For Calendar Year 2013

Site Environmental Report

Pantex Plant

NPO PANTEX ★ Y12

CNS consolidated nuclear security, llc
PANTEX PLANT | Y-12 NATIONAL SECURITY COMPLEX

Site Environmental Report

Pantex Plant 2013

Prepared for
U.S. Department of Energy/National Nuclear Security Administration
Production Office

Prepared by
Environmental Stewardship Department,
Waste Operations Department,
and the Projects Division

Consolidated Nuclear Security, LLC
(CNS Pantex) Amarillo, Texas 79120-0020

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Help Us Make This Site Environmental Report More Useful for You!

We want this summary to be easy to read and useful. To help continue this effort, please take a few minutes to let us know if this annual report meets your needs. Please tear out this page and mail or fax it to:

Zelda Martinez, Pantex Plant/12-132
P.O. Box 30020, Amarillo, TX 79120-0020
Phone: (806) 477-6049; Fax: (806) 477-5613

1. How do you use the information in this summary? Please circle.

To become more familiar with Pantex Plant monitoring
To help me make a decision about moving to the Texas Panhandle
To send to others outside the Texas Panhandle
To prepare for public meetings
Other (please explain).

2. What parts of the summary do you use? Please circle.

Pantex Plant overview/mission
Site management
Environmental compliance
Environmental monitoring
Quality assurance
Regulatory oversight
Current issues and actions

3. Does this guide contain?

Enough detail   Too much detail   Too little detail

Comments:

4. If you could change this guide to make it more readable and useful to you, what would you change?

What is your affiliation? Please circle.

Pantex contractor	DOE
State agency	Federal agency
Public interest group	Member of the public
Member of Native American Nation	Local government
University	Industry

Other Comments
Thank you!

Annual Site Environmental Report for Pantex Plant
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TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Chapter 5 - Air Monitoring

Chapter 6 - Groundwater Monitoring

Chapter 7 - Drinking Water

Chapter 8 - Wastewater

Chapter 9 - Surface Water

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AEC	Atomic Energy Commission
AFV	Alternative Fuel Vehicle
AISD	Amarillo Independent School District
AQMR	Air Quality Management Requirement
ARC	Acquisition Review Committee
ARPA	Archaeological Resource Protection Act
B&W Pantex	Babcock & Wilcox Technical Services Pantex, LLC
BCG	Biota Concentration Guide
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CAP	Corrective Action Plan
CAR	Corrective Action Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS/FS	Corrective Measures Study/Feasibility Study
COC	Chain of Custody
COC	Contaminants of Concern
COD	Chemical Oxygen Demand
COPC	Contaminant of Potential Concern
CP	Compliance Plan
CRM	Cultural Resource Management
CWA	Clean Water Act
CY	Calendar Year
D&Z	Day and Zimmerman
DBP	Disinfectant By-Product
DCS	Derived Concentration Standard
DPA	Data Package Assessment
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DQO	Data Quality Objective
EA	Environmental Assessment
EDD	Electronic Data Deliverable
EID	Environmental Information Document
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Administration
ESA	Endangered Species Act
ESD	Environmental Stewardship Department
ESTAR	Environmental Sustainability Award
FEC	Federal Electronics Challenge
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FM	Farm-to-Market Road
FS-4	Firing Site 4
FY	Fiscal Year (October 1 - September 30)
GAC	Granular Activated Carbon
GHG	Greenhouse Gas

ABBREVIATIONS AND ACRONYMS

GPS	Global Positioning Satellite
GWPS	Groundwater Protection Standard
HAA5	Haloacetic Acid
HAP	Hazardous Air Pollutant
HE	High Explosives
HEPA	High-Efficiency Particulate Air
HVAC	Heating-ventilation-air conditioning
IAG	Interagency Agreement
ICRP	International Commission of Radiological Protection
IEDB	Integrated Environmental Database
IRAR	Interim Remedial Action Report
ISB	In-situ Bioremediation
ISM	Interim Stabilization Measure
ISMS	Integrated Safety Management System
ISPM	In-Situ Performance Monitoring
ISO	International Standards Organization
IWQP	Inland Water Quality Parameter
LQAP	Laboratory Quality Assurance Program
LTM	Long-Term Monitoring
MAPEP	Mixed Analyte Performance Evaluation Program
Max	Maximum
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
MHC	Mason and Hanger Corporation
Min	Minimum
MIOX	Mixed-Oxide
MSDS	Material Safety Data Sheet
MSGP	Multi-Sector General Permit
N/A	Not Applicable
NS	No Sample
NAGPRA	Native American Graves Protection and Repatriation Act
NAPL	Non-Aqueous Phase Liquid
NCR	Nonconformance Report
NCRP	National Council on Radiation Protection and Measurements
ND	Not Detected
NELAC	National Environmental Laboratory Accreditation Conference
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NNSA	National Nuclear Security Administration
No.	Number
NPO	National Nuclear Security Administration Production Office
NPS	National Park Service
NRF	NEPA Review Form
NTNC-PWS	Non-Transient, Non-Community Public Water System
NWS	National Weather Service
O&M	Operation and Maintenance
ODS	Ozone Depleting Substance

ABBREVIATIONS AND ACRONYMS

ORP	Oxidation Reduction Potential
OSSF	On-Site Sewage Facility
P1PTS	Playa 1 Pump and Treat System
P2	Pollution Prevention
PA/CRMP	Programmatic Agreement/ Cultural Resources Management Plan
PBR	Permits-by-Rule
PE	Performance Evaluation
PGCD	Panhandle Groundwater Conservation District
PIDAS	Perimeter Intrusion Detection and Surveillance
PM	Particulate Matter
PMU	Playa Management Unit
PPOA	Pollution Prevention Opportunity Assessment
PQL	Practical Quantitation Limit
PRCM	Pantex Radiation Control Manual
PREP	Pantex Renewable Energy Project
PST	Petroleum Storage Tank
PTE	Potential to Emit
PWS	Public Water System
PXSO	Pantex Site Office
QA	Quality Assurance
QC	Quality Control
Qtr	Quarter
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RER	Replicate Error Ratio
RFIR	RCRA Facility Investigation Report
ROD	Record of Decision
RRS	Risk Reduction Standard
RSD	Radiation Safety Department
S&A	Sampling and Analysis
SAR	Sodium Absorption Rate
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SE	Standard Exemption
SEISB	Southeast In-Situ Bioremediation
SEPTS	Southeast Pump and Treat System
SHPO	State Historic Preservation Office
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	Spill Prevention, Control, and Countermeasure
SSI	Statistically Significant Increase
Std Dev	Standard Deviation
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SWEIS	Site-wide Environmental Impact Statement
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TCAA	Texas Clean Air Act

ABBREVIATIONS AND ACRONYMS

TCEQ	Texas Commission on Environmental Quality
TDSHS	Texas Department of State Health Services
TLAP	Texas Land Application Permit
TLD	Thermoluminescent Dosimeter
TNI	The NELAC Institute
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRI	Toxic Chemical Release Inventory
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
THM	Total Trihalomethanes
TTRF	Texas Tech Research Farm
TTU	Texas Tech University
TYSP	Ten Year Site Plan
UCL	Upper Confidence Limit
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
VEE	Visual Emission Evaluations
VOC	Volatile Organic Compound
VMF	Vehicle Maintenance Facility
WMG	Waste Management Group
WWTF	Wastewater Treatment Facility

ACKNOWLEDGEMENTS

In 2013, Babcock & Wilcox, LLC (B&W Pantex) was the Managing and Operating Contractor of the Pantex Plant. On July 1, 2014, Consolidated Nuclear Security, LLC (CNS) took over as Managing and Operating Contractor. Any and all data collected for the 2013 ASER was under the B&W contractor.

This report was prepared primarily by the staffs of the Environmental Programs of Babcock & Wilcox Technical Services Pantex, LLC. The Environmental Stewardship Department is managed by Jeffrey R. Flowers, the Projects Division (at the time of preparation) is managed by Dennis E. Huddleston, Jr., and the Waste Operations Department is managed by Jimmy C. Rogers.

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The results presented in this report are from samples collected by the Projects Divisions Programs Department. Many other staff members in the environmental departments worked on validating data, conducting quality checks, and making the data available electronically.

The *2013 Site Environmental Report for Pantex Plant* was reviewed for classification and security issues; it was determined to be Unclassified.

GLOSSARY

Activity - The rate of disintegration or transformation of radioactive material, generally expressed in units of Curies (Ci). The official SI unit is the Becquerel (Bq). One Bq (one disintegration or transformation per second) is equivalent to 2.7 X 10^{-11} Ci.

ALARA - An acronym and phrase, "As Low As Reasonably Achievable," used to describe an approach to radiation exposures and emission control or management whereby the exposures and resulting doses to the public are maintained as far below the specified limits as economic, technical, and practical considerations will permit. ALARA is not a dose limit.

Aliquot – Contained an exact number of times in something else – used of a divisor or part.

Alpha particle - Type of particulate radiation (identical to the nucleus of the helium atom) consisting of two protons and two neutrons.

Ammonium nitrate - A colorless crystalline salt ($N_2H_4O_3$) used in explosives, fertilizers, and veterinary medicine.

Anion - A negatively charged ion that migrates to an anode, as in electrolysis.

ANSI - American National Standards Institute, a voluntary standards organization; Administrator, U.S. Technical Advisory Group to the International Standards Organization (ISO).

Aquifer - Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Archeology - The scientific discipline responsible for recovering, analyzing, interpreting, and explaining the unwritten portion of the prehistoric and historic past.

Archival - Relating to, contained in, or constituting archives, which are places where generally unpublished public records or historical documents are preserved.

Artifact - Any object manufactured or modified by human beings.

Asbestos - Group of naturally occurring minerals that separate into fibers. The asbestos family includes actinolite, anthophyllite, chrysotile, crocidolite, and tremolite.

Assembly - The process of putting together a nuclear weapon or nuclear weapon component. This process takes place at Pantex Plant.

Background or control samples - Samples obtained from a background sampling location for comparison with samples obtained at or near Pantex. Background or control samples are not expected to be affected by Pantex operations. The U.S. Department of Agriculture Research Station and the Texas Agri-Life Bush Research Farm at Bushland, Texas, have often been used as a control or background location.

Background radiation - Ionizing radiation which is in the natural environment, including cosmic rays and radiation from the naturally radioactive elements, both outside and inside the bodies of humans and animals.

Becquerel (Bq) - The *Système International d'Unités* (SI units) unit of radioactivity is the becquerel, defined as one nuclear disintegration per second; therefore, one Curie (Ci) is equivalent to 3.7 X 10^{10} Bq.

Best Management Practices - Practices that are not required by law, regulation, or permit, but are designed to help ensure that Pantex Plant produces the highest quality services and products.

Beta particle - Type of particulate radiation emitted from the nucleus of an atom that has a mass and charge equal in magnitude to that of the electron.

Biomass - Literally, "living weight," refers to mass having its origin as living organisms.

Biome - Recognizable community units formed by the interaction of regional climate, regional biota, and substrate, e.g., the same biome units generally can be found on different continents at the same latitudes with approximately the same weather conditions and where topography is similar. Biomes are the largest land community units recognized.

Biota - Living organisms.

Biota Concentration Guide – The limiting concentration of a radionuclide in soil, sediment, or water that would not cause dose limits for protection of aquatic and terrestrial biota to be exceeded. An analogue to the Derived Concentration Guide (DCG) used for human exposure.

Blackwater Draw Formation - Quaternary formation consisting primarily of pedogenically modified eolian sands and silts interbedded with numerous caliche layers. The Blackwater Draw Formation overlies the Tertiary Ogallala Formation at Pantex.

Burning Ground - The Pantex Plant location where thermal processing (burning) of high explosives (HE) is conducted.

Calibration - The adjustment of a measurement system and the determination of its accuracy using known sources and instrument measurements. Adjustment of flow, temperature, humidity, or pressure gauges and the determination of system accuracy should be conducted using standard operating procedures and sources that are traceable to the National Institute of Standards and Technology.

Categorical Exclusion – Categorical exclusions are categories of actions under the National Environmental Policy Act (NEPA) that DOE has determined, by regulation, do not individually or cumulatively have a significant effect on the human environment and for which; therefore, neither an environmental assessment nor an environmental impact statement normally is required.

Cation – A positively charged ion that in an electrolyte moves toward a negative electrode.

Cell - (1) This is the smallest unit capable of independent functioning. (2) A structure at Pantex in which certain nuclear explosive assembly or disassembly operations are conducted.

Central flyway - A major migratory route used by large numbers of migrating birds in fall and spring that crosses the central portion of North America from Canada to Mexico.

Centripetal drainage - The flow of water in a basin toward a central drain or sink, such as a pond or lake.

Code of Federal Regulations (CFR) - Final federal regulations in force: published in codified form.

Composite samples – Samples that contain a certain number of subsamples.

Council on Environmental Quality (CEQ) - Created, in the Executive Office of the President, by the National Environmental Policy Act (NEPA), such that its members are exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the Federal Government in the light of the policy set forth in Title I of NEPA; to be conscious of and responsive to the scientific, economic, social, aesthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

Cultural Resources - Districts, sites, structures, and objects and evidence of some importance to a culture, a subculture, or a community for scientific, traditional, religious, and other reasons. These resources and relevant environmental data are important for describing and reconstructing past lifeways, for interpreting human behavior, and for predicting future courses of cultural development.

Depleted uranium - Uranium for which the content of the isotope of uranium-235 is smaller than 0.7 percent; the level found in naturally occurring uranium (and thus generally synonymous with isotope uranium-238).

GLOSSARY

Derived Concentration Guide - The concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (for example, ingestion of water or breathing the air) would result in an effective dose equivalent of 100 mrem, (0.1 rem or 1 mSv). Values for these concentrations are tabulated in DOE-STD-1196-2011; Derived Concentration Technical Standard.

Dismantlement - The disassembly of a nuclear weapon no longer required by the DOD. This process takes place at Pantex Plant.

Dockum Group - Triassic sedimentary rocks that underlie the Ogallala Formation at Pantex Plant. The Dockum Group rocks consist of shale, clayey siltstone, and sandstone.

Dose - The quantity of ionizing radiation received. Often used in the sense of exposure dose (a measure of the total amount of ionization that the radiation could produce in air, measured in roentgens [R]). This should be distinguished from the absorbed dose (measured in rads) that represents the energy absorbed from the radiation per gram of any material. Furthermore, dose equivalent (or biological dose), given in rem, is a term used to express the amount of effective radiation when modifying factors such as quality factors have been considered. It is therefore a measure of the biological damage to living tissue from the radiation exposure.

Duplicate sample - A sample that is taken at the same location and the same site; it may be taken simultaneously or consecutively. This sample may be collected for the purpose of evaluating the performance of a measurement system or of the homogeneity of a sample population; i.e., to determine whether the sample results are representative or an anomaly. The duplicates are supposed to be similar in terms of the population sampled.

Ecosystem - Living organisms and their nonliving (abiotic) environment functioning together as a community.

Effective Dose Equivalent (EDE) - The sum of the products of the exposures to individual organs and tissues and appropriate weighting factors representing the risk relative to that for an equal dose to the whole body.

Effects Screening Levels (ESL) - Guideline concentrations established by the TCEQ to evaluate the potential impacts of air pollutant emissions including acute and chronic health effects, odor nuisance potential, vegetation effects or corrosion effects. ESLs are set to provide a margin of safety below levels at which adverse effects are reported in scientific literature. This margin of safety is added to protect sensitive sub-populations, such as children, the elderly, and persons with pre-existing illnesses.

Effluent - A fluid discharged into the environment; an outflow of waste. Its monitoring is conducted at the point of release.

Emission - A substance discharged to the air.

Emissions standards - Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

Encephalitis - Inflammation of the brain (specifically western equine and eastern equine). In the U.S., this is an acute, often fatal, viral disease of the central nervous system that is transmitted to humans by mosquitoes (arthropods) after a blood meal from infected horses or mules.

Environmental Assessment – A concise public document that a Federal agency prepares under NEPA to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement or a finding of no significant impact.

Environmental Impact Statement – The detailed written statement that is required by Section 102(2)(C) of NEPA for a proposed major federal action significantly affecting the quality of the human environment.

Environmental Monitoring - Sample collection and analysis of environmental media, i.e., air, water, soil, foodstuff, and biota for the purpose of assessing effects of operations at that site on the local environment. It consists of effluent monitoring and environmental surveillance.

Environmental Protection Agency (EPA) - Federal agency created to protect the nation's water, land, and air from pollution or environmental damage.

Environmental Restoration (ER) Program - Program at Pantex responsible for investigation and remediation of Solid Waste Management Units.

Environmental Surveillance - The collection and analysis of samples, or direct measurements of air, water, soil, foodstuff, and other media for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public, and assessing the effects, if any, on the local environment.

