⁸	5.11×10 ⁻⁸	2.44×10 ⁻⁶	5.51×10 ⁻⁷	4.11×10 ⁻⁸	
CBD	2	4.29×10 ⁻⁶	8.66×10 ⁻⁷	4.18×10 ⁻⁸	1.71×10 ⁻⁷	1.17×10 ⁻⁷	5.14×10 ⁻⁸	4.81×10 ⁻⁶	9.55×10 ⁻⁷	4.14×10 ⁻⁸	
CBD	3	3.10×10 ⁻⁶	6.36×10 ⁻⁷	3.92×10 ⁻⁸	2.15×10 ⁻⁷	1.28×10 ⁻⁷	4.85×10 ⁻⁸	3.00×10 ⁻⁶	6.22×10 ⁻⁷	1.07×10 ⁻⁷	
CBD	4	2.08×10 ⁻⁶	4.81×10 ⁻⁷	4.07×10 ⁻⁸	7.44×10 ⁻⁸	1.06×10 ⁻⁷	1.73×10 ⁻⁷	2.80×10 ⁻⁶	5.99×10 ⁻⁷	4.07×10 ⁻⁸	
MLR	1	2.07×10 ⁻⁶	4.70×10 ⁻⁷	1.15×10 ⁻⁷	8.18×10 ⁻⁷	9.29×10 ⁻⁸	1.42×10 ⁻⁷	2.16×10 ⁻⁶	4.88×10 ⁻⁷	1.31×10 ⁻⁷	
MLR	2	4.44×10 ⁻⁶	8.81×10 ⁻⁷	4.11×10 ⁻⁸	1.30×10 ⁻⁷	1.01×10 ⁻⁷	5.03×10 ⁻⁸	4.22×10 ⁻⁶	8.44×10 ⁻⁷	4.07×10 ⁻⁸	
MLR	3	2.91×10 ⁻⁶	6.33×10 ⁻⁷	4.26×10 ⁻⁸	1.93×10 ⁻⁷	1.26×10 ⁻⁷	5.22×10 ⁻⁸	2.53×10 ⁻⁶	5.70×10 ⁻⁷	1.15×10 ⁻⁷	
MLR	4	2.63×10 ⁻⁶	5.92×10 ⁻⁷	1.27×10 ⁻⁷	1.91×10 ⁻⁷	1.31×10 ⁻⁷	5.77×10 ⁻⁸	2.43×10 ⁻⁶	5.59×10 ⁻⁷	4.66×10 ⁻⁸	
SEC	1	2.42×10 ⁻⁶	5.25×10 ⁻⁷	3.74×10 ⁻⁸	1.25×10 ⁻⁷	1.01×10 ⁻⁷	1.11×10 ⁻⁷	2.39×10 ⁻⁶	5.22×10 ⁻⁷	3.74×10 ⁻⁸	
SEC	2	3.81×10 ⁻⁶	7.44×10 ⁻⁷	1.23×10 ⁻⁷	2.45×10 ⁻⁷	1.32×10 ⁻⁷	4.44×10 ⁻⁸	3.85×10 ⁻⁶	7.51×10 ⁻⁷	3.58×10 ⁻⁸	
SEC	3	2.64×10 ⁻⁶	5.55×10 ⁻⁷	3.52×10 ⁻⁸	1.44×10 ⁻⁷	1.09×10 ⁻⁷	1.18×10 ⁻⁷	2.54×10 ⁻⁶	5.37×10 ⁻⁷	3.51×10 ⁻⁸	
SEC	4	2.05×10 ⁻⁶	5.14×10 ⁻⁷	5.18×10 ⁻⁸	1.18×10 ⁻⁷	1.07×10 ⁻⁷	6.40×10 ⁻⁸	2.59×10 ⁻⁶	6.07×10 ⁻⁷	5.18×10 ⁻⁸	
²³⁸U											

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Table G.1 - Radionuclide Concentrations (Bq/m³) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN] ^a	2xTPU ^b	MDC ^c	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