Ephemeral - Lasting only a short period of time. Used in this document to describe water bodies that often does not have water year round. Typically, these water bodies have water following the wet seasons and then are dry during the dry seasons.

Evapotranspiration - The sum of evaporation, the process by which water passes from the liquid to the vapor state, and transpiration, the process by which plants give off water vapor through their leaves.

Extirpate – To destroy completely.

Fauna - Animal life, or animals as a whole, especially those that are characteristic of a region.

Fecal coliform bacteria - Simple organisms associated with the intestine of warm-blooded animals that are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.

Flora - Plant life or plants as a whole, especially those that are characteristic of a region.

Gamma ray (gamma radiation) – High-energy, short wavelength electromagnetic radiation (a packet of energy) emitted from the nucleus. (Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission.) Gamma rays are very penetrating and can be stopped or shielded against by dense materials such as lead or uranium. Gamma rays are similar to X-rays, but are usually more energetic.

Grab sample - A single sample, collected at one time and place.

Greenhouse Gases (GHGs) – Chemical compounds found in the earth's atmosphere which absorb infrared radiation (heat) from the reflection of sunlight striking the earth's surface and cause rising temperatures. Some occur in nature (e.g., carbon dioxide, methane, and nitrous oxide), and others such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are anthropogenic (man-made). For Federal agencies emissions of greenhouse gases are further classified as:
Scope 1: direct GHG emissions from sources that are owned or controlled by the Federal agency;
Scope 2: direct GHG emissions resulting from the generation of electricity, heat, or steam purchased by a Federal agency; and,
Scope 3: GHG emissions from sources not owned or directly controlled by a Federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting.

Hantavirus Pulmonary Syndrome - The hantavirus is found in saliva, urine, or feces of various rodent species and is transmitted to humans by inhalation. It causes rapidly progressive pulmonary symptoms that result in serious illness. Human-to-human transmission has not been demonstrated.

Hazardous material - A material, including a hazardous substance, as defined by 49 CFR 171.8 that poses a risk to health, safety, and property when handled or transported.

Hazardous waste - Defined by 40 CFR Part 261, as any material that a) is a solid waste, and b) is a listed hazardous waste (Subpart D), or c) exhibits any of the characteristics of ignitibility, corrosivity, reactivity or toxicity (Subpart C).

Hemoglobin - A protein found in red blood cells that transports oxygen.

Herpesvirus - Any virus belonging to the family Herpesviridae. It is basically a wildlife disease, and offers possible implications to research on human viruses.

Herbicide - A substance (usually chemical) used to destroy undesirable plants.

Herpetofauna - Reptiles (snakes, turtles, lizards, etc.) and amphibians (frogs, toads, salamanders).

High explosives (HE) - Any chemical compound or mechanical mixture which, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressure in the surrounding medium.

Histopathology - The science or study of dealing with the structure of abnormal or diseased tissue; examination of the tissue changes that accompany a disease.

Historic - Of, relating to, or existing in times postdating the development of written records. Historic cultural resources are all evidences of human occupations that date to recorded periods in history. Historic resources also may be considered to be archeological resources when archeological work is involved in their identification and interpretation.

Industrial solid waste - Solid waste resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations.

Infrastructure - The basic services, facilities and equipment needed for the functioning and growth of an area.

Insecticide - A substance used to destroy undesirable insects.

Interim Stabilization Measure (ISM) - Action taken to control or abate threats to human health and/or the environment from releases and/or to prevent or minimize the further spread of contamination while long-term remedies are pursued.

International System of Units - An internationally accepted coherent system of physical units, derived from the Meter, Kilogram, Second, Ampere (MKSA) system, using the meter, kilogram, second, ampere, kelvin, mole, and candela as the basic units (SI units) of the fundamental quantities length, mass, time, electric current, temperature, and luminous intensity. Abbr.: SI from the French “Système Internationale d”Unités.”

Invertebrate - Animals characterized by not having a backbone or spinal column, including a wide variety of organisms such as insects, spiders, worms, clams, crayfish, etc.

Isotope - Any of two or more species of atoms of a chemical element with the same atomic number and position in the periodic table and nearly identical chemical behavior but with different numbers of neutrons in their nuclei, and thus differing atomic mass number and different physical properties.

Lacustrine - Pertaining to, produced by, or inhabiting a lake or lakes.

Lagomorph - Any of the various gnawing mammals in the order Lagomorpha, including rabbits, hares, and pikas.

Less than 55-gallon Hazardous Waste Accumulation Sites - Temporary hazardous or mixed waste accumulation points located at or near the point of generation to collect no more than a total of 55 gallons of hazardous waste or no more than 1 quart of acutely hazardous waste. This area must be under the control of the operator of the process generating the waste.

Less than 90-Day Hazardous Waste Accumulation Sites - These are temporary accumulation areas used to collect hazardous wastes for 90 days or less before transfer to an interim status or permitted hazardous waste processing or storage facility.

Llano Estacado - Spanish for "staked plains", used to refer to the Southern High Plains.

Low-level radioactive waste - Waste containing radioactivity not classified as high-level, transuranic waste, spent nuclear fuel, or special by-product material.

Mammal - Animals in the class Mammalia that are distinguished by having self-regulating body temperature, hair, and in females, milk-producing mammary glands to feed their young.

Matrix spike duplicates - Used to evaluate the precision of a specific analysis.

Maximum Contaminant Levels (MCLs) - The maximum permissible level of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards.

Method Detection Limit - A measure of instrument sensitivity using solutions that have been subjected to all sample preparation steps for the method.

Metric System - See International System of Units.

Mitigation - The alleviation of adverse impacts on resources by avoidance through project redesign or project relocation.

Mixed waste - Waste containing both radionuclides as defined by the Atomic Energy Act, and hazardous constituents as defined by 42 USC 6901 et seq. and 40 CFR 261.

Mortuary remains - Human physical remains and associated artifacts that exist in prehistoric and historic temporal contexts.

National Ambient Air Quality Standards (NAAQS) - Standards developed, under the authority of the Clean Air Act by the Environmental Protection Agency, to protect the quality of the air we breathe. Standards are set for six pollutants: sulfur dioxide, particulate matter with a mean aerodynamic diameter of 10 microns or less, carbon monoxide, ozone, nitrogen dioxide, and lead.

National Environmental Policy Act (NEPA) - Federal statute promulgated under 40 CFR part 1500 through 1508; requires Federal facility actions be evaluated for environmental impacts, usually in the form of Environmental Impact Statements or Environmental Assessments. 10 CFR 1021 is DOE's Implementing Procedures for NEPA.

National Pollutant Discharge Elimination System (NPDES) - U.S. Federal Regulation (40 CFR, Parts 122 and 125) that requires permits for the discharge of pollutants from any point source into the waters of the United States.

National Register of Historic Places - A national list of districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, engineering, and culture.

Native American - A tribe, people, or culture that is indigenous to the United States.

Necropsy - Autopsy, postmortem examination.

Nuclear weapon - Any weapon with a nuclear device designed specifically to produce a large release of energy (nuclear explosion) from the fission and/or fusion of atomic nuclei.

Off-Normal Event - Abnormal or unplanned events or conditions that adversely affect, potentially affect, or are indicative of degradation in, the safety, security, environmental or health protection performance or operation of a facility.

Off-site - Outside the Pantex Plant site boundary.

GLOSSARY

On-site - Within the Pantex Plant site boundary.

Ogallala Formation - Tertiary formation consisting of gravel, sand, silt, and clay. This is the principal geologic unit in the High Plains Aquifer. Comprises the Ogallala Aquifer in the Panhandle of Texas, the primary source of groundwater in the region. The top of the Ogallala Formation in large areas of Texas and New Mexico consists of a resistant caliche layer. The Ogallala Formation at Pantex overlies the Triassic Dockum Group strata and underlies the Quaternary Blackwater Draw Formation.

Outfall - The outlet of a body of water. In the surface water permitting program, the term outfall refers to the effluent monitoring location identified by the permit. An outfall may be "internal" (associated with a building) or "final" (the last monitoring point at Pantex.)

Perched aquifer - Groundwater separated from the underlying main body of groundwater, or aquifer, by unsaturated rock.

Permian - The last period of the Paleozoic era (after the Pennsylvanian) thought to have covered the span of time between 280 and 225 million years ago (Ma); also, the corresponding system of rocks. It is named after the province of Perm, Russia, where rocks of this age were first studied.

Plague - An acute infection caused by the bacterium *Yersinia pestis*. It is transmitted from rodent to humans by the bite of an infected flea. It is less commonly transmitted by direct contact with infected animals or airborne droplets. This disease is also manifested by an acute onset of fever followed by shock, multiple organ failure, and death; caught early, it is treatable with antibiotics.

Playa - A natural depression acting as a detention basin receiving surface runoff within a watershed area; an ephemeral lake.

Plume - An elongated pattern of contaminated air or water originating at a point source, such as a smoke stack or a hazardous waste disposal site.

Plutonium - A heavy, radioactive, manmade metallic element with atomic number 94. Its most important isotope is fissile plutonium-239, which is produced by neutron irradiation of uranium-238. The nuclei of all atoms of this isotope contain 94 protons and 145 neutrons.

Pollution prevention – The process of reducing and/or eliminating the generation of waste materials through source reduction, process modification, and recycling/reuse to minimize environmental or health hazards associated with hazardous wastes, pollutants or contaminants.

Potable - Suitable for drinking.

Potentially interested parties - Under the National Historic Preservation Act (NHPA), organizations that have requested to be informed of Federal actions at a particular site.

Practical Quantitation Limit (PQL) - The Final Risk Reduction Rule Guidance is used to identify the quantifiable limit of detection for sampled constituents at Pantex. This limit is defined as Practical Quantitation Limit. A PQL is the lowest level that can be accurately and reproducibly quantified.

Prehistoric - Of, relating to, or existing in times antedating written history. Prehistoric cultural resources are those that antedate written records of the human cultures that produced them.

Process knowledge - Used to characterize a waste stream when it is difficult to sample because of physical form, the waste is too heterogeneous to be characterized by one set of samples, or the sampling and analysis of the waste stream results in unacceptable risks of radiation exposure.

Programmatic Agreement - The document outlining specific plans for the management of cultural resources at Pantex Plant before the long-term Cultural Resource Management Plan was implemented. The parties to the agreement were the U.S. Department of Energy, the President's Advisory Council on Historic Preservation, and the Texas State Historic Preservation Office.

Pseudorabies - A highly contagious disease affecting cattle, horses, dogs, swine, and other mammalian species, caused by porcupine herpes virus 1, which has its reservoir in swine. In species other than swine, pseudorabies is highly fatal.

Pullman soil series - Silty clay loams; soils found in the interplaya areas at Pantex Plant.

Quaternary - The most recent of the three periods of the Cenozoic Era in the geologic time scale. It follows the Neogene Period and spans from 2.588 ± 0.005 million years ago to the present. It is divided into two epochs: the Pleistocene and the Holocene.

Rabies - A rapidly fatal disease of the central nervous system that may be transmitted to any warm-blooded animal. The disease starts with a fever, headache, muscle aches, nausea, and vomiting. It progresses to agitation, confusion, combativeness, increased salivation and decreased swallowing, followed by coma and death. It is transmitted to humans by the bite of an infected dog, cat, skunk, wolf, fox, raccoon, or bat.

Radiation (nuclear) – Particles (alpha, beta, neutrons) or photons (gamma) emitted from the nucleus of an unstable (radioactive) atom as a result of radioactive decay. It does not include non-ionizing radiation, such as microwaves or visible, infrared or ultraviolet light.

Radioactive - The state of emitting radiation in the form of waves (rays) or particles.

Radioactivity – The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nucleus of an unstable isotope.

Randall soil series - Clay soils present in the playa bottoms at Pantex Plant.

Raptor - Birds of prey including various species of hawks, falcons, eagles, vultures and owls.

Replicate analysis - A repeated operation occurring within an analytical procedure, e.g., two or more analyses for the same constituent in an extract of a single sample. *Replicate environmental samples* measure the overall precision of the sampling or analytical methods, while *replicate analyses* are identical analyses carried out on the same sample multiple times. They measure analytical laboratory precision only.

Resource Conservation and Recovery Act (RCRA) - Federal statute which governs current and planned hazardous waste management activities.

Risk Reduction Rules - 30 TAC 335 Subchapter S, outline three risk reduction levels to be considered relative to the corrective measures.

> ***Risk Reduction Standard 1 -*** Closure/remediation to background levels by removing or decontaminating all waste, waste residues, leachate, and contaminated media to levels unaffected by waste management activities.
>
> ***Risk Reduction Standard 2 -*** Closure/remediation to health-based standards and criteria by removing, containing, or decontaminating all waste, waste residues, leachate, and contaminated media to meet standards and criteria such that any substantial present and future threats to human health and the environment are very low.
>
> ***Risk Reduction Standard 3 -*** Closure/remediation with controls, which entails removal, containment, or decontamination of waste, waste residues, leachate, and contaminated media to such levels and in such a manner that any substantial present or future threats to human health and the environment are reduced to an acceptable level, based on use.

Sanitization - The irreversible modification or destruction of a component or part of a component of a nuclear weapon, device, trainer or test assembly, as necessary, to prevent revealing classified or otherwise controlled information, as required by the Atomic Energy Act of 1954, as amended.

Saturated zone - The zone in which the voids in the rock or soil are filled with water at a pressure greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer.

Sedimentation - The process of deposition of sediment, especially by mechanical means from a state of suspension in air or water.

Seismic - Pertaining to any earth vibration, especially an earthquake.

Sievert (Sv) - The *Système International d'Unités* (SI units) unit of equivalent dose. One sievert is equivalent to 100 rem.

Site - A geographic entity comprising leased or owned land, buildings, and other structures required to perform program activities.

Site (archeological) - Any area or location occupied as a residence or used by humans for a sufficient length of time to leave physical remains or traces of occupancy. The sites are extremely variable in size and may range from a single hunting camp to an extensive land surface with evidence of numerous settlements and activities. The site(s) may consist of secondarily deposited archeological remains.

Slug test - An aquifer test made either by pouring a small instantaneous charge of water into a well or by withdrawing a slug of water from the well. The rate of recovery of the water table to equilibrium conditions is monitored as the stress is applied to the aquifer. Information from slug tests can be used to estimate the hydraulic conductivity of the aquifer.

Solid Waste Management Unit (SWMU) - Any unit from which hazardous constituents may migrate, as defined by RCRA. A designated area that is, or is suspected to be, the source of a release of hazardous material into the environment that will require investigation and/or corrective action.

Split - One larger sample is split into "equal" parts. The goal of a split sample is to evaluate analytical accuracy. If a sample is split into two parts: one may go to the contractor, one to the regulator; or the two parts may go to two different labs for comparison purposes, or one may be sent to a laboratory for analysis; the second one held for later confirmatory analysis, or in case the first one is lost/broken.

Standard deviation - The absolute difference between one of a set of numbers and their means. It is a statistic used as a measure of dispersion in a distribution, the square root of the arithmetic average of the squares of the deviations from the mean.

Storm water - A precipitation event that leads to an accumulation of water; it includes storm water runoff, snowmelt runoff, surface runoff, and drainage.

Supplement Analysis - A document that DOE prepares in accordance with DOE NEPA regulations (10 CFR 1021.314(c)) to determine whether a supplemental or new EIS should be prepared pursuant to CEQ NEPA regulations (40 CFR 1502.9(c).

Surface water - Water that is open to the atmosphere and subject to surface runoff. Surface water includes storm water.

Tertiary - The first period of the Cenozoic era (after the Cretaceous of the Mesozoic era and before the Quaternary) thought to have covered the span of time between 65 and 2 Ma; also, the corresponding system of rocks.

Texas Commission on Environmental Quality (TCEQ) -The state agency responsible for the environmental quality of Texas. TCEQ has the lead regulatory role for RCRA-regulated waste generated at Pantex Plant.

Thermoluminescent Dosimeter (TLD) - A device containing crystalline materials that, when struck by radiation, contain more energy than in their normal state. At the end of the measurement period, heat is used to anneal the crystals and free the energy, which emerges as a light pulse. The pulse is then mathematically converted to the dose received by the TLD. Correction factors in the conversion equation are adjusted for various filters, TLD crystal elements and incident radiation. The device can either be carried by a radiation worker, or, as used in this document, placed at a specific location to measure the cumulative radiation dose.

Thorium - A radioactive metallic element that occurs combined in minerals and is usually associated with rare earth elements. Thorium's atomic number is 90.

Toxic Substances Control Act (TSCA) - Federal statute that establishes requirements for identifying and controlling toxic chemical hazards to human health and the environment.

Tracer - A labeled element used to trace the course of a chemical or biological process.

Transuranic waste (TRU) - Waste, without regard to source or form, that is contaminated with alpha-emitting radionuclides of atomic number greater than 92 (uranium) and with half-lives greater than 20 years in concentrations greater than 100 nanocuries per gram.

Triassic - The first period of the Mesozoic era (after the Permian of the Paleozoic era, and before the Jurassic) thought to have covered the span of time between 225 and 190 Ma; also, the corresponding system of rocks.

Trihalomethanes - One of the families of organic compounds (methane derivatives) in which three of the four hydrogen atoms in methane are substituted by a halogen atom in the molecular structure.

2,4,6-trinitrotoluene (TNT) - A flammable toxic compound ($C_7H_5N_3O_6$) obtained by nitrating toluene and used as a high explosive and in chemical synthesis.

Trip blanks - Provided for each shipping container to be analyzed for VOCs. Analytical results from trip blanks are used to evaluate whether there was any contamination of the sample bottle during shipment from the manufacturer, storage of the bottles, during shipment to the laboratories, or during analysis at the laboratory.

Tritiated – Containing and especially labeled with tritium**.**

Tritium - A radioactive isotope of hydrogen with one proton and two neutrons in its nucleus. It is chemically identical to natural hydrogen and reacts with other substances and is absorbed into the body in the same manner. Elemental tritium incorporates readily with water to form tritiated water (HTO) or oxidized tritium. When this tritiated water is present in the gaseous state in the atmosphere, it is referred to as tritiated water vapor. Tritium decays by beta emission with a radioactive half-life of about 12.5 years.

Tularemia - A disease caused by *Francisella tularensis* and transmitted to humans by rodents through the bite of a deer fly, *Chrysops discalis*, and other bloodsucking insects; it can also be acquired directly through the bite of an infected animal or through handling of an infected animal carcass.

Uranium - A silvery, heavy, radioactive, polyvalent metallic element that is found especially in pitchblende and uraninite and exists naturally as a mixture of three isotopes of mass number 234, 235, and 238 in the proportions of 0.006 percent, 0.71 percent, and 99.28 percent, respectively. Uranium has an atomic number of 92.

Vadose zone - Also called the unsaturated zone, the zone between the land surface and the water table. The pore spaces in the vadose zone contain water at less than atmospheric pressure, as well as air and other gases. Saturated bodies, such as perched aquifers, may exist in the vadose zone.

Volatile organic compounds (VOCs) - Organic compounds capable of being readily vaporized at normal temperatures and pressures. Examples are benzene, toluene, and carbon tetrachloride.

Waste generator - Any individual or group of individuals that generate radioactive, mixed, hazardous, or other types of wastes at Pantex Plant.

GLOSSARY

Waste minimization - Refers to a practice that reduces the environmental or health hazards associated with hazardous wastes, pollutants, or contaminants after generation.

Waste Tracking System Database - Computerized log maintained by the Waste Operations Department.

Watershed – A ridge of high land dividing two areas that are drained by different river systems. It can also be the region draining into a river, river system, or body of water.

Weapon component - A part specifically designed for use in a weapon.

Weir - A fence or enclosure set in a waterway to raise the water level or to gauge or divert its flow.

Wetlands - Land or areas exhibiting hydric soil concentrations saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions.

CHEMICALS AND UNITS OF MEASURE

Ag	silver
As	arsenic
Ba	barium
Be	beryllium
Bq	Becquerel
ºC	degrees Celsius
Ca	calcium
Cd	cadmium
cfm	cubic feet per minute
Ci	Curie
cm	centimeter
CO	carbon monoxide
Cr	chromium
Cu	copper
cu yd	cubic yard
DMSO	dimethyl sulfoxide
DNX	hexahydro-1,3-Dinitroso-5-Nitro 1,3,5-triazine
dps	disintegrations per second
E ±n	exponential (E) is10± n where n is some number (see Helpful Information on inside back cover)
ºF	degrees Fahrenheit
Fe	iron
ft	foot/feet
ft/sec	feet per second
ft^2	square foot
ft^3	cubic feet
g or gm	gram
g/dL	grams per deciliter
gal	gallon
gpd	gallons per day
gpm	gallons per minute
Hg	mercury
hr	hour
HMX	octahydro-1,3,5,7-tetranitro 1,3,5,7-tetrazocine
in	inch(es)
K_2O	potassium oxide
kg	kilogram
km	kilometer
kW	kilowatt
L	liter(s)
lb	pound
m	meter
m/s	meters per second
m^2	square meter
m^3	cubic meter (approx. 1.308 cubic yards)
Ma	million years ago
Mcf	thousand cubic feet
MEK	methyl ethyl ketone
MeV	Megavolt (a.k.a. Million electron volts)

mg/dL	milligrams per deciliter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mi	mile
mi^2	square mile
min	minute
Mn	manganese
MNX	hexahydro-1-Nitroso-3,5-Dinitro-1,3,5-triazine
mph	miles per hour
mps	meters per second
mrem/hr	millirem per hour
mSv	millisievert
μCi	microcurie
μCi/ml	microcuries per milliliter
μg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
μL	microliter
μmho/cm	micromhos per centimeter
μR	microroentgen
NO_2	nitrogen dioxide
NOx	nitrogen oxides
O_3	ozone
Pb	lead
PCBs	polychlorinated biphenyls
pCi/g	picocuries per gram
pCi/mL	picocuries per milliliter
PETN	Pentaerythrithol tetranitrate
PM_{10}	particulate matter with a mean aerodynamic diameter ≤10 micrometers
ppb	parts per billion
ppm	parts per million
psf	pounds per square foot
psi	pounds per square inch
R	Roentgen
rem	Roentgen equivalent man
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
scfm	standard cubic ft per minute
sec	second
SO_2	sulfur dioxide
SOx	sulfur oxides
SU	standard units
Sv	Sievert
TCE	trichloroethylene/ethene
THF	tetrahydrofuran
Ti	titanium
TNB	trinitrobenzene
TNT	trinitrotoluene

CHEMICALS AND UNITS OF MEASURE

TNX	hexahydro-1,3,5-Trinitroso-1,3,5-triazine
TPY	tons per year
yr	year
Zn	zinc
μ	micro (1.0 x 10^{-6})

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) oversees the operation of Pantex Plant through the National Nuclear Security Administration (NNSA) Production Office (NPO). Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex) managed the environmental aspects of its operations systematically from January 2013 to December 2013, in a manner consistent with Integrated Safety Management.

The Purpose of the Report

The *2013 Site Environmental Report for Pantex Plant* summarizes the efforts, data, and status of Pantex's environmental protection, compliance, and monitoring programs for calendar year 2013. This report is prepared in accordance with DOE Order 231.1B, *Environment, Safety and Health Reporting* (DOEf), and DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOEi). These orders outline the requirements for environmental protection programs at DOE facilities to ensure that programs fully comply with applicable federal, state, and local environmental laws and regulations, executive orders, and DOE policies.

Environmental Management and Monitoring

Pantex Plant has a comprehensive environmental program. The environmental policies (pp. xxxiii - xxxv) define the program that contains components of environmental management including, but not limited to, regulatory compliance, pollution prevention, and environmental monitoring.

The purpose of the environmental monitoring component of the Plant's Environmental Management System (EMS) is to provide indicators of potential impact to human health and the environment and to demonstrate compliance with applicable regulatory limits. The environmental monitoring program monitors air, groundwater, drinking water, surface water, wastewater, soil, vegetation, and fauna. Pantex also operates a meteorological monitoring program that supports several of the requirements. Samples for 2013 were routinely collected at diverse locations, and 19,469 analyses were performed for substances including explosives, metals, organic chemicals, inorganic chemicals, radionuclides, and water quality indicators.

Data from the monitoring program obtained in past years are summarized in previous annual site environmental reports, which are available in the DOE Information Repositories at the Amarillo Public Library Downtown Branch, in Amarillo, Texas and at the Carson County Library in Panhandle, Texas. The monitoring data, as well as the annual site environmental reports since 1996, have been made available electronically on the Pantex worldwide website at http://www.pantex.com.

In 2013, the calculated annual radiation dose from releases to the atmosphere from Plant operations was 7.00×10^{-7} mrem (7.00×10^{-9} mSv) for a hypothetical, maximally exposed member of the public. This annual dose continues to be several orders of magnitude below the U.S. Environmental Protection Agency's (EPA's) standard for the air pathway of 10 mrem per year above background. The radiological monitoring results in 2013 were consistent with those of previous years. The background radiation dose measured at control locations (excluding radon) were attributed to naturally occurring terrestrial and cosmic radiation, and averaged 92.0 mrem for the calendar year 2013. This is consistent with historical data. No unplanned radionuclide releases occurred at Pantex Plant in 2013. Ambient air monitoring results for 2013 were generally similar to those from previous years. All results were below the applicable DOE Derived Concentration Standard (DCS).

As in past years, monitoring results of perched groundwater beneath the Zone 12 operations area and beneath the safety and security buffer property to the south and southeast provide evidence of non-radiological contamination. Primary contaminants in perched groundwater beneath the Zone 12 operations area are explosives, metals, and organic solvents. The primary contaminant in perched groundwater beneath the safety and security buffer property to the south and southeast is explosives. Constituents detected in the Ogallala Aquifer were either one-time detections (i.e., not reproduced upon confirmation sampling) or attributable to sediments in the groundwater.

Pantex monitors drinking water for organic chemicals, inorganic chemicals, metals, water quality parameters, radionuclides, residual disinfectants, and miscellaneous constituents. Results from routine drinking water sampling in 2013 confirmed that the drinking water system at Pantex Plant met all applicable regulatory requirements.

Storm water sampling of run-off involving industrial activities at Pantex Plant is conducted in accordance with Texas Pollutant Discharge Elimination System (TPDES) Multi-sector General Permit No. TXR050000. Monitoring conducted during 2013 was consistent with past monitoring results. All sample results were within effluent limitations established by the general permit.

Environmental surveillance monitoring was conducted at the playas as a best management practice. Minimal playa sampling results were obtained during 2013 due to continuing drought conditions; therefore, historical comparisons were limited. Results obtained during 2013 were very similar with past monitoring results.

Soil samples were collected and analyzed for metals and explosives at the Burning Ground, and for agricultural parameters, explosives, one semi-volatile organic compound (SVOC), ignitability, and reactivity at the Texas Land Application Permit irrigation sites. On-site soil monitoring results for 2013 were within the concentration ranges observed for uncontaminated local soil and were comparable to historical results. Samples in most cases indicate that concentrations observed were naturally occurring and at background levels.

Flora and fauna monitoring results indicated that there were no detrimental impacts from Plant operations in 2013.

The final chapter of this report describes the quality assurance program. Quality assurance is incorporated into all aspects of the B&W Pantex environmental program and includes performance checks, rigorous quality control checks, and intensive data management.

Environmental Remediation

Historical waste management practices at the Plant resulted in impacts to on-site soil and perched groundwater. High explosives, solvents, and metals were found in the soil in the main operational areas and the Burning Ground at the Plant, and in the perched groundwater beneath Pantex. Data collected in 2013 indicate that the main drinking water aquifer remains unaffected by natural migration of contaminants from soil and perched groundwater.

Pantex has completed investigations and soil cleanup of all solid waste management units, with the exception of units that remain in an active status. This allowed Pantex to transition to Long-Term Stewardship in 2009. A Record of Decision was issued by the EPA in September 2008 that described the final remedial actions for all investigated units.

As part of the transition to Long-Term Stewardship, Pantex operated and maintained the groundwater remediation systems, monitored the systems to determine effectiveness of the remedy, and maintained the soil remedies. Pantex installed two types of remediation systems: two in-situ bioremediation (ISB) and two pump and treat systems. Although Pantex is in the early stage of its groundwater remedial action, monitoring results indicate that the groundwater systems are effectively treating contamination and reducing saturated thickness in the perched aquifer as designed. The systems will continue to be monitored to determine the effectiveness of the remedy and to determine if changes to the systems will be required over time to ensure the continued success of remedial actions.

Soil remedies were also inspected, maintained, or scheduled for maintenance during 2013. The soil vapor extraction (SVE) system located at the Burning Ground continued to operate during 2013.

Regulatory Compliance

As required by DOE Order 436.1, *Departmental Sustainability* (DOEh), every three years the Pantex EMS has an audit conducted to determine the level of conformance with the International Organization for Standardization (ISO) 14001 *Environmental Management Systems – Requirements with Guidance for Use*. In August of 2011 an audit, consistent with instructions for implementing Executive Order 13423, *Strengthening Federal Environmental and Transportation Management*, was conducted. A "qualified" party outside the control or scope of the Pantex EMS Program performed the audit. The outcome of the audit indicated that Pantex has fully implemented an EMS program that conforms to ISO 14001 standards. The next three-year validation audit will be performed in 2014.

The Pantex EMS provides the foundation to administer sound stewardship practices that protect natural and cultural resources while cost-effectively demonstrating compliance with environmental, public health and resource protection laws, regulations, and DOE requirements. Notable accomplishments in 2013 relating to the Pantex EMS include:

- Pantex was selected as the U.S. Department of Energy's (DOE) 2013 nominee for the Presidential Migratory Bird Federal Stewardship Award. Pantex's program was selected as the one that exemplifies innovation and commitment to the conservation of migratory birds and their habitat.
- Pantex received a DOE EStar award for "Energy Savings Performance Contracts Leader".
- For the nineteenth consecutive year, no violations or areas of concern were noted during the annual Resource Conservation and Recovery Act (RCRA) comprehensive compliance investigation conducted by the Texas Commission on Environmental Quality.
- Pantex was extremely active in conducting environmental outreach initiatives. The initiatives included sponsoring public meetings to share status of environmental management activities including groundwater status meetings, Natural and Cultural Resource Program accomplishments, Earth Day activities, and Science Bowl Competition for area Middle Schools and High Schools.
- Pantex completed and the NPO Manager signed the determination for the Final Supplement Analysis (SA) for the Pantex Site-wide Environmental Impact Statement.

Pollution Prevention

Efforts to reduce and eliminate waste from routine operations at Pantex Plant have resulted in significant waste reductions over the last 26 years. From 1987 to 2013, the Plant population and workload increased as the focus of the Plant's mission changed from weapons assembly during the Cold War to primarily dismantlement. Even with these increases, the Pollution Prevention (P2) Program’s efforts were successful in reducing the generation of hazardous waste by more than 99 percent.

Pantex continues to make progress toward meeting the goals from EO 13514 to divert 50 percent of construction and demolition waste and 50 percent of Plant municipal solid waste from landfill disposal. For 2013, Pantex increased the diversion of municipal solid waste to 58 percent and the diversion of construction and demolition waste to 57 percent.

The DOE, through NPO, is supportive of the Plant’s Environmental Policies. Environmental policy statements are provided on pages xxxiii through xxxv.

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Please complete the questionnaire following the title page of this report to give us your comments or request information.

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Post: *June 5, 2012*
Remove: *June 5, 2014*

Bulletin No: *BLTN-924*
Issue No: *003*

ENVIRONMENTAL MANAGEMENT SYSTEM

Date: June 5, 2012

From: John D. Woolery Location: 12-69A

To: B&W Pantex Employees

Subject: Pantex Environmental Policy

As part of the B&W Pantex Strategic Plan, we have an environmental policy to protect and conserve the natural environment within which we perform the Plant mission. This policy is the basis for our Environmental Management System (EMS). The EMS is a significant component of the Pantex Integrated Safety Management System that holds superior the goal of protecting our employees, the community and the environment. Important areas of focus within the EMS are environmental compliance, waste management, natural resource management, pollution prevention, recycling, environmental remediation, and sustainability in all activities.

This policy is a concise declaration of how we, B&W Pantex employees, will conduct work. The policy should be incorporated into each individual's personal commitment to protect the environment while accomplishing the Pantex mission.

B&W Pantex's Environmental Policy

To Excel in:

- Implementing appropriate controls and actions to minimize environmental impacts caused by our activities, products, and services.
- Continual improvement of our protection of the environment in plant processes, including pollution prevention, recycling, and sustainability.
- Strict compliance with relevant regulations and requirements.
- Setting and reviewing environmental objectives and targets.
- Communication of this policy to all employees.
- Availability of the policy to the public.

ENERGY HOG

B&W Pantex

CLEAN TEXAS

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PROTECTION OF PLANT EMPLOYEES, THE PUBLIC, AND THE ENVIRONMENT

1. POLICY STATEMENT.

The Pantex Site Office is committed to partnering with B&W Pantex to ensure that all work at the Pantex Plant is performed in a manner that is compliant with Environment, Safety and Health (ES&H) requirements. PXSO values human life above all else and strives to provide a workplace free of occupational injuries and illnesses. PXSO values the environment and strives to protect it for the public and future generations by avoiding unacceptable risks from its operations. We fulfill these commitments through active identification, evaluation, prevention, and management of hazards and by striving to comply with the letter and spirit of all ES&H laws and regulations.