SMR	1	2.36×10 ⁻⁶	5.33×10 ⁻⁷	4.22×10 ⁻⁸	2.31×10 ⁻⁷	1.38×10 ⁻⁷	5.22×10 ⁻⁸	2.26×10 ⁻⁶	5.22×10 ⁻⁷	1.26×10 ⁻⁷
SMR	2	4.26×10 ⁻⁶	8.44×10 ⁻⁷	4.22×10 ⁻⁸	1.91×10 ⁻⁷	1.36×10 ⁻⁷	1.41×10 ⁻⁷	4.11×10 ⁻⁶	8.21×10 ⁻⁷	4.18×10 ⁻⁸
SMR	3	2.69×10 ⁻⁶	5.59×10 ⁻⁷	9.77×10 ⁻⁸	1.47×10 ⁻⁷	1.01×10 ⁻⁷	4.44×10 ⁻⁸	2.71×10 ⁻⁶	5.59×10 ⁻⁷	3.58×10 ⁻⁸
SMR	4	2.58×10 ⁻⁶	5.99×10 ⁻⁷	5.33×10 ⁻⁸	4.85×10 ⁻⁸	6.88×10 ⁻⁸	6.59×10 ⁻⁸	2.56×10 ⁻⁶	6.03×10 ⁻⁷	1.82×10 ⁻⁷
WEE	1	2.34×10 ⁻⁶	5.40×10 ⁻⁷	1.29×10 ⁻⁷	7.88×10 ⁻⁸	7.96×10 ⁻⁸	5.33×10 ⁻⁸	2.35×10 ⁻⁶	5.40×10 ⁻⁷	4.29×10 ⁻⁸
WEE	2	4.51×10 ⁻⁶	8.84×10 ⁻⁸	3.96×10 ⁻⁸	1.62×10 ⁻⁷	1.11×10 ⁻⁷	4.88×10 ⁻⁸	4.18×10 ⁻⁶	8.29×10 ⁻⁷	3.96×10 ⁻⁸
WEE	3	2.93×10 ⁻⁶	6.44×10 ⁻⁷	4.48×10 ⁻⁸	1.84×10 ⁻⁷	1.26×10 ⁻⁷	5.55×10 ⁻⁸	2.61×10 ⁻⁶	5.88×10 ⁻⁷	4.48×10 ⁻⁸
WEE	4	2.66×10 ⁻⁶	5.99×10 ⁻⁷	4.33×10 ⁻⁸	1.77×10 ⁻⁷	1.21×10 ⁻⁷	5.33×10 ⁻⁸	2.33×10 ⁻⁶	5.44×10 ⁻⁷	1.17×10 ⁻⁷
WFF	1	2.10×10 ⁻⁶	4.74×10 ⁻⁷	4.14×10 ⁻⁸	1.20×10 ⁻⁷	1.05×10 ⁻⁷	1.23×10 ⁻⁷	1.75×10 ⁻⁶	4.18×10 ⁻⁷	4.14×10 ⁻⁸
WFF	2	4.59×10 ⁻⁶	8.51×10 ⁻⁷	4.33×10 ⁻⁸	2.95×10 ⁻⁷	1.58×10 ⁻⁷	5.33×10 ⁻⁸	4.14×10 ⁻⁶	7.84×10 ⁻⁸	4.29×10 ⁻⁸
WFF	3	2.77×10 ⁻⁶	5.92×10 ⁻⁷	4.07×10 ⁻⁸	2.03×10 ⁻⁷	1.27×10 ⁻⁷	5.00×10 ⁻⁸	2.70×10 ⁻⁶	5.81×10 ⁻⁷	4.03×10 ⁻⁸
WFF	4	2.54×10 ⁻⁶	5.55×10 ⁻⁷	1.16×10 ⁻⁷	0.00×10 ⁻⁰	0.00×10 ⁻⁰	2.10×10 ⁻⁷	2.25×10 ⁻⁶	5.07×10 ⁻⁷	1.16×10 ⁻⁷
WSS	1	2.01×10 ⁻⁶	4.48×10 ⁻⁷	3.61×10 ⁻⁸	1.04×10 ⁻⁷	9.10×10 ⁻⁸	1.07×10 ⁻⁷	2.14×10 ⁻⁶	4.70×10 ⁻⁷	8.66×10 ⁻⁸