To accomplish this, I expect:

- That established environment, safety, or health standards would never be compromised because the protection of human life and the environment are more important that Pantex Plant production goals.
- The use of our Integrated Safety and Environmental Management Systems to protect human health and the environment by:
    - Defining the scope of work.
    - Identifying and analyzing the hazards.
    - Developing and implementing hazard controls.
    - Performing work safely.
    - Soliciting and using feedback for continuous improvement of ES&H performance.
- A healthful and safe workplace that is maintained free of recognized hazards to prevent occupational injuries and illnesses.
- The wise use and conservation of our natural resources while conducting our activities in a sustainable manner.
- That operations are conducted such that the exposure to radiation is maintained as low as reasonably achievable.
- That environmental considerations, pollution prevention, safety, health and quality are integrated into project planning, design, construction, operations, maintenance, and decommissioning of facilities.
- That policies, programs and professional ES&H staff are in place to ensure line management can carry out their responsibility for ES&H implementation.

- That workers have the authority and responsibility to stop, or not perform, any task without retaliation, when there is a reasonable belief that the task poses imminent risk of death or serious injury. In such a case, the workers must report this to their supervisor immediately.
- That there are clear contract accountability and performance objectives for ES&H compliance.

2. CANCELLATION.

This Policy supersedes PXSO Policy PXSO-08-1, *Protection of Plant Employees, the Public, and the Environment,* dated 4-17-08.

STEVEN C. ERHART
Manager

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The Pantex Plant site, consisting of 7,001 hectares (17,503 acres), is located 27 kilometers (17 miles) northeast of Amarillo, Texas, in Carson County. The Plant was a World War II munitions factory and was converted to a nuclear weapons assembly facility in 1951. Today, it is one of the nation's assembly/ disassembly facilities supporting the nuclear weapons arsenal. Included within this chapter are brief discussions of the Plant location, history and mission, and facility description, followed by the climate, geology, hydrology, seismology, land use, and population of the area around Pantex Plant.

1.1 Site Location and Environmental Setting

The Pantex Plant site is located in Carson County in the Texas Panhandle, north of U.S. Highway 60. The Plant is located 27 km (17 mi)[1] northeast of downtown Amarillo (Figure 1.1). It is centered on approximately 7,001 hectare (17,503 acres) site. The site consists of land owned and leased by the U.S. Department of Energy (DOE). The DOE owns 4,681 hectares (11,703 acres), including 3,683 hectares (9,100 acres) in the main Plant area, 610 hectares (1,526 acres) in four tracts purchased in the latter part of 2008 (east of FM 2373 near the main Plant area), and 436 hectares (1,077 acres) at Pantex Lake, which is located approximately 4 km (2.5 mi) northeast of the main Plant area. Although Pantex Plant proposes to develop the Pantex Renewable Energy Project (PREP) on the newly acquired land east of FM 2373, no government industrial operations are conducted at the Pantex Lake property. In addition, 2,347 hectares (5,800 acres) of land south of the main Plant area are leased from Texas Tech University for a safety and security buffer zone.

Pantex Plant is located on the Llano Estacado (staked plains) portion of the Great Plains at an elevation of approximately 1,067 m (3,500 ft.). The topography at Pantex Plant is relatively flat, characterized by rolling grassy plains and numerous natural playa basins. The term "playa" is used to describe shallow lakes, mostly less than 1 km (0.6 mi) in diameter. The region is a semi-arid farming and ranching area. Pantex Plant is surrounded by agricultural land, but several industrial facilities are located nearby.

1.2 Facility History and Mission

Pantex Plant is a government-owned, contractor-operated facility. DOE oversees the operation of Pantex Plant through the National Nuclear Security Administration (NNSA) Production Office (NPO). At the end of 2013, just over 3000 people were employed at the Plant either as a contracted or subcontracted employee. Mason & Hanger Corporation (MHC) was the operating contractor of the Pantex Plant from 1956 through May 1999 when it became a subsidiary of Day & Zimmermann, Inc. (D&Z). MHC (D&Z) was replaced as operating contractor by BWXT Pantex, LLC on February 1, 2001. BWXT Pantex combined elements of BWXT Technologies, Honeywell, and Bechtel. Effective in January 2008, the name of the company was officially changed to Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex).

From 1942 to 1945, the U.S. Army used the Pantex Ordnance Plant for loading conventional ammunition shells and bombs. In 1951, the Atomic Energy Commission (AEC) arranged to begin rehabilitating portions of the original Plant and constructing new facilities for nuclear weapons operations. In 1974, the Energy Research and Development Administration (ERDA) replaced the AEC and took responsibility for the operation of Pantex Plant, and in 1977, the ERDA was replaced by the DOE. In 2000, the DOE enfolded the NNSA into its structure.

[1] This report will generally use the convention of identifying a unit of measure in Système Internationale (abbreviated SI) units and providing the "English unit" equivalent in parentheses, for example "X kilometers (Y miles)." Because radiological measurements are compared to several limits that are generally specified using "English units," the convention is reversed for those measurements, for example "X :Ci/mL (Y Bq/m^3)."

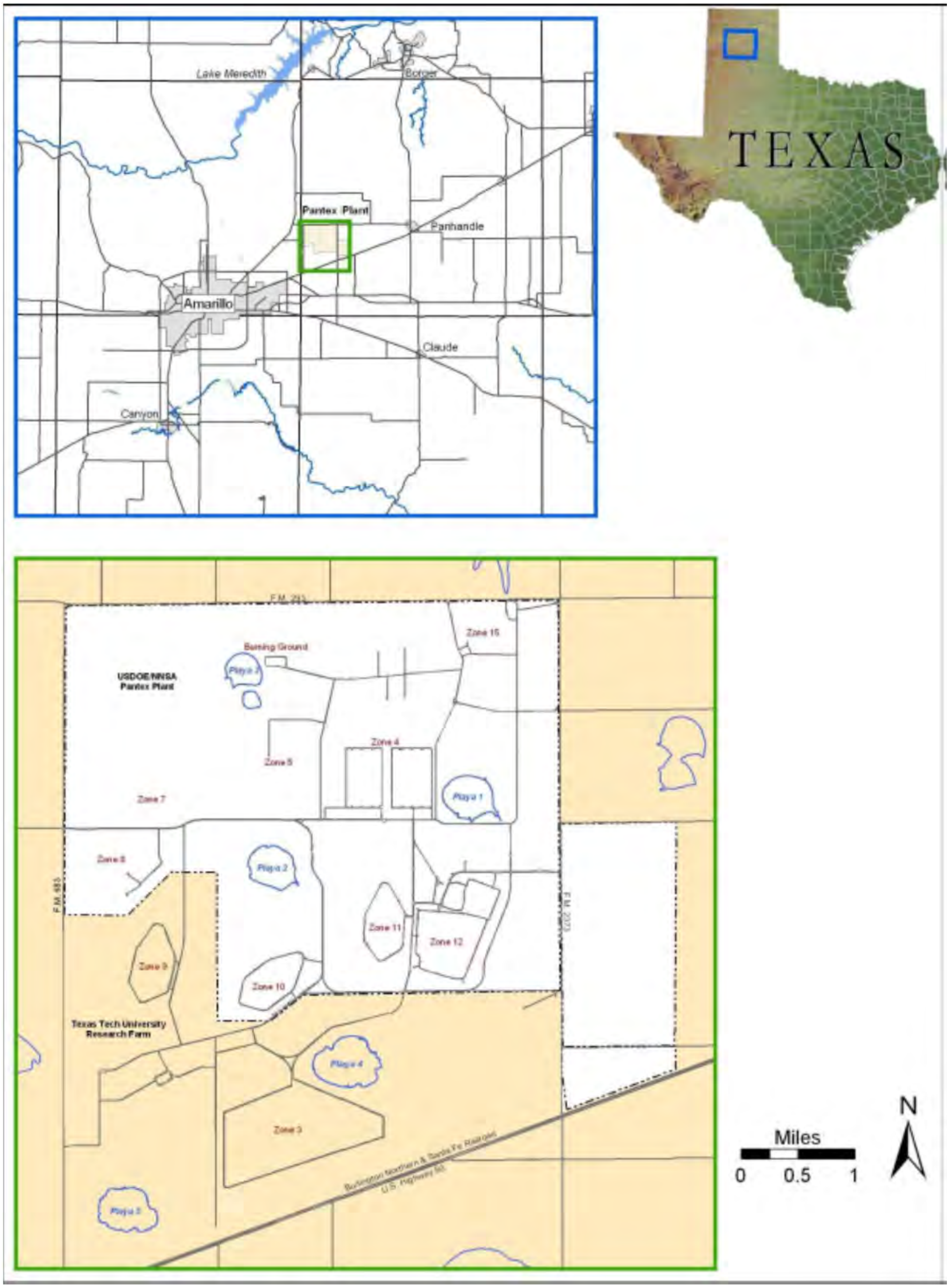

FIGURE 1.1 — *Pantex Plant Site Location*

Pantex Plant's primary mission is to:

- **Assemble** nuclear weapons for the nation's stockpile,
- **Disassemble** nuclear weapons being retired from the stockpile,
- **Evaluate, repair, and retrofit** nuclear weapons in the stockpile,
- **Provide** interim storage for plutonium pits, and
- **Develop, fabricate, and test** chemical explosives and explosive components for nuclear weapons and to support DOE initiatives.

Weapon assembly, disassembly, maintenance, and evaluation activities involve short-term handling (but not processing) of encapsulated tritium, uranium, and plutonium, as well as a variety of nonradioactive hazardous or toxic chemicals. In addition, environmental restoration of the facility is an integral part of the DOE environmental management's mission to clean up its sites.

1.3 Facility Description

The Plant is composed of several functional areas, commonly referred to as numbered zones (Figure 1.2). Overall, there are more than 600 buildings at the Plant. Many of these areas are grouped into large functional zones, four of which remain active. Included within the zones are a weapons assembly/disassembly area, a weapons staging area, an area for experimental explosives development, a drinking water treatment plant, a sanitary wastewater treatment facility, a vehicle maintenance facility and administrative areas. Other functional areas include a utilities area for steam and compressed air, an explosives test-firing facility, a Burning Ground for thermally processing (i.e., burning or flashing) explosive materials, and landfills. One functional area is currently used only for storage.

The weapons assembly/disassembly area covers approximately 80 hectares (200 acres) and contains more than 100 buildings. Nuclear components, parts received from other DOE plants, chemical explosive components, and metal parts fabricated at Pantex Plant can be assembled into nuclear weapons in this zone. Nuclear weapons are also disassembled there.

One zone is used for general warehousing and temporary holding (or staging) of weapons and weapon components awaiting movement to another area for modification, repair, or disassembly; for shipment to other DOE facilities for reworking; for shipment to a facility for sanitization; or for shipment to the military. The warehouse area is also used for interim storage of plutonium components from disassembly operations.

The explosives development area consists of facilities for synthesizing, formulating, and characterizing experimental explosives.

The drinking water treatment facility consists of production wells, water treatment/pumping facilities, storage tanks, and associated distribution lines. This facility also supplies water to the high-pressure fire protection system.

Wastewater generated at Pantex Plant is routed through a sewer system to a wastewater treatment facility. On October 6, 2003, the Texas Commission on Environmental Quality (TCEQ) issued Pantex a Texas Land Application Permit that authorizes beneficial reuse of the wastewater for the purpose of agricultural

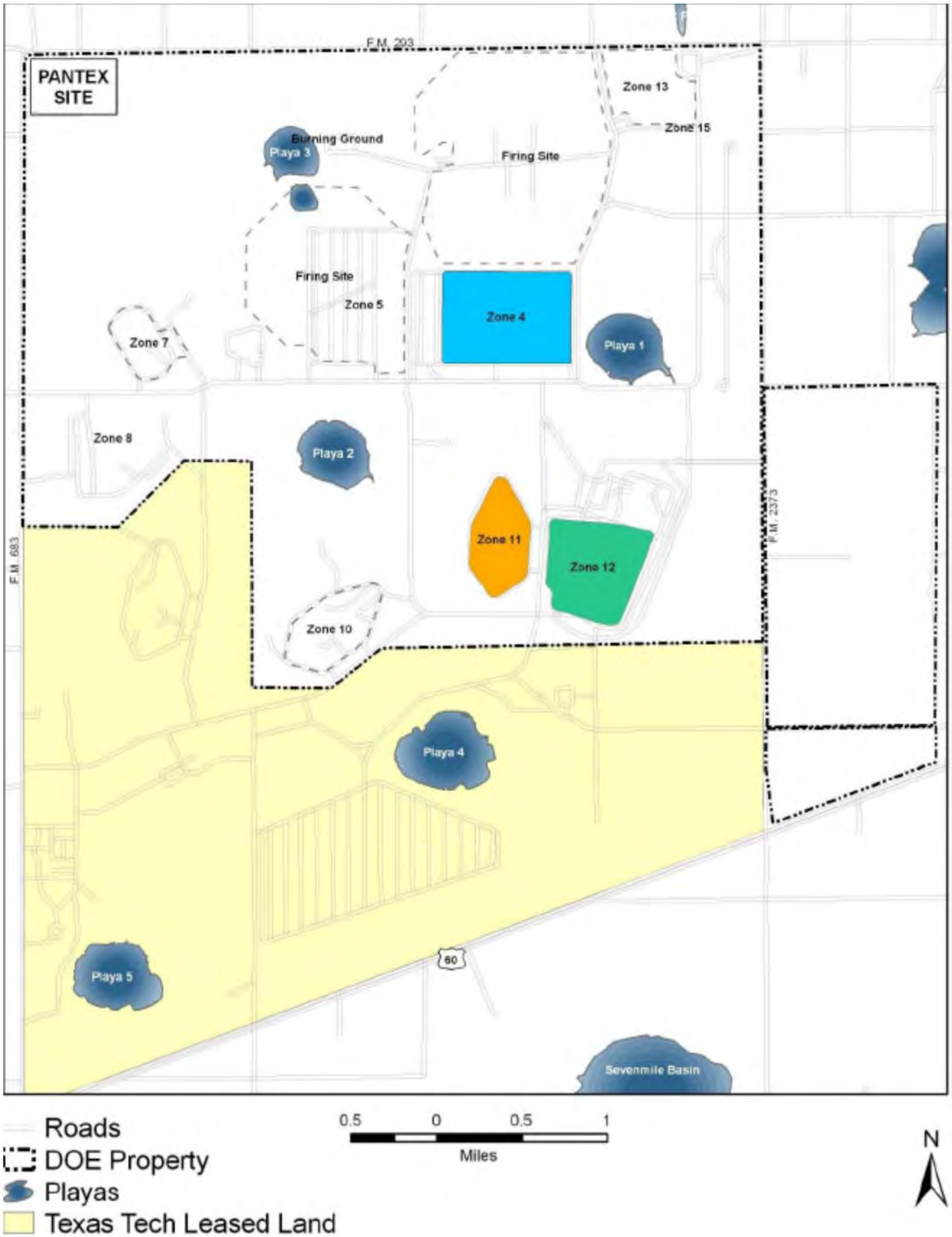

FIGURE 1.2 — *Principal Features of the Pantex Plant Site*

irrigation via a subsurface fluid distribution system. Construction of the subsurface fluid distribution system was completed prior to the end of 2004. Treated effluent from the wastewater treatment facility and from the perched aquifer pump and treat system are currently discharged to this subsurface irrigation system. Pantex is also authorized to discharge wastewater to an on-site playa lake pursuant to a Texas Water Quality Permit issued by the TCEQ.

The explosives test-firing facility (commonly called “firing sites”) includes several test-shot stands and small-quantity, test-firing chambers for measuring detonation properties of explosive components. The firing sites also include supporting facilities for setting up test-shots, interpreting the results, and sanitizing some components.

The Burning Ground is used for processing explosives, explosive components, and explosives-contaminated materials and waste by means of controlled open burning and flashing.

The land disposal area, north of Zone 10, is divided into two landfill sites, one of which currently receives nonhazardous solid wastes, primarily construction debris, and one that receives nonhazardous solid waste management unit debris. Before 1989, the Plant's domestic solid waste was sent to an on-site sanitary landfill for disposal. Since then, this waste has been processed to remove recyclable materials and the non-recyclable material is sent to an off-site landfill. Practices preclude disposal of hazardous materials in on-site landfills; therefore, hazardous materials are transported off-site for disposal in accordance with applicable regulations.

The newly acquired land east of FM 2373 has not been assigned a formal zone designation. However, meteorological towers and proposed wind turbines for the generation of electrical power will be installed during the completion of the proposed PREP in the near future.

1.4 Climatological Data

The area’s climate is classified as semi-arid and is characterized by hot summers and relatively cold winters, with large variations in daily temperatures, low relative humidity, and irregularly spaced rainfall of moderate amounts. Three-fourths of the average precipitation (51.7 cm [20.4 in]) (Department of Commerce [DOCa]) falls from April through September, generally occurring with thunderstorm activity. The average annual snowfall is 17.8 inches (DOCa). Snow usually melts within a few days after it falls. Heavier snowfalls of l0 inches or more, usually with near blizzard conditions, average once every five years and last two to three days. The potential gross lake surface evaporation in the area is estimated to be about 140 cm (55 in) (Bomar, 1995) or 280 percent of the average annual precipitation.