WSS	2	4.29×10 ⁻⁶	8.62×10 ⁻⁷	4.18×10 ⁻⁸	7.59×10 ⁻⁸	7.70×10 ⁻⁸	5.14×10 ⁻⁸	4.37×10 ⁻⁶	8.73×10 ⁻⁷	4.14×10 ⁻⁸
WSS	3	2.79×10 ⁻⁶	5.85×10 ⁻⁷	3.70×10 ⁻⁸	1.85×10 ⁻⁷	1.15×10 ⁻⁷	4.55×10 ⁻⁸	2.61×10 ⁻⁶	5.55×10 ⁻⁷	3.69×10 ⁻⁸
WSS	4	2.62×10 ⁻⁶	5.74×10 ⁻⁷	4.07×10 ⁻⁸	5.55×10 ⁻⁸	6.44×10 ⁻⁸	5.00×10 ⁻⁸	2.40×10 ⁻⁶	5.37×10 ⁻⁷	4.03×10 ⁻⁸
WAB	1	1.57×10 ⁻²	3.74×10 ⁻³	3.24×10 ⁻⁴	1.18×10 ⁻³	8.58×10 ⁻⁴	4.00×10 ⁻⁴	1.76×10 ⁻²	4.11×10 ⁻³	3.23×10 ⁻⁴
WAB	2	2.18×10 ⁻²	4.74×10 ⁻³	3.15×10 ⁻⁴	8.58×10 ⁻⁴	7.14×10 ⁻⁴	3.89×10 ⁻⁴	2.35×10 ⁻²	5.03×10 ⁻³	8.51×10 ⁻⁴
WAB	3	2.02×10 ⁻²	4.29×10 ⁻³	2.79×10 ⁻⁴	1.14×10 ⁻³	7.84×10 ⁻⁴	3.45×10 ⁻⁴	1.74×10 ⁻²	3.85×10 ⁻³	2.78×10 ⁻⁴
WAB	4	1.69×10 ⁻²	3.77×10 ⁻³	2.81×10 ⁻⁴	6.40×10 ⁻⁴	5.81×10 ⁻⁴	3.47×10 ⁻⁴	1.68×10 ⁻²	3.77×10 ⁻³	7.62×10 ⁻⁴
Minimum		2.01×10 ⁻⁶	4.48×10 ⁻⁷	3.52×10 ⁻⁸	0.00×10 ⁻⁰	0.00×10 ⁻⁰	4.44×10 ⁻⁸	1.75×10 ⁻⁶	4.18×10 ⁻⁷	3.51×10 ⁻⁸
Maximum		4.59×10 ⁻⁶	8.51×10 ⁻⁷	1.29×10 ⁻⁷	8.18×10 ⁻⁷	9.29×10 ⁻⁸	2.10×10 ⁻⁷	4.81×10 ⁻⁶	9.55×10 ⁻⁷	1.82×10 ⁻⁷
Mean		2.96×10 ⁻⁶	1.66×10 ⁻⁶	5.80×10 ⁻⁸	1.69×10 ⁻⁷	2.82×10 ⁻⁷	7.74×10 ⁻⁸	2.90×10 ⁻⁶	1.63×10 ⁻⁶	6.42×10 ⁻⁸

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Table G.1 - Radionuclide Concentrations (Bq/m³) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	⁴⁰ K				⁶⁰ Co			
		[RN] ^a	2xTUPU ^b	MDC ^c	[RN]	2xTUPU	MDC	[RN]	2xTUPU
CBD	1	6.14×10 ⁻³	9.40×10 ⁻⁴	6.85×10 ⁻⁴	7.47×10 ⁻⁶	3.24×10 ⁻⁵	3.69×10 ⁻⁵		
CBD	2	4.63×10 ⁻⁴	3.06×10 ⁻⁴	3.62×10 ⁻⁴	3.92×10 ⁻⁵	2.98×10 ⁻⁵	3.57×10 ⁻⁵		