The Amarillo area is subject to extreme and rapid temperature changes, especially during the fall and winter months when cold fronts from the northern Rocky Mountain and Plains states sweep across the area. Temperature drops of 50° to 60° F within a 12-hour period are not uncommon. Temperature drops of 40° F have occurred within a few minutes.

Humidity averages are low, occasionally dropping below 20 percent in the spring. Low humidity moderates the effect of summer afternoon high temperatures, permits evaporative cooling systems to be very effective, and provides many pleasant evenings and nights. Severe local storms are infrequent throughout the cool season, but occasional thunderstorms with large hail, lightning, and damaging wind occur during the warm season, especially during the spring. These storms are often accompanied by heavy rain, which can produce local flooding, particularly of roads and streets.

Pantex Plant is located in an area with a relatively high frequency of tornadoes, convective wind events[2] and hail. An average of 17 tornadoes occurred each year in the 20 counties of the Texas Panhandle and the adjacent three counties of the Oklahoma Panhandle during the period between 1950 and 2012 (DOCb). While the threat of tornadoes is real, tornado occurrences in Amarillo are generally rare. Tornadoes are most common from April to June. There were a total of seven tornadoes reported in the Texas and Oklahoma Panhandles during 2013 (DOCc), a small fraction of the number observed (58) during the very active year of 2007.

Based upon the annual review prepared by the National Weather Service (NWS) Forecast Office for Amarillo (located at Rick Husband International Airport) the mean temperature at the official NWS location during 2013 was 14.7˚C (58.4˚F) (DOCc). The normal annual mean temperature in Amarillo is 14.1˚C (57.3˚F). During 2013, the area of the Pantex Plant experienced more precipitation than that experienced in 2012 (although still only approximately 3/4 of the "normal") as the official NWS rain gauge recorded 38.6 cm (15.2 in) of precipitation. Significant weather events in the area included winter storms and blizzards in the month of February including the 2nd largest snowfall for a single calendar day in Amarillo of 19.0 inches on February 25. In addition to the continuing drought conditions through May, the other major weather events during 2013 were severe storms (including multiple reports of damaging hail and strong winds as well as tornadoes) on May 28 and severe thunderstorms which caused isolated flooding in some areas of the Oklahoma and northern Texas Panhandles on August 7-8. (DOCc).

The Pantex Plant maintains a meteorological monitoring station on the northeast corner of the site. The monitoring station is an instrumented 60 m (197 ft.) tower located approximately 3.7 km (2.3 mi) north of the Zone 12 production area. The tower is equipped with two sets of sensors, located at the 10 and 60 m (33 and 197 ft.) levels. Wind speed, wind direction, and temperature sensors are located at both levels and a relative humidity sensor is located at the 10 m (33 ft.) level. A barometer measures the atmospheric pressure on the tower approximately 1.8 m (6 ft.) above the tower base. A pyranometer (instrument that measures insolation or incoming solar radiation) and a tipping bucket rain gauge are located adjacent to the tower at approximately 1 m (3.3 ft.) above ground level. Sensor measurements are nominally taken every five seconds and stored in a "data logger" (mini-computer) located at the tower. Every 15 minutes, the system calculates statistical parameters (e.g., the average, maximum and standard deviation of the measurements from the previous 15 minute interval) for most sensors[3] and transfers the meteorological data for the latest 15 minute interval to a stand-alone personal computer located in the Operations Center. The data from the Plant's meteorological tower are compared with those obtained from the Amarillo Airport NWS site located approximately 16 km (10 mi) to the west-southwest of the Pantex Plant's meteorological tower to determine if the instrumentation is operating correctly. On a monthly basis, data outliers are identified and, when necessary, eliminated from the meteorological data set.

The frequencies of wind direction and speed during 2013 at the Pantex Plant are illustrated by the "wind roses" (graphical depictions of the annual frequency distribution of wind speed and the direction from which the wind has blown) in Figure 1.3. Figure 1.3(a) indicates that, as in most previous years, a large percentage (approximately 45 percent) of the winds blew from southerly directions during the year. Figure 1.3(b) shows that wind direction and speed frequencies vary by season: Winds arise more frequently from the northern sectors during the periods from January 1 through March 31 and from October 1 through December 31 (roughly corresponding to "winter" and "fall"). The vast majority of winds are from the southern sector in "summer" (i.e., July 1 through September 30), including over 50 percent from the south and southeasterly directions.

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[2] High speed "straight-line" winds produced in the downdraft region of a thunderstorm.

[3] The number of one-hundredths of an inch of rain received (corresponding to the number of times the "tipping cup" has "tipped over") during the 15 minute interval is the only parameter transferred for "precipitation".

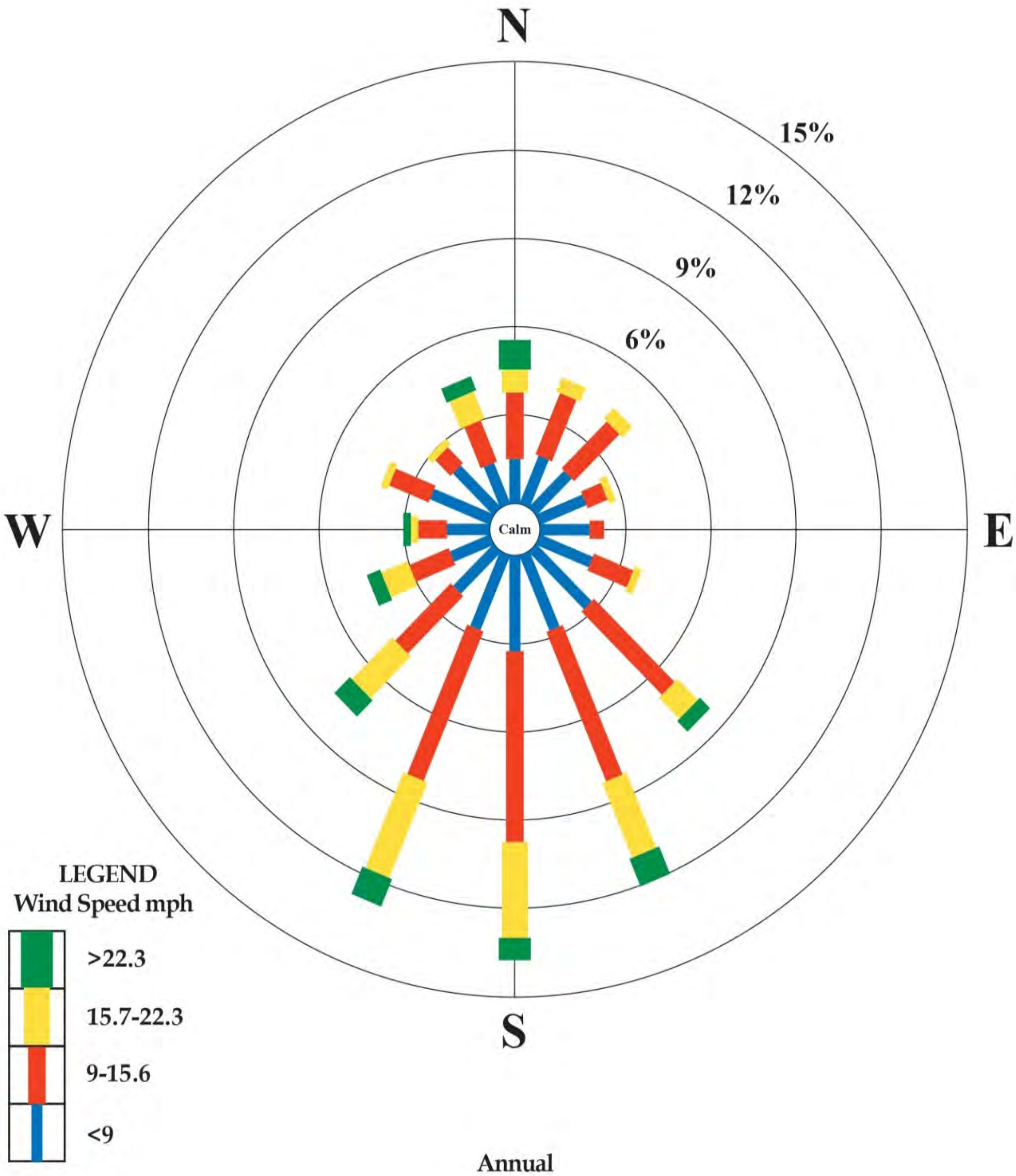


FIGURE 1.3(a) — *Pantex Plant Annual Wind Rose for 2013*

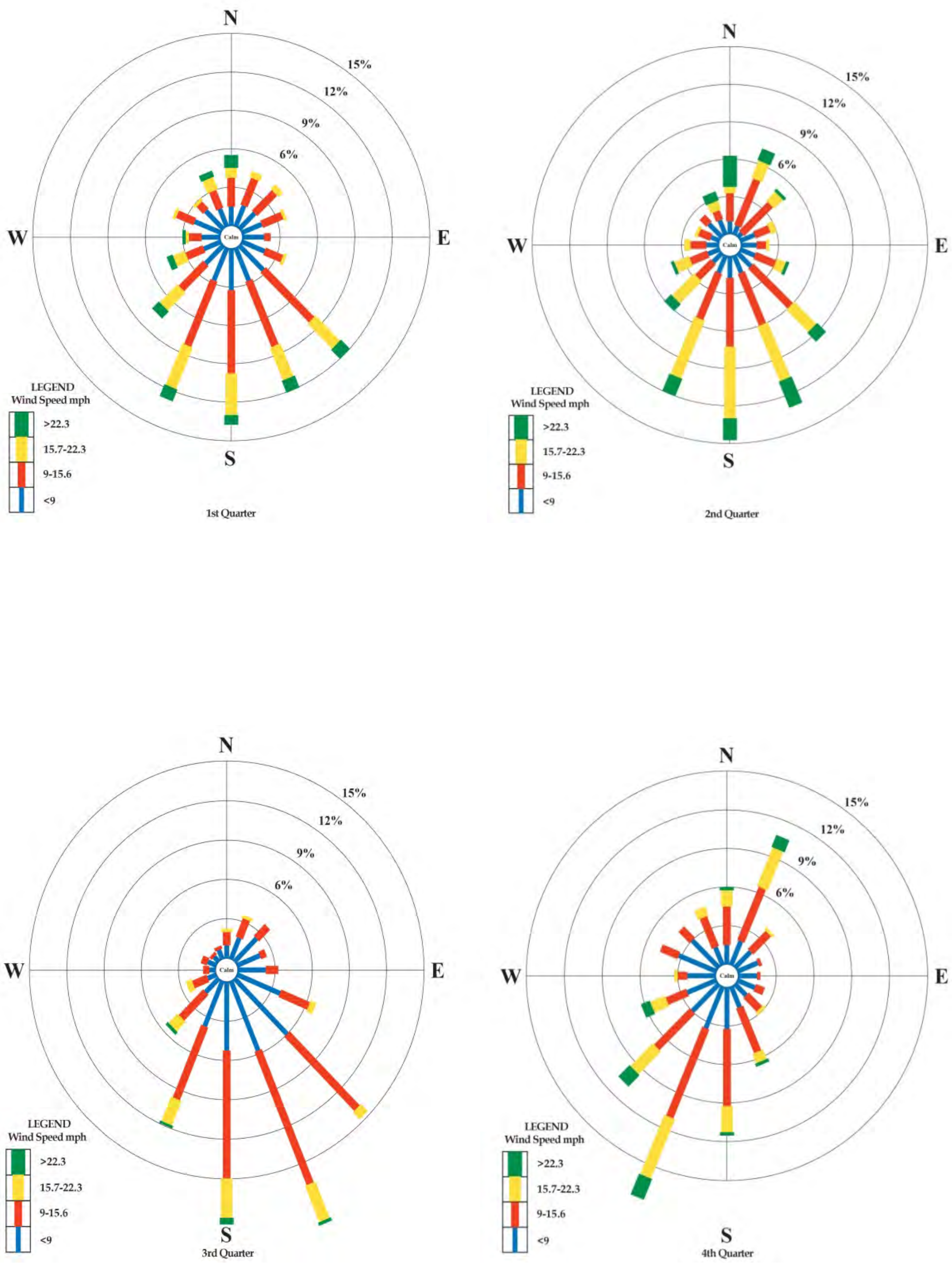


FIGURE 1.3(b) — ***Pantex Plant Quarterly Wind Roses for 2013***

Table 1.1 is a compilation of climatological data (temperature, relative humidity, precipitation; including the water equivalent of any snowfall and wind speed) for 2013 from the Pantex Plant or Amarillo Airport NWS meteorological instrumentation. The range of mean monthly temperatures during the year measured at the Pantex Plant's meteorological tower and the monthly precipitation totals as measured at the Amarillo Airport NWS site are shown in Figures 1.4 and 1.5.

TABLE 1.1 — *Pantex 2013 Climatological Data by Month*

Month	Temperature °C (°F)			Mean Relative Humidity (percent)	Precipitation[a] mm (inches)	Wind Speed m/s (mph)	
	Maximum	Minimum	Mean Monthly			Mean	Maximum
January	21.7 (71.1)	-11.4 (11.4)	2.1 (35.7)	61	19.30 (0.76)	5.1 (11.3)	14.5 (32.1)
February	20.4 (68.8)	-9.3 (15.2)	2.9 (37.2)	59	64.26 (2.53)	6.1 (13.5)	19.8 (44.0)
March	26.8 (80.3)	-7.6 (18.4)	8.6 (47.4)	48	3.81 (0.15)	5.8 (12.8)	19.2 (42.6)
April	32.5 (90.5)	-20.6 (-5.0)	10.6 (51.1)	49	1.27 (0.05)	6.7 (14.9)	16.6 (36.8)
May	34.6 (94.3)	-2.7 (27.2)	18.8 (65.9)	45	71.12 (2.80)	6.6 (14.6)	20.3 (45.2)
June	38.2 (100.7)	11.4 (52.5)	24.7 (76.5)	51	71.12 (2.80)	6.6 (14.7)	20.3 (45.1)
July	35.7 (96.3)	14.0 (57.2)	24.4 (76.0)	53	47.24 (1.86)	5.3 (11.7)	12.5 (27.7)
August	37.8 (100.0)	7.4 (45.3)	24.7 (76.4)	57	36.07 (1.42)	4.5 (10.0)	13.0 (28.9)
September	33.7 (92.7)	10.5 (50.9)	22.7 (72.8)	56	46.48 (1.83)	4.4 (9.8)	12.7 (28.2)
October	31.6 (88.8)	0.3 (32.5)	13.7 (56.6)	46	4.32 (0.17)	5.5 (12.2)	14.8 (32.9)
November	21.8 (71.3)	-7.4 (18.7)	10.6 (51.0)	58	13.21 (0.52)	5.5 (12.3)	16.2 (36.1)
December	21.6 (70.9)	-16.6 (2.2)	3.8 (38.9)	57	8.13 (0.32)	4.8 (10.7)	14.9 (33.2)
Annual[b]			**13.5 (56.4)**	**53**	**386.33 (15.21)**	**5.6 (12.4)**	

[a] Includes water equivalent of snowfall. (Precipitation data from Amarillo Airport NWS site.)
[b] Total precipitation and the annual mean of parameter (when indicated) except for precipitation is indicated. Annual maximum and/or minimum values of temperature and wind speed may be obtained by reviewing the data in the appropriate column.

1.5 Geology

The primary surface deposits at Pantex Plant are the Pullman and Randall soil series, which grade downward to the Blackwater Draw Formation. This formation consists of about 15 m (50 ft) of interbedded silty clays with caliche and very fine sands with caliche.

Underlying the Blackwater Draw Formation, the Ogallala Formation consists of interbedded sands, silts, clays, and gravels. The base of the Ogallala Formation is an irregular surface that represents the pre-Ogallala topography. As a result, depths to the base of the Ogallala vary. At Pantex Plant, the vertical distance to the base of the Ogallala varies from 90 m (300 ft.) at the southwest corner to 220 m (720 ft.) at the northeast corner of the property (Purtymun and Becker, 1982).