CBD	3	3.23×10 ⁻⁴	2.41×10 ⁻⁴	3.13×10 ⁻⁴	5.96×10 ⁻⁶	2.43×10 ⁻⁵	2.95×10 ⁻⁵		
CBD	4	1.65×10 ⁻⁴	1.92×10 ⁻⁴	2.38×10 ⁻⁴	-3.33×10 ⁻⁶	2.13×10 ⁻⁵	2.37×10 ⁻⁵		
MLR	1	2.10×10 ⁻⁴	1.71×10 ⁻⁴	2.19×10 ⁻⁴	4.48×10 ⁻⁶	1.64×10 ⁻⁵	1.98×10 ⁻⁵		
MLR	2	2.78×10 ⁻⁴	2.41×10 ⁻⁴	3.08×10 ⁻⁴	-1.64×10 ⁻⁶	2.36×10 ⁻⁵	2.73×10 ⁻⁵		
MLR	3	2.26×10 ⁻⁴	1.04×10 ⁻⁴	1.36×10 ⁻⁴	-1.25×10 ⁻⁶	2.20×10 ⁻⁵	2.48×10 ⁻⁵		
MLR	4	3.92×10 ⁻⁴	2.52×10 ⁻⁴	3.36×10 ⁻⁴	2.97×10 ⁻⁵	2.40×10 ⁻⁵	3.21×10 ⁻⁵		
SEC	1	6.44×10 ⁻³	9.77×10 ⁻⁴	6.99×10 ⁻⁴	-1.28×10 ⁻⁵	3.43×10 ⁻⁵	3.77×10 ⁻⁵		
SEC	2	1.11×10 ⁻⁴	1.35×10 ⁻⁴	2.16×10 ⁻⁴	-3.45×10 ⁻⁶	1.86×10 ⁻⁵	2.11×10 ⁻⁵		
SEC	3	2.82×10 ⁻⁴	2.90×10 ⁻⁴	3.39×10 ⁻⁴	1.64×10 ⁻⁵	3.06×10 ⁻⁵	3.57×10 ⁻⁵		
SEC	4	3.29×10 ⁻⁴	2.76×10 ⁻⁴	3.54×10 ⁻⁴	1.99×10 ⁻⁶	2.71×10 ⁻⁵	3.23×10 ⁻⁵		
SMR	1	2.57×10 ⁻⁴	1.37×10 ⁻⁴	1.89×10 ⁻⁴	2.81×10 ⁻⁶	2.50×10 ⁻⁵	2.73×10 ⁻⁵		
SMR	2	6.03×10 ⁻⁴	5.55×10 ⁻⁴	8.84×10 ⁻⁴	3.96×10 ⁻⁵	4.00×10 ⁻⁵	4.48×10 ⁻⁵		
SMR	3	4.92×10 ⁻⁴	3.02×10 ⁻⁴	3.59×10 ⁻⁴	-1.32×10 ⁻⁵	2.94×10 ⁻⁵	3.22×10 ⁻⁵		
SMR	4	4.29×10 ⁻⁴	3.64×10 ⁻⁴	5.74×10 ⁻⁴	9.99×10 ⁻⁶	4.51×10 ⁻⁵	5.07×10 ⁻⁵		
WEE	1	2.46×10 ⁻⁴	2.43×10 ⁻⁴	3.06×10 ⁻⁴	3.92×10 ⁻⁶	2.38×10 ⁻⁵	2.79×10 ⁻⁵		
WEE	2	6.44×10 ⁻⁵	2.46×10 ⁻⁴	2.91×10 ⁻⁴	1.58×10 ⁻⁵	2.26×10 ⁻⁵	2.85×10 ⁻⁵		
WEE	3	2.79×10 ⁻⁴	2.32×10 ⁻⁴	2.99×10 ⁻⁴	2.52×10 ⁻⁵	2.15×10 ⁻⁵	2.86×10 ⁻⁵		
WEE	4	1.50×10 ⁻⁴	8.92×10 ⁻⁵	1.27×10 ⁻⁴	9.32×10 ⁻⁶	1.79×10 ⁻⁵	2.14×10 ⁻⁵		
WFF	1	4.44×10 ⁻⁵	2.56×10 ⁻⁴	3.02×10 ⁻⁴	-1.17×10 ⁻⁵	2.60×10 ⁻⁵	2.80×10 ⁻⁵		
WFF	2	-5.29×10 ⁻⁵	2.37×10 ⁻⁴	2.59×10 ⁻⁴	1.48×10 ⁻⁶	1.95×10 ⁻⁵	2.31×10 ⁻⁵		
WFF	3	1.88×10 ⁻⁴	1.82×10 ⁻⁴	2.28×10 ⁻⁴	7.84×10 ⁻⁷	2.04×10 ⁻⁵	2.31×10 ⁻⁵		
WFF	4	2.70×10 ⁻⁴	1.86×10 ⁻⁴	2.42×10 ⁻⁴	-1.97×10 ⁻⁶	1.99×10 ⁻⁵	2.24×10 ⁻⁵		
WSS	1	1.93×10 ⁻⁴	2.44×10 ⁻⁴	3.01×10 ⁻⁴	-6.25×10 ⁻⁷	2.31×10 ⁻⁵	2.65×10 ⁻⁵		

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Table G.1 - Radionuclide Concentrations (Bq/m³) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN] ^a	2xTUP ^b	MDC ^c	[RN]	2xTUP	MDC	[RN]	2xTUP	MDC
WSS	2	2.93×10 ⁻⁴	1.84×10 ⁻⁴	2.41×10 ⁻⁴	-3.56×10 ⁻⁶	1.88×10 ⁻⁵	2.13×10 ⁻⁵			
WSS	3	1.84×10 ⁻⁴	2.39×10 ⁻⁴	2.96×10 ⁻⁴	1.85×10 ⁻⁵	1.93×10 ⁻⁵	2.49×10 ⁻⁵			
WSS	4	3.10×10 ⁻⁴	1.24×10 ⁻⁴	1.60×10 ⁻⁴	-2.09×10 ⁻⁶	2.05×10 ⁻⁵	2.32×10 ⁻⁵			
WAB	1	3.07×10 ⁰	1.32×10 ⁰	1.81×10 ⁰	6.70×10 ⁻²	1.32×10 ⁻¹	1.62×10 ⁻¹			
WAB	2	3.06×10 ⁰	2.29×10 ⁰	2.70×10 ⁰	8.10×10 ⁻³	2.28×10 ⁻¹	2.59×10 ⁻¹			
WAB	3	3.24×10 ⁰	1.57×10 ⁰	2.13×10 ⁰	-1.03×10 ⁻¹	2.94×10 ⁻¹	3.18×10 ⁻¹			
WAB	4	3.25×10 ⁰	2.35×10 ⁰	2.77×10 ⁰	2.06×10 ⁻¹	2.36×10 ⁻¹	2.76×10 ⁻¹			
Minimum		-5.29×10 ⁻⁵	2.37×10 ⁻⁴	1.27×10 ⁻⁴	-1.32×10 ⁻⁵	2.94×10 ⁻⁵	1.98×10 ⁻⁵			
Maximum		6.44×10 ⁻³	2.46×10 ⁻⁴	8.84×10 ⁻⁴	3.96×10 ⁻⁵	4.00×10 ⁻⁵	5.07×10 ⁻⁵			
Mean		6.90×10 ⁻⁴	3.11×10 ⁻³	3.31×10 ⁻⁴	6.32×10 ⁻⁶	2.72×10 ⁻⁵	2.89×10 ⁻⁵			
⁹⁰Sr										
CBD	1	2.55×10 ⁻⁶	4.14×10 ⁻⁶	6.99×10 ⁻⁶	3.70×10 ⁻⁵	3.70×10 ⁻⁵	4.00×10 ⁻⁵			
CBD	2	-5.00×10 ⁻⁶	5.11×10 ⁻⁶	8.81×10 ⁻⁶	-3.81×10 ⁻⁵	3.28×10 ⁻⁵	3.32×10 ⁻⁵			