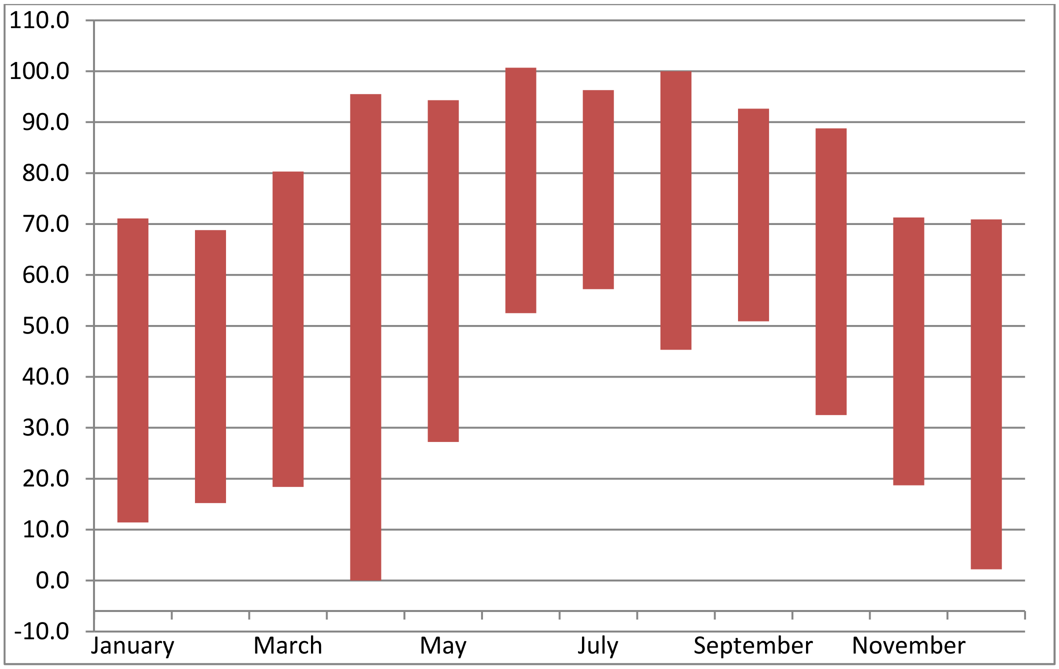


FIGURE 1.4 — *Pantex Plant Monthly Temperature Range during 2013 (ºFahrenheit)*

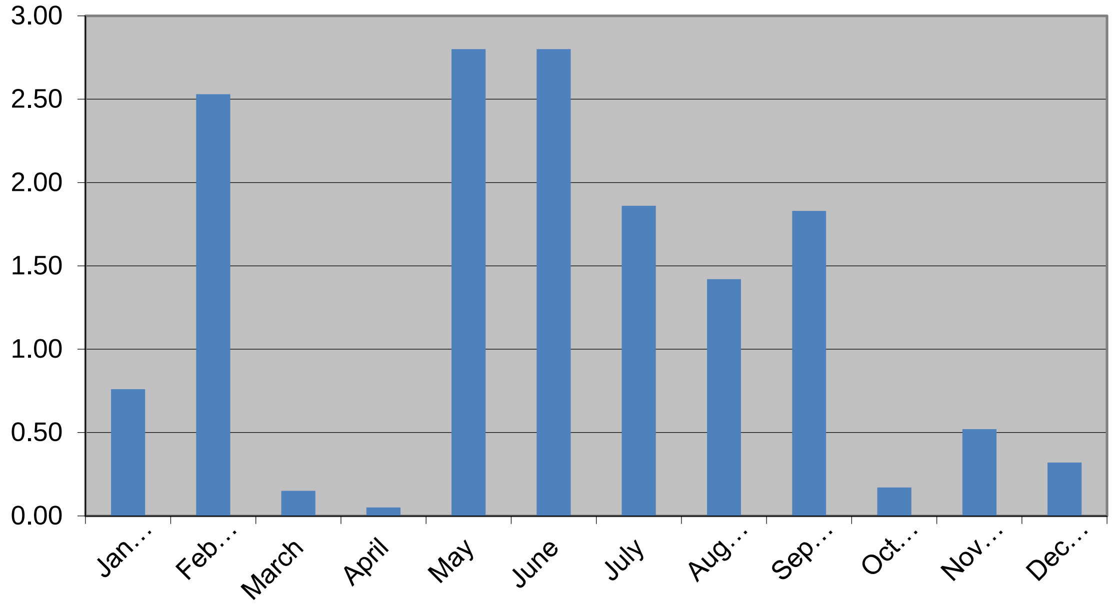


FIGURE 1.5 — *Amarillo National Weather Service (NWS) Precipitation During 2013 (in inches)*

Underlying the Ogallala Formation is sedimentary rock of the Dockum Group, consisting of shale, clayey siltstone, and sandstone. The deep geology (1,200 m or 4,000 ft.) below the Plant has a major influence on the natural radiation environment, because radon is released from the granitic rocks there.

1.6 Hydrology

The principal surface water feature on the Southern High Plains is the Canadian River, which flows southwest to northeast approximately 27 km (17 mi) north of the Plant. Plant surface waters do not drain into this system, but for the most part discharge into on-site playas. Storm water from agricultural areas at the periphery of the Plant drains into off-site playas. From the various playas, water either evaporates or infiltrates the soil. Two principal subsurface water-bearing units exist beneath Pantex Plant and adjacent areas: the Ogallala Aquifer and the underlying Dockum Group Aquifer. The perched aquifer lies within the vadose, or unsaturated, zone above the Ogallala Aquifer. The vadose zone consists of as much as 140 m (460 ft.) of sediment that lies between the land surface and the Ogallala Aquifer.

1.6.1 Ogallala Aquifer

The water-bearing units within the Ogallala Formation beneath Pantex Plant are the perched aquifer in the vadose zone and the Ogallala Aquifer below. A discontinuous perched aquifer is present above the main zone of saturation. Perched aquifers form above clayey layers that have lower permeability. Data collected from wells at Pantex Plant indicate that the zone of saturation in the perched aquifer varies in thickness by as much as 15 to 25 m (~70 ft.). Depths from the surface to the perched aquifer range from 64 to 85 m (209 to 280 ft.).

The main Ogallala Aquifer lies beneath the perched water zones. Depth to the main Ogallala Aquifer ranges from 102 to 168 m (~325 to 500 ft.) below ground surface. The saturated thickness varies from 12 to 98 m (~39 to ~400 ft.) (PGCD, 1980). The aquifer is defined as the basal water-saturated portion of the Ogallala Formation and is a principal water supply on the High Plains. The regional gradient of the Ogallala Aquifer beneath Pantex Plant trends from the southwest to the northeast, where the zone of saturation is thickest. The Plant's production wells are located in this northeast area. The City of Amarillo's Carson County Well Field is located north and northeast of Pantex Plant's well field.

1.6.2 Dockum Group Aquifer

The Dockum Group Aquifer lies under the Ogallala Formation at Pantex Plant. Water contained in sandstone layers within the Dockum Group supplies domestic and livestock wells south and southeast of Pantex Plant. Other wells reaching the Dockum Group Aquifer are located 16 km (10 mi) south and west of the Plant. The aquifer may be semi confined with respect to the overlying Ogallala Aquifer because of lateral variations in the Ogallala and shale layers within the Dockum Group.

1.6.3 Water Use

The major surface water source near Pantex Plant is the Canadian River, which flows into man-made Lake Meredith approximately 40 km (25 mi) north of the Plant. Many local communities use water from Lake Meredith for domestic purposes. The major groundwater source in the vicinity of the Plant is the Ogallala Aquifer, which is used as a domestic source by numerous municipalities, and by industries in the High Plains. Historical groundwater withdrawals, and long-term pumping from the Ogallala in Carson County and the surrounding eight-county area, have exceeded the natural recharge rate to the Ogallala. These overdrafts have removed large volumes of groundwater from recoverable storage, and have caused substantial water-level declines.

The large demands of the Amarillo area; which are primarily agricultural, are responsible for the drop in the water table. The average change in “depth to water” from 1,209 Ogallala Aquifer observation wells in the Panhandle during 1988 to 1997 was 1.49 ft. Groundwater withdrawals from the Ogallala Aquifer in Carson County have averaged 14,931 hectare-meters (121,000 acre-ft.) over the last several years (Brady, 2005). This groundwater withdrawal rate is more than 10 times greater than the estimated annual recharge rate of 1,419 hectare-meters (11,500 acre-ft.). Groundwater withdrawal rates are expected to decline each decade to approximately 8,018 hectare-meters (65,000 acre-ft.) in 2060 (Crowell, 2007).

The City of Amarillo, the largest municipal Ogallala water user in the area, pumps water for public use from the Carson County Well Field north and northeast of the Plant. Pantex Plant obtains water from five wells in the northeast corner of the site. In 2013, Pantex pumped approximately 51 hectare-meters (414 acres-ft.) from the Ogallala Aquifer. Most of the water used at Pantex Plant is for domestic purposes. Through an agreement with Texas Tech University, Pantex Plant provides water for its domestic and livestock uses.

1.7 Seismology

Seismic events have occurred infrequently in the region, and their magnitudes have been low. The stress conditions at the site are such that the possibility of high-order seismic events is extremely unlikely. A qualitative understanding of present conditions at Pantex Plant indicates that anticipated seismic activity is well below the level that is necessary to cause significant damage to structures at the Plant. The potential for local or regional earthquakes (with a magnitude great enough to damage structures at the site to the degree that hazardous materials would be released) is extremely low (McGrath, 1995).

1.8 Land Use and Population

The land around Pantex Plant is used mainly for winter wheat and grain sorghum farming, for ranching, and for mining (oil and gas). Although dryland farming is dominant, some fields are irrigated from the Ogallala Aquifer or, less commonly, from local playas. Ranching in the region consists of cow-calf and yearling operations. The economy of the rural Panhandle region depends mainly on agriculture, but diversification has occurred in the more populated counties of the region and includes manufacturing, distribution, food processing, and medical services. Nationally known businesses that are major employers in the greater Amarillo area include Bell Helicopter; Tyson Foods (a single rail beef-slaughtering operation), Pantex Plant; Owens-Corning Fiberglass (a fiberglass reinforcement plant), ASARCO (a large silver and copper refiner), and Cactus Feeders, one of the largest cattle-feeding operations in the world. Conoco-Phillips Petroleum and Xcel Energy are also major industrial presences in the Panhandle region.

A land-use census of the residential population surrounding Pantex Plant showed that most of the population is located west-southwest of Pantex Plant in the Amarillo metropolitan area. Population data from the 2010 Census are now available at most tracking levels and were used to generate Figure 1.6, showing the population distribution at 5-mile intervals within 50 miles of the Plant. According to the 2010 Census, the total population within 50 miles of the Pantex Plant is 316,132 people (Bureau of the Census, 2010).

The total population of the 20 county area (defined as the Texas Panhandle) surrounding the Plant is 389,721. The population of the City of Amarillo (190,695 in 2010) represents about 49 percent of the counties’ population. Another approximately 32 percent of the population lives in other incorporated cities, and about 19 percent reside in unincorporated areas. The communities of Pampa, Borger, Hereford, Dumas, and Canyon each have populations between 13,000 and 18,000. The population density of these counties ranges from 12 to 132 persons per square mile. The 20 county areas can be

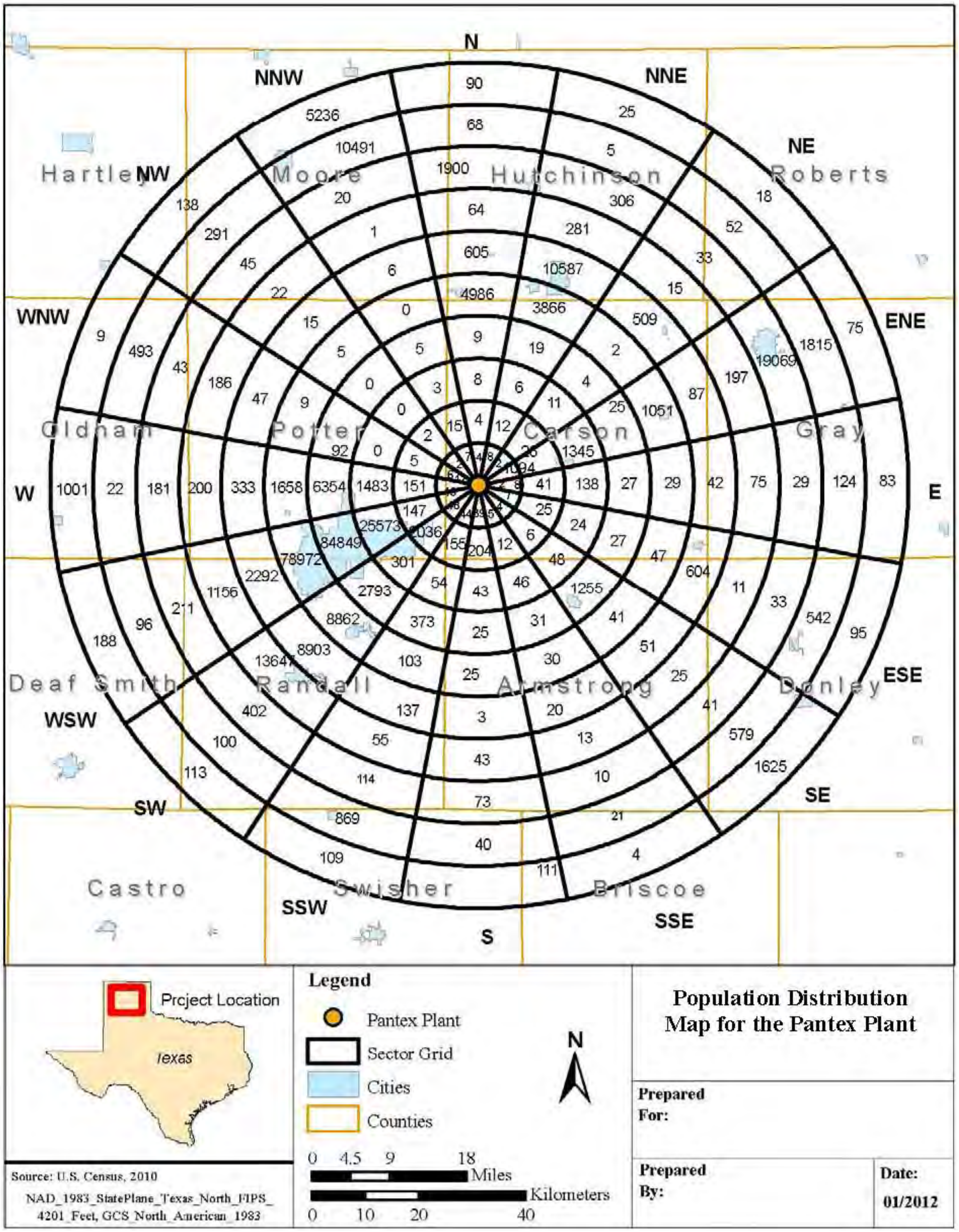


FIGURE 1.6 — *Population Distribution within 50 Miles of Pantex Plant (2010)*

described as sparsely populated, with Potter and Randall Counties being the exception. Potter, Randall, Carson, and Armstrong Counties make up the Amarillo Metropolitan Statistical Area. Hutchinson County (in which Borger is located) and Gray County (in which Pampa is located) are now classified as micropolitan statistical areas (DOCd). Hartley, Moore, Roberts, Oldham, Deaf Smith, Donley, Dallam, Sherman, Hansford, Ochiltree, Lipscomb, Hemphill, Wheeler, and Collingsworth are the remaining counties of the defined area; although, the population contained in the northerly portions of Castro, Swisher, and Briscoe counties is also included in the 80 km (49 mi) population estimate described above.

1.9 Organization of the Report

The remainder of this report is organized into 12 chapters and three appendices:

Chapter 2 discusses regulatory requirements for environmental compliance during 2013 and describes the Plant's compliance-related issues and activities. It presents results of various regulatory inspections and environmental activities and lists the environmental permits issued to the Pantex Plant.

Chapter 3 provides a brief summary of the environmental programs that are conducted at Pantex Plant. Overviews are provided for environmental management, pollution prevention, natural and cultural resources management, and environmental restoration.

Chapter 4 describes the environmental radiological monitoring program, which deals with the potential exposure of the public and the environment to radiation resulting from Plant operations. Also discussed are results of the environmental thermoluminescent dosimetry program and other radiological monitoring programs for various environmental media (i.e., air, groundwater, surface water, plants, and animals).

Chapters 5 through 12 discuss radiological and non-radiological monitoring and surveillance programs for individual environmental media. Chapter 5 discusses the air-monitoring program. The groundwater, drinking water, wastewater, and surface water monitoring programs are discussed in Chapters 6, 7, 8, and 9, respectively. Chapter 10 describes the soil-monitoring program, and vegetation and faunal monitoring are discussed in Chapters 11 and 12, respectively. Each of these chapters includes a description of the monitoring program for the specific medium and an analysis of radiological (if available) and non-radiological data for the 2013 samples.

Chapter 13 reviews Pantex Plant's quality assurance program for environmental monitoring efforts, as initiated in response to 10 CFR 830.120 and DOE Order 414.1.C (DOEg). The chapter also includes an analysis of quality control samples collected during 2013 and a data validation summary.