CBD	3	8.03×10 ⁻⁸	4.66×10 ⁻⁶	7.77×10 ⁻⁶	1.47×10 ⁻⁵	2.13×10 ⁻⁵	2.50×10 ⁻⁵			
CBD	4	5.88×10 ⁻⁷	4.55×10 ⁻⁶	7.81×10 ⁻⁶	1.61×10 ⁻⁶	1.61×10 ⁻⁵	1.91×10 ⁻⁵			
MLR	1	5.33×10 ⁻⁶	4.88×10 ⁻⁶	8.03×10 ⁻⁶	-9.66×10 ⁻⁶	1.54×10 ⁻⁵	1.69×10 ⁻⁵			
MLR	2	-3.23×10 ⁻⁶	5.33×10 ⁻⁶	9.03×10 ⁻⁶	-1.28×10 ⁻⁵	2.34×10 ⁻⁵	2.49×10 ⁻⁵			
MLR	3	1.37×10 ⁻⁷	4.88×10 ⁻⁶	8.18×10 ⁻⁶	-9.40×10 ⁻⁶	1.75×10 ⁻⁵	1.95×10 ⁻⁵			
MLR	4	3.43×10 ⁻⁶	5.40×10 ⁻⁶	9.10×10 ⁻⁶	-5.59×10 ⁻⁶	2.46×10 ⁻⁵	2.81×10 ⁻⁵			
SEC	1	6.33×10 ⁻⁶	4.40×10 ⁻⁶	7.14×10 ⁻⁶	1.44×10 ⁻⁵	3.65×10 ⁻⁵	3.92×10 ⁻⁵			
SEC	2	-4.70×10 ⁻⁶	5.14×10 ⁻⁶	8.81×10 ⁻⁶	4.77×10 ⁻⁶	1.42×10 ⁻⁵	1.71×10 ⁻⁵			
SEC	3	-2.55×10 ⁻⁶	4.29×10 ⁻⁶	7.36×10 ⁻⁶	-1.52×10 ⁻⁵	2.97×10 ⁻⁵	3.26×10 ⁻⁵			
SEC	4	3.92×10 ⁻⁶	5.77×10 ⁻⁶	9.69×10 ⁻⁶	-4.70×10 ⁻⁶	2.50×10 ⁻⁵	2.76×10 ⁻⁵			
SMR	1	7.77×10 ⁻⁷	4.96×10 ⁻⁶	8.55×10 ⁻⁶	-2.07×10 ⁻⁶	2.29×10 ⁻⁵	2.57×10 ⁻⁵			
SMR	2	-1.58×10 ⁻⁶	8.47×10 ⁻⁶	1.44×10 ⁻⁵	3.66×10 ⁻⁵	3.89×10 ⁻⁵	4.55×10 ⁻⁵			
SMR	3	-3.02×10 ⁻⁶	4.29×10 ⁻⁶	7.40×10 ⁻⁶	-2.91×10 ⁻⁵	3.26×10 ⁻⁵	3.39×10 ⁻⁵			
¹³⁷Cs										
CBD	1	2.55×10 ⁻⁶	4.14×10 ⁻⁶	6.99×10 ⁻⁶	3.70×10 ⁻⁵	3.70×10 ⁻⁵	4.00×10 ⁻⁵			
CBD	2	-5.00×10 ⁻⁶	5.11×10 ⁻⁶	8.81×10 ⁻⁶	-3.81×10 ⁻⁵	3.28×10 ⁻⁵	3.32×10 ⁻⁵			
CBD	3	8.03×10 ⁻⁸	4.66×10 ⁻⁶	7.77×10 ⁻⁶	1.47×10 ⁻⁵	2.13×10 ⁻⁵	2.50×10 ⁻⁵			
CBD	4	5.88×10 ⁻⁷	4.55×10 ⁻⁶	7.81×10 ⁻⁶	1.61×10 ⁻⁶	1.61×10 ⁻⁵	1.91×10 ⁻⁵			
MLR	1	5.33×10 ⁻⁶	4.88×10 ⁻⁶	8.03×10 ⁻⁶	-9.66×10 ⁻⁶	1.54×10 ⁻⁵	1.69×10 ⁻⁵			