Appendix A lists all of the analytes for which environmental analyses were conducted.

Appendix B lists all of the birds sighted at Pantex Plant.

Appendix C provides references.

Pantex's policy is to conduct all operations in compliance with applicable environmental statutes, regulations, and the requirements of the various authorizations issued to the Plant. This chapter reviews current issues and actions related to these requirements. In 2013, Pantex demonstrated its commitment to maintaining full compliance with all applicable environmental requirements by receiving no significant violations or adverse regulatory actions from environmental regulators. In addition to maintaining full compliance with all applicable environmental requirements, Pantex efforts to excel in its environmental management systems is exemplified by the Gold Level status in the TCEQ's Clean Texas Program awarded to the Pantex Plant.

2.1 Environmental Regulations

This chapter summarizes the compliance status of Pantex Plant for 2013. It describes initiatives and clean-up agreements in place, regulatory authorizations issued to the Plant, and measures to support the U.S. Department of Energy (DOE) health, safety, and environmental performance indicators. Table 2.1 presents the major environmental regulations applicable to operations at the Pantex Plant.

TABLE 2.1 - *Major Environmental Regulations Applicable to Pantex Plant*

Regulatory Description	Authority	Codification	Status
ARCHAEOLOGICAL RESOURCE PROTECTION ACT (ARPA) ARPA provides for the protection of archeological resources and sites located on public and Native American lands.	Federal: Advisory Council on Historic Preservation State: State Historic Preservation Office (SHPO)	Federal: Title 36 of the Code of Federal Regulations (CFR), Chapter 79 (39 CFR §79), 43 CFR §7	All archeological surveys and testing at Pantex Plant conformed to ARPA standards.
CLEAN AIR ACT (CAA) CAA and the Texas Clean Air Act (TCAA), through their implementing regulations, control the release of regulated emissions to the atmosphere and provide for the maintenance of ambient air quality.	Federal: U.S. Environmental Protection Agency (EPA) State: Texas Commission on Environmental Quality (TCEQ) Texas Department of State Health Services (TDSHS)	Federal: 40 CFR §50-§82 State: Title 30 of the Texas Administrative Code, Chapter 101 through Chapter 122 (30 TAC §101-§122) & §305 25 TAC §295 (Asbestos only)	Pantex Plant complies with permits and Permits-by-Rule issued or promulgated by the TCEQ to authorize releases of pollutants to the atmosphere. Pantex Plant complies with the applicable requirements codified in the CFR and TAC. Pantex is a self-certified "Minor" emission source under the Federal Operating Permit program.
COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) CERCLA provides the regulatory framework for the remediation of releases of hazardous substances and cleanup of inactive hazardous substance disposal sites. Section 107 provides for the protection of natural resources on publicly owned property through designation of Natural Resource Trustees.	Federal: U.S. Environmental Protection Agency	Federal: 40 CFR §300, §302, §355, & §370	Pantex Plant has been on the National Priorities List since 1994. The EPA, TCEQ, and the NNSA Production Office (NPO) have signed an Interagency Agreement concerning the conduct of the remediation at the Pantex Plant. A Record of Decision (ROD) was issued and approved in 2008 (DOEc) and Pantex was added to the Construction Completion List in 2010. Interested Co-Trustees have been involved in the planning and completion of the ecological risk assessment (ERA) for Pantex, and selection of the final remedy.

Regulatory Description	Authority	Codification	Status
			The Agency for Toxic Substances and Disease Registry published its final report *Public Health Assessment-Pantex Plant* in September 1998.
ENDANGERED SPECIES ACT (ESA) ESA prohibits federal agencies from taking any action that would jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of a critical habitat.	Federal: U.S. Fish and Wildlife Service State: Texas Parks and Wildlife Department (TPWD)	Federal: 50 CFR §10; 50 CFR §17; Title 16 of the United States Code, Chapter 153 (16 USC §153), et seq. State: Texas Parks and Wildlife Code, §68	Ongoing and proposed actions are assessed as to their potential adverse effects on threatened and endangered species.
FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA) FIFRA governs the manufacture and use of biocides, specifically the use, storage, and disposal of all pesticides and pesticide containers and residues.	Federal: EPA State: Texas Department of Agriculture; Structural Pest Control Board	Federal: 40 CFR §170-§171 State: 4 TAC §7.1-§7.40; Structural Pest Control Act (Art. 135b-5)	State-licensed personnel apply pesticides in accordance with applicable regulations. The Plant implemented a land-applied chemical use plan in 1996. The plan was most recently updated in 2011.
FEDERAL WATER POLLUTION CONTROL ACT / CLEAN WATER ACT (CWA) The Texas Water Code, through its implementing regulations, regulates the quality of water discharged to waters of the State of Texas.	Federal: EPA State: TCEQ	Federal: 40 CFR §120-§136 & 40 CFR §300 - §583 State: 30 TAC §205-§299, §305 §317 & §319	As currently defined, the Pantex Plant does not discharge its wastewaters to 'Waters of the United States'. The Pantex Plant discharges its industrial wastewaters pursuant to Permits WQ0002296000, WQ0004397000, and UIC 5W2000017. The Plant has coverage under Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit, for storm water via Permit No. TXR150000. It complies with requirements of the permit whenever applicable to a project. As of the end of 2013, four active projects had been registered with the TCEQ. The Plant operates under TCEQ General Permit for Discharges of Storm Water from Industrial Sources Registration No. TXR05P506.
MEDICAL WASTE	Federal: U.S. Department of Transportation State: Texas Department of State Health Services	Federal: 49 CFR §173 State: 30 TAC §330.1201-1221	The Plant manages medical waste in accordance with applicable regulations.

Regulatory Description	Authority	Codification	Status
MIGRATORY BIRD TREATY ACT Establishes criteria for the protection of migratory birds. Pantex provides habitat for many migratory bird species protected by federal law. At Pantex, all migratory birds, their parts, and their nests were fully protected as required by statute.	Federal: U.S. Fish and Wildlife Service State: TPWD	Federal: 50 CFR §10 pursuant to 16 USC § 704-§707a and §712 State: Texas Parks and Wildlife Code, §64 (2-5, 7, & 26-27)	Actions being considered at Pantex Plant are reviewed through the National Environmental Protection Act (NEPA) process, which considers impacts to migratory species. Nuisance and other bird situations are handled within compliance of the Migratory Bird Treaty Act.
Executive Order 13186: Responsibilities for Federal Agencies to Protect Migratory Birds (2001) Establishes commitment to migratory bird protection, management, research, and outreach on federal properties. Reaffirms relationship between the U.S. Fish and Wildlife Service and other federal agencies.	Federal: U.S. Department of Energy	Volume 66 Federal Register, page 3853 (66 FR 3853), 2001	Actions being considered at Pantex Plant are reviewed through the NEPA process, which considers impacts to migratory species.
NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) NEPA establishes a broad national policy to conduct federal activities in ways that promote the general welfare of the environment. NEPA procedures must ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken.	Federal: U.S. Department of Energy; Council for Environmental Quality	Federal: 10 CFR §1021, 40 CFR §1500-§1508	In 2013, ten Standard NEPA Review Forms, 27 Internal NEPA Review Forms, and seven amendments were prepared. Pantex did not prepare an Environmental Assessment (EA) during calendar year 2013. The Supplement Analysis for the Final Environmental Impact Statement for Pantex was approved by NPO in January 2013.
PROTECTION OF BIRDS, NONGAME SPECIES, AND FUR-BEARING ANIMALS Requires the protection of all indigenous birds and ring-necked pheasants, non-game species, and fur-bearing animals except where exceptions are stated in the Texas Parks & Wildlife Code.	Federal: U.S. Fish and Wildlife Service State: TPWD	Federal: 50 CFR §10 State: Texas Parks and Wildlife Code, §67, §71	Actions being considered at Pantex Plant are reviewed through the NEPA process, which considers impacts to all protected species.

Regulatory Description	Authority	Codification	Status
RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) RCRA and the Texas Solid Waste Disposal Act govern the generation, storage, handling, treatment, and disposal of solid waste, including hazardous waste. These statutes and regulations also regulate underground storage tanks and spill cleanup.	Federal: EPA State: TCEQ	Federal: 40 CFR §260-§280 State: 30 TAC §305, §327, §334, and §335	Pantex Plant is defined as a large-quantity generator. Permit HW-50284 authorizes the management of hazardous wastes in various storage and processing units at the Plant. Compliance Plan CP-50284 addresses corrective action requirements at the Plant. The Plant operates five regulated underground storage tanks.
SAFE DRINKING WATER ACT (SDWA) SDWA and the Texas Water Code govern public water supplies.	Federal: EPA State: TCEQ	Federal: 40 CFR §141-§143 State: 30 TAC §290	Pantex operates a Non-Transient, Non-Community Public Water Supply System (No. 0330007). The system is recognized as a Superior Public Water System by the TCEQ.
TOXIC SUBSTANCES CONTROL ACT (TSCA) TSCA requires the characterization of toxicity and other harmful properties of manufactured substances and regulates the manufacture, distribution, and use of regulated materials.	Federal: EPA	Federal: 40 CFR §700-§766 & 10 CFR §850	The Plant manages polychlorinated biphenols (PCBs), asbestos, beryllium, and chemicals in compliance with applicable regulations.

2.2 Clean Air Act

Most requirements of the Federal Clean Air Act in Texas are implemented under the Texas Clean Air Act, which is administered by the TCEQ, as approved by the EPA through the Texas State Implementation Plan. The exceptions to this delegation of authority from the EPA include: 40 CFR §61, Subpart H (Emissions of Radionuclides Other Than Radon from DOE Facilities), 40 CFR §61, Subpart M (National Emissions Standard for Asbestos) and regulations dealing with greenhouse gasses. The primary regulatory authority for 40 CFR §61, Subpart M, is delegated to the Texas Department of State Health Services (TDSHS).

2.2.1 40 CFR §61 Subpart H (Emissions of Radionuclides Other Than Radon from DOE Facilities)

According to the standard established by the EPA at 40 CFR §61.92, emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 millirem per year (10 mrem/yr) or 0.10 milliSievert per year (0.10 mSv/yr). Based upon evaluations using the most conservative assumptions about the emissions of radionuclides from several Plant locations that have the potential to emit radioactive materials, Pantex has determined that the maximum effective dose equivalent that any member of the public received in 2013 was 7.0×10^{-6} mrem (7.0×10^{-8} mSv). Accordingly, Pantex is in compliance with the EPA standard.

Continuous emission monitoring, as described in 40 CFR §61.93, is not required of any source at Pantex Plant, based on each source's emission potential. The Plant does perform periodic confirmatory measurements, as well as modeling, to assure compliance with 40 CFR §61 Subpart H regulations.

In accordance with 40 CFR §61.96, all new construction projects and activities (or modifications to existing structures or activities) that have the potential to emit radioactive materials are evaluated to determine if the effective dose equivalent, caused by all emission is less than one percent of the 40 CFR §61.92 standard (i.e., is less than 0.1 mrem/yr [0.001 mSv/yr]). During 2013, none of the evaluations resulted in the identification of exceedances of this reduced standard, and accordingly, there was no need to make an application for approval or notifications of startup to the EPA under the provisions of 40 CFR §61.96.

2.2.2 40 CFR §61 Subpart M (National Emissions Standard for Asbestos)

Each year, Pantex files a "Notification of Consolidated Small Operations Removing Asbestos-Containing Material" with the TDSHS for maintenance activities to be conducted by the Plant in the next calendar year. To verify that operations are consistent with the notification, Pantex keeps a log of all its affected maintenance activities to track quantities of material disturbed.

Subcontractors at Pantex Plant are required to prepare separate notifications for work that qualifies as "demolition" or "renovation" as defined in 40 CFR §61, Subpart M, and 25 TAC §295.61, which implements the "Texas Asbestos Health Protection Act." Separate notifications are also required for jobs conducted by Pantex personnel that involve amounts that would require job-specific notifications. Pantex maintains the required certifications for the personnel who plan, oversee, and conduct these efforts. By filing the required forms and maintaining the described records, Pantex demonstrates that it is in compliance with 40 CFR §61, Subpart M.

2.2.3 40 CFR §68 (Chemical Accident Prevention)

Pantex has established and maintains controls on the introduction of new chemicals to any area of the Plant. Through this process, Pantex has been able to demonstrate that it has control of the chemicals in use. It continues to ensure that the quantities of chemicals at any location are below the threshold quantities stated in 40 CFR §68, thus, exempting Pantex from having to perform risk management planning.

2.2.4 40 CFR §82 (Ozone Depleting Substances)

Pantex installs and maintains fixed and mobile air conditioning systems at the Plant. The technicians that perform this work have been trained in the proper use of approved recycling devices while conducting these efforts. Pantex maintains records of training and maintenance activities to demonstrate compliance with these regulations.

2.2.5 Air Quality Permits and Authorizations

Pantex continues to use a combination of an air quality permit issued under 30 TAC §116 (Permit 84802) and authorizations issued under 30 TAC §106 (Permits by Rule) to authorize operations conducted at the Plant.

2.2.6 Federal Operating Permit Program

The Title V Federal Operating Permit Program is administered and enforced by the EPA Region 6 Office and the TCEQ. During 2013, Pantex maintained documentation demonstrating that it was not a major source, as defined by the Federal Operating Permit Program.

2.2.7 Air Quality Investigation

The TCEQ did not perform an air quality related compliance inspection of Pantex Plant during 2013.

2.2.8 Emission Tracking and Calculation

2.2.8.1 Scope of the Pantex Plant Emission Tracking System

Pantex Plant is subject to the federal Clean Air Act and the State of Texas regulations under 30 Texas Administrative Code §101, §106, §111, §112, §114, §116, and §122. The main scope or function of the Plant's air emission tracking system is to monitor process emissions, in order to (a) maintain the facility designation of "Synthetic Minor" under the federal Title V program, and (b) demonstrate compliance with authorizations issued to the Pantex Plant.

The Pantex Plant initiated a comprehensive system for tracking emissions from specific sources (facilities) in September of 1999, and has continued to update the tracking process to comply with changing regulations and best management practices. Pantex Plant processes that have emissions are conducted under the authority of various regulations and authorizations [Permits, Standard Exemptions (SE), and Permits-by-Rule (PBR)]. Table 2.2, below, identifies the tracked emission sources at Pantex and their authorizations.

TABLE 2.2 - *Tracked Emission Sources at Pantex*

Process:[a]	Authorization Permit #	Standard Exemption [b]	Permit By Rule
HE Synthesis Facility	Permit 84802		
HE Fabrication	Permit 84802		
Firing Site Activities	Permit 84802		
Boiler House	Permit 84802		
Stationary Standby Emergency Engines	Permit 84802		
Boiler House, Diesel Storage	Permit 84802		
Burning Ground Activities	Permit 84802		
Hazardous Waste Storage	Permit 84802		
Hazardous Waste Processing	Permit 84802		
Welding and Cutting		SE 39	
Dual Chamber Incinerator	Permit 84802		
Plastics Shop	Permit 84802		
Epoxy Foam Production	Registration 43702		PBR 262
Component Sanitization	Registration 41577		PBR 261 & 262
Machining		SE 41	PBR 432 & 452
VMF Fueling Operations	Permit 84802		PBR 412
HWTPF Liquid Processing Facility	Permit 84802		
Pantex Site-wide Cooling Towers	Permit 84802		PBR 371

Process:[a]	Authorization Permit #	Standard Exemption [b]	Permit By Rule
Stationary Standby Emergency Engines	Permit 84802		PBR 511 for those engines added after issuance of Permit 84802
Painting Facilities	Registration 32674, 52638, 52639	SE 75	
Pressing & Transferring HE & Mock		SE 106 & 118	
Burning Ground-Soil Vapor Extraction			PBR 533
Miscellaneous Chemical Operations		SE 34	PBR 106.122, PBR 106.123, “de minimus”
Chemical Transfer Operations	Registration 72373		PBR 262, 472, and 473
Drum Management Operations	Registration 92876		PBR 261, 262, and 512

[a] Authorization dates (the effective dates) can be found in Table 2.5.
[b] Standard Exemptions pre-date and were replaced by Permits by Rule.

2.2.8.2 Program Structure and Requirements

Pantex Plant is categorized as a Synthetic Minor air emission source. The upper threshold of emission limits for a facility to remain in this category is 25 tons per year of Hazardous Air Pollutants (HAP) (or 10 tons of a single HAP) and 100 tons per year of the criteria pollutants. Under this designation, a facility is not required to declare its emissions every year to the TCEQ; however, a certification of potential to emit (PTE) is required by 30 TAC §122.122 when significant changes of emissions take place. The PTE, once submitted to the TCEQ, becomes a federally enforceable document for allowable emissions. Essentially, the PTE establishes emission limits that are administratively set by Pantex and authorized/enforceable by the TCEQ and the EPA.