MLR	2	-3.23×10 ⁻⁶	5.33×10 ⁻⁶	9.03×10 ⁻⁶	-1.28×10 ⁻⁵	2.34×10 ⁻⁵	2.49×10 ⁻⁵			
MLR	3	1.37×10 ⁻⁷	4.88×10 ⁻⁶	8.18×10 ⁻⁶	-9.40×10 ⁻⁶	1.75×10 ⁻⁵	1.95×10 ⁻⁵			
MLR	4	3.43×10 ⁻⁶	5.40×10 ⁻⁶	9.10×10 ⁻⁶	-5.59×10 ⁻⁶	2.46×10 ⁻⁵	2.81×10 ⁻⁵			
SEC	1	6.33×10 ⁻⁶	4.40×10 ⁻⁶	7.14×10 ⁻⁶	1.44×10 ⁻⁵	3.65×10 ⁻⁵	3.92×10 ⁻⁵			
SEC	2	-4.70×10 ⁻⁶	5.14×10 ⁻⁶	8.81×10 ⁻⁶	4.77×10 ⁻⁶	1.42×10 ⁻⁵	1.71×10 ⁻⁵			
SEC	3	-2.55×10 ⁻⁶	4.29×10 ⁻⁶	7.36×10 ⁻⁶	-1.52×10 ⁻⁵	2.97×10 ⁻⁵	3.26×10 ⁻⁵			
SEC	4	3.92×10 ⁻⁶	5.77×10 ⁻⁶	9.69×10 ⁻⁶	-4.70×10 ⁻⁶	2.50×10 ⁻⁵	2.76×10 ⁻⁵			
SMR	1	7.77×10 ⁻⁷	4.96×10 ⁻⁶	8.55×10 ⁻⁶	-2.07×10 ⁻⁶	2.29×10 ⁻⁵	2.57×10 ⁻⁵			
SMR	2	-1.58×10 ⁻⁶	8.47×10 ⁻⁶	1.44×10 ⁻⁵	3.66×10 ⁻⁵	3.89×10 ⁻⁵	4.55×10 ⁻⁵			
SMR	3	-3.02×10 ⁻⁶	4.29×10 ⁻⁶	7.40×10 ⁻⁶	-2.91×10 ⁻⁵	3.26×10 ⁻⁵	3.39×10 ⁻⁵			

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Table G.1 - Radionuclide Concentrations (Bq/m³) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN] ^a	2xTPU ^b	MDC ^c	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
SMR	4	2.21×10 ⁻⁶	6.96×10 ⁻⁶	1.19×10 ⁻⁵	-3.28×10 ⁻⁵	4.63×10 ⁻⁵	4.88×10 ⁻⁵			
WEE	1	4.51×10 ⁻⁶	4.51×10 ⁻⁶	7.47×10 ⁻⁶	5.00×10 ⁻⁶	2.11×10 ⁻⁵	2.41×10 ⁻⁵			
WEE	2	-7.47×10 ⁻⁶	5.66×10 ⁻⁶	9.84×10 ⁻⁶	9.14×10 ⁻⁶	2.16×10 ⁻⁵	2.49×10 ⁻⁵			
WEE	3	7.92×10 ⁻⁸	5.11×10 ⁻⁶	8.55×10 ⁻⁶	1.56×10 ⁻⁵	2.21×10 ⁻⁵	2.59×10 ⁻⁵			
WEE	4	-9.21×10 ⁻⁷	4.44×10 ⁻⁶	7.73×10 ⁻⁶	9.10×10 ⁻⁶	1.46×10 ⁻⁵	1.78×10 ⁻⁵			
WFF	1	5.40×10 ⁻⁶	5.03×10 ⁻⁶	8.29×10 ⁻⁶	-6.33×10 ⁻⁶	2.32×10 ⁻⁵	2.52×10 ⁻⁵			
WFF	2	-3.33×10 ⁻⁶	6.70×10 ⁻⁶	1.12×10 ⁻⁵	-1.01×10 ⁻⁵	1.85×10 ⁻⁵	2.06×10 ⁻⁵			
WFF	3	-2.80×10 ⁻⁷	5.40×10 ⁻⁶	9.07×10 ⁻⁶	-3.10×10 ⁻⁶	1.52×10 ⁻⁵	1.75×10 ⁻⁵			
WFF	4	-1.61×10 ⁻⁷	4.59×10 ⁻⁶	7.96×10 ⁻⁶	7.59×10 ⁻⁶	1.50×10 ⁻⁵	1.82×10 ⁻⁵			
WSS	1	5.62×10 ⁻⁶	4.51×10 ⁻⁶	7.36×10 ⁻⁶	-7.59×10 ⁻⁶	2.13×10 ⁻⁵	2.31×10 ⁻⁵			
WSS	2	-4.11×10 ⁻⁶	5.74×10 ⁻⁶	9.73×10 ⁻⁶	8.10×10 ⁻⁷	1.48×10 ⁻⁵	1.76×10 ⁻⁵			
WSS	3	-8.36×10 ⁻⁷	5.55×10 ⁻⁶	9.40×10 ⁻⁶	-4.74×10 ⁻⁶	2.09×10 ⁻⁵	2.31×10 ⁻⁵			
WSS	4	1.84×10 ⁻⁶	4.66×10 ⁻⁶	7.88×10 ⁻⁶	2.36×10 ⁻⁶	1.58×10 ⁻⁵	1.88×10 ⁻⁵			
WAB	1	4.63×10 ⁻³	3.27×10 ⁻²	5.62×10 ⁻²	-4.96×10 ⁻²	1.15×10 ⁻¹	1.30×10 ⁻¹			
WAB	2	-2.22×10 ⁻²	3.74×10 ⁻²	6.33×10 ⁻²	-3.10×10 ⁻²	2.24×10 ⁻¹	2.53×10 ⁻¹			
WAB	3	-2.12×10 ⁻²	3.35×10 ⁻²	5.74×10 ⁻²	5.62×10 ⁻²	2.11×10 ⁻¹	2.53×10 ⁻¹			
WAB	4	1.08×10 ⁻²	3.16×10 ⁻²	5.37×10 ⁻²	-3.40×10 ⁻¹	2.51×10 ⁻¹	2.50×10 ⁻¹			
Minimum		-7.47×10 ⁻⁶	5.66×10 ⁻⁶	6.99×10 ⁻⁶	-3.81×10 ⁻⁵	3.28×10 ⁻⁵	1.69×10 ⁻⁵			
Maximum		6.33×10 ⁻⁶	4.40×10 ⁻⁶	1.44×10 ⁻⁵	3.70×10 ⁻⁵	3.70×10 ⁻⁵	4.88×10 ⁻⁵			
Mean		2.01×10 ⁻⁷	7.08×10 ⁻⁶	8.77×10 ⁻⁶	-7.71×10 ⁻⁷	3.35×10 ⁻⁵	2.62×10 ⁻⁵			

^a Radionuclide Concentration

^b Total Propagated Uncertainty

^c Minimum Detectable Concentration

^d Arithmetic Average Concentration and MDC; TPU equals the standard deviation of the mean.

**Appendix H
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Executive Summary

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