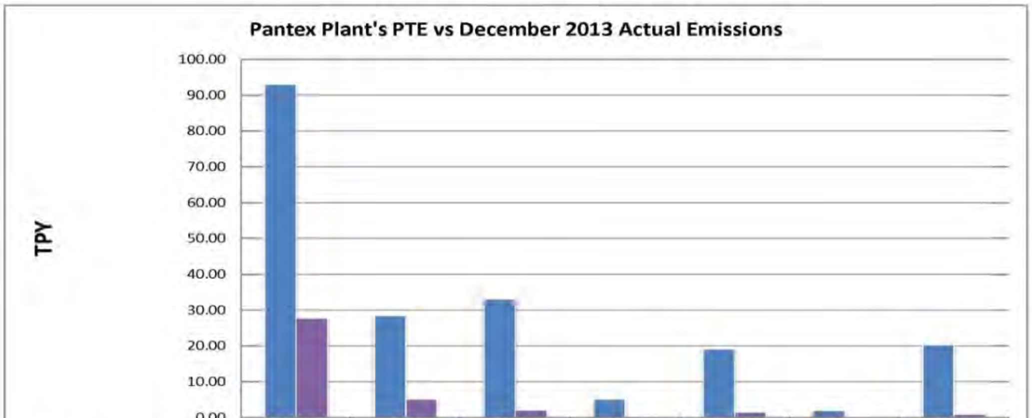
The Pantex Plant maintains a tracking process to verify compliance with certified emissions limits. This tracking process is implemented through Air Quality Management Requirement (AQMR) documents, which are placed into the every-day operational procedures/activities that have either point source or fugitive emissions. AQMRs are management-driven documents that outline regulatory requirements for operators to follow based upon process activities and the requirements of the federal and state air emissions regulations. The approved AQMRs usually incorporate sections of the authorization that outline the internal reporting and recordkeeping requirements for process operators. Operational data are gathered by process operators and then input on a monthly basis into enhanced commercial off-the-shelf computer software. The software uses emission factors from source tests, manufacturer’s data, and EPA documentation to calculate both hourly and rolling 12-month emissions.

2.2.8.3 Types and Tracking of Emissions

During 2013, Pantex tracked the emissions from 30 different processes both at specific locations and grouped sources across the Plant. Pantex personnel responsible for air program compliance gathered facility data on emissions of common air pollutants including nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), sulfur oxides (SOx), particulate matter (PM), and hazardous air pollutants (HAPs). The data, once gathered, are compiled into a monthly report that compares the cumulative past 12 month emissions for the Plant, to the annual limits set in the authorized PTE.

2.2.8.4 Conclusions of Air Emission Tracking for 2013

Over the 12 months of air emission tracking for 2013, operations at the Pantex Plant remained well below the certified and authorized PTE levels for each of the pollutants tracked. Figure 2.1 below is a graphic presentation of the emission information gathered from January through December 2013, expressed in relation to the PTE certification in Tons per Year. It provides a demonstration that Pantex Plant continues to meet the requirements of the Title V program for the designation as a Synthetic Minor Source.



	NOX	CO	VOC	SO2	PM10	HF	HAP
Cert. PTE-Jan 2010	93.08	28.53	33.17	5.14	19.14	2.00	20.36
Plant Total Emission Rates:	27.83	5.24	2.19	0.11	1.55	0.08	0.98

FIGURE 2.1 - *PTE Versus Actual Yearly Emissions*

2.3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)

Because Pantex Plant is listed on the National Priorities List, CERCLA Section 107 (Title 42 of the United States Code, Chapter 9607) is applicable to Pantex Plant. Section 107 provides for the designation of federal and state trustees who are responsible for assessing damages, for injury to, destruction of, and loss of natural resources. As Pantex Plant's primary Natural Resource Trustee [per 40 CFR §300.600(b)(3)], the DOE is responsible for encouraging the involvement of designated federal and state trustees. To meet this responsibility, DOE held meetings with state and federal agencies. DOE and EPA jointly issued an Interagency Agreement (IAG) in December 2007 in conclusion of negotiations between DOE, Pantex, EPA, and TCEQ. This agreement became effective in February 2008.

Pantex submitted the Site Management Plan (SMP), a primary document required by Article 7.2 of the IAG in November 2008. The SMP is a schedule with deadlines and timetables for completion of all primary documents and additional work identified pursuant to the IAG. Pantex completed all but two of the primary documents by 2013. The SMP is submitted annually to update schedules for the Five-Year Review and the Final Remedial Action Completion Report. No additional work has been identified for inclusion in the SMP.

Accordingly, Pantex was added to the Construction Completion List, signifying the start of the Operation and Maintenance phase of the remedy. Progress reports are prepared and submitted to EPA and TCEQ quarterly to communicate the status and accomplishments of the remedial action systems. Also, an annual report is prepared to document a more thorough evaluation, and five-year reviews will be conducted to ensure periodic comprehensive analyses of the protectiveness of the selected remedy. The first five-year review was conducted during 2012.

2.4 Endangered Species Act

Pantex Plant provides habitat for several species protected by federal and state endangered species laws. In 1992, Pantex Plant began a program to assess its natural resources (See Chapter 3). Each year, wildlife observations are recorded and state and federal rare species lists are examined for changes. The current status of endangered or threatened species, as well as species of concern, known to appear on or near Pantex Plant (Carson and Potter counties) is summarized in Table 2.3. Pantex Plant is in compliance with the applicable provisions of the Endangered Species Act.

TABLE 2.3 - *Endangered, Threatened, and Candidate Species and Species of Concern Known to Appear on or near Pantex Plant*

Common Name	Scientific Name	Present in 2013	Federal Status	State Status
Birds				
American peregrine falcon	*Falco peregrinus anatum*	[b]	Delisted	Threatened
Arctic peregrine falcon	*Falco peregrinus tundrius*	[b]	Delisted	Threatened[a]
Baird's sparrow	*Ammodramus bairdii*		-	Concern
Bald eagle	*Haliaeetus leucocephalus*	[b]	Delisted	Threatened
Ferruginous hawk	*Buteo regalis*		-	Concern
Interior least tern	*Sterna antillarum athalassos*		Endangered	Endangered
Lesser prairie chicken	*Tympanuchus pallidicinctus*		Candidate	Threatened
Mountain plover	*Charadrius montanus*		-	Concern
Western Snowy plover	*Charadrius alexandrinus*		-	Concern
Western burrowing owl	*Athene cunicularia hypugea*	[b]	-	Concern
Prairie falcon	*Falco mexicanus*		-	Concern
White-faced ibis	*Plegadis chihi*	[b]	-	Threatened
Whooping crane	*Grus Americana*		Endangered	Endangered
Mammals				
Big free-tailed bat	*Nyctinomops macrotis*		-	Concern
Black bear	*Ursus americanus*		-	Threatened
Black-tailed prairie dog	*Cynomys ludovicianus*	[b]	-	Concern
Cave myotis bat	*Myotis velifer*		-	Concern
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*		-	Concern
Plains spotted skunk	*Spilogale putorius interrupta*		-	Concern
Swift fox	*Vulpes velox*		-	Concern
Western small-footed bat	*Myotis ciliolabrum*		-	Concern
Reptiles				
Texas horned lizard	*Phrynosoma cornutum*	[b]	-	Threatened

[a] Threatened only based on similarity with *F.p. anatum*.
[b] Presence documented at Pantex Plant in 2013.

Several species are listed for Carson County or surrounding counties, yet are not included in Table 2.3 because of their dependence on habitat that are not found on High Plains soils, or because they are considered extirpated from the region. The Arkansas River shiner (*Notropis girardi*) and peppered chub (*Macrhybopsis tetranema*) would only be expected in streams on the Canadian River floodplain located in adjacent Potter County. The Wiest's sphinx moth (*Euproserpinus wiesti*) is listed, but its host plants are restricted to aeolian dunes in the Canadian River valley. The Mexican mud-plantain (*Heteranthera mexicana*) is an aquatic plant that grows sporadically and has been documented a few times growing in Panhandle ditches and ponds. The gray wolf (*Canis lupus*) and black-footed ferret (*Mustela nigripes*) are listed but are considered extirpated in this area. Ferret releases are being made in surrounding states, as the captive-reared program has resulted in an ample captive population. Captive ferret numbers are so high that the U.S. Fish and Wildlife Service is relaxing protocol concerning requirements for acceptable release sites. Thus, dispersing ferrets could potentially occur in the region.

2.5.1 Agricultural Pesticide Use in 2013

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the manufacture and use of pesticides. The EPA has federal jurisdiction pursuant to 40 CFR §150-§189, and the Texas Department of Agriculture and the Structural Pest Control Board have state jurisdiction pursuant to 4 TAC, Chapter 7. Regulations promulgated under FIFRA govern the use, storage, and disposal of pesticides and pesticide containers. State-licensed personnel, in accordance with federal and state regulations, apply pesticides needed for Pantex Plant operations.

Texas Tech Research Farm submitted 38 agricultural spray requests during the 2013 growing season. Although all 38 agricultural spray requests were reviewed and approved by Pantex and NPO, two of the approved applications were not made due to inclement weather. Table 2.4 shows the number of pesticide applications conducted at Pantex since 2005.

TABLE 2.4 - *Number of Pesticide Applications Conducted at Pantex*

Year of Pesticide Applications	Texas Tech Research Farm	Maintenance Department	Contractors	Total
2005	29	174	2	205
2006	16	151	11	178
2007	25	84	13	122
2008	28	105	2	135
2009	32	81	23	136
2010	44	55	36	135
2011	21	150	4	175
2012	33	121	7	161
2013	36	113	13	162

2.5.2 Maintenance Department and Contractor Pesticide Use in 2013

The Pantex Plant's Maintenance Department made 113 applications of pesticides during 2013. The majority of these applications were for weed control in Zone 4, Zone 11, Zone 12, and the associated Perimeter Intrusion Detection and Surveillance beds. The second most frequent pesticide use was Aquashade and Cutrene-Plus for algae suppression in the facultative lagoon and the irrigation storage ponds. Contractors made thirteen applications that accounted for the remainder of pesticide use in 2013.

The majority of the contractor applications were herbicides applied as soil sterilants before roads or structures were built, weed control in rock landscaped areas, and prairie dog control.

2.6 Federal Water Pollution Control Act (or Clean Water Act) and Texas Water Code

The Pantex Plant does not discharge wastewaters into or adjacent to waters of the United States; thus, Pantex is not subject to the Federal Water Pollution Control Act (storm water excluded). Pantex is however subject to the requirements of the Texas Water Code. All discharges must be done in compliance with the requirements of the Texas Water Code and its implementing regulations.

During 2013, Pantex maintained two permits and one authorization issued by the TCEQ authorizing the disposal of industrial wastewaters. In 2013, Pantex disposed all of its treated industrial wastewaters via a subsurface irrigation system. This system is authorized by Permit WQ0004397000 (also known as a Texas Land Application Permit) and Underground Injection Control (UIC) Authorization 5W2000017. Combined, these authorizations supported the production of approximately 400 acres of crops. Permit WQ0004397000 authorizes the disposal of treated wastewaters when the subsurface irrigation area is covered by vegetation. UIC Authorization 5W2000017 allows the application of limited quantities of treated wastewater to the irrigation area during periods when the agricultural fields are fallow. Pantex also maintains a Texas Water Quality Permit WQ0002296000 that authorizes the disposal of treated wastewater to an on-site playa.

Pantex obtains coverage as needed from the Texas Pollutant Discharge Elimination System (TPDES) Storm Water General Permit for Construction Activities (Permit TXR150000). The Notices of Intent for individual projects that were filed pursuant to the permit and active in 2013 and other Pantex environmental authorizations and permits are listed in Table 2.5.

TABLE 2.5 — *Permits Issued to Pantex Plant*

Building or Activity	Permit Number	Issuing Agency	Effective Date	Expiration Date
Air				
Air Quality Permit	84802	TCEQ	09/21/2011	05/04/2019
All other small sources	Standard Exemptions & Permit-by Rule	TCEQ	Various dates	When changes occur to the process that modify the character or nature of the air emission, or modify the process so that the Permit-by-Rule may no longer be used.
Clean Air Act Title V Declaration, 30 TAC §122	N/A	TCEQ	05/22/2000 (first filing)	None
Solid Waste				
Solid Waste Registration Number	TX4890110527 30459	EPA TCEQ	10/30/1980 10/30/1980	None None
Industrial and Solid Waste Management Site Permit RCRA Compliance Plan	HW-50284 CP-50284	TCEQ TCEQ	10/21/2003 06/09/2003	10/20/2013 10/20/2013 As an application to renew Permits HW-50284 and CP-50284 was submitted timely, these permits are in effect until a new permit is issued or the application is denied.

Building or Activity	Permit Number	Issuing Agency	Effective Date	Expiration Date
Underground Injection Control (UIC) TLAP associated	5W2000017	TCEQ	11/29/2004	When cancelled.
UIC- Environmental Restoration Program	5X2600215	TCEQ	10/23/2001	When cancelled.
UIC - Environmental Restoration Program	5X2500106	TCEQ	11/28/2005	When cancelled.
Water				
Texas Water Quality Permit	WQ0002296000	TCEQ	02/17/2013	01/01/2015
Texas Land Application Permit	WQ0004397000	TCEQ	04/12/2013	01/01/2020
TPDES Multi-Sector (Industrial) Storm Water Permit	TXR05P506	TCEQ	8/14/2011	08/14/2016
TPDES Storm Water General Permit for Construction Activities	TXR150000	TCEQ	03/01/2013	03/01/2018
High Pressure Fire Loop Replacement Project	TXR15OT07	TCEQ	05/03/2013[1]	When completed.
Steam Line Replacement	TXR15VM06	TCEQ	04/30/2013[1]	When completed.
Pantex Renewable Energy Project	TXR15XW43	TCEQ	08/13/2013[1]	When completed.
Bldg. 11-61, HE Pressing Facility	TXR15XA45	TCEQ	05/31/2013[1]	When completed.
Natural Resources				
Scientific Permit	SPR-1296-844	TXPWD	12/05/2011	12/05/2014
Letter of Authorization: Trap and Release Fur-bearing Animals	None	TXPWD	07/28/2000 (Initial)	Renewed annually.
Bee Removal Permit	None	BR-12-128	08/10/2010 (Initial)	Renewed annually.
Intrastate Bee and Equipment Permit	01/12/003	Texas Apiary Inspection Service	08/10/2010 (Initial)	Renewed annually.

[1] The Permit Number and Effective Date represent coverage under the TPDES Storm Water General Permit for Construction Activities issued on 03/01/2013.

At seven of its more remote buildings, Pantex operates “On-site Sewage Facilities” (OSSFs) or septic tank systems, to dispose of domestic wastewaters from these buildings. Newer OSSFs have been approved by the TCEQ via permits. However, several of the systems were installed prior to the promulgation of applicable regulations and are not currently registered. As unregistered OSSF’s are replaced, permits authorizing the upgrading or installation of the new system will be acquired from the TCEQ.

2.6.1 Wastewater Discharge Permit Inspections

The TCEQ conducted a Comprehensive Compliance Investigation of WQ0004397000 during calendar year 2013. Self-reported sanitary sewer overflows and collection/irrigation system discharges were identified as noted and resolved.

2.7 Medical Waste

Medical waste at Pantex Plant is regulated by the U.S. Department of Transportation, the State of Texas, and associated Plant requirements. Pantex remains in compliance with applicable requirements.

2.8 National Environmental Policy Act

The National Environmental Policy Act (NEPA) establishes requirements that federal agencies must meet to make well-informed decisions on proposed activities. The decisions must be based on alternatives that consider, in part, detailed information concerning potential significant environmental impacts. To minimize environmental impacts from Pantex Plant operations, proposed activities are reviewed for NEPA requirements.

At Pantex, the NEPA process is initiated by completing a NEPA Review Form (NRF). The NRF includes a description of the proposed action and subject matter experts review for potential environmental concerns. The NRF is used to determine which level of NEPA documentation will be required, if any. The levels of NEPA documentation range from internal reviews that tier off previously approved NEPA documents, categorical exclusions, environmental assessments (EA), and environmental impact statements (EIS). *Implementation Guidance for DOE Policy on Documentation and Online Posting of Categorical Exclusion Determinations: NEPA Process Transparency and Openness*, October 16, 2009, mandates that all determinations for categorical exclusions involving classes of actions listed in Appendix B to Subpart D of the DOE's NEPA regulations, 10 CFR §1021 be published online.

Every five years, the DOE is required to evaluate Site-wide EISs (SWEIS) by means of a Supplement Analysis (SA). Based on the SA, DOE determines whether the existing SWEIS remains adequate, or whether to prepare a new SWEIS or supplement the existing SWEIS. The determination and supporting analysis will be made available in the appropriate DOE public reading room(s) or in other appropriate location(s) for a reasonable time. An SA that was prepared in 2011-2013 was approved by NPO in January 2013.

In 2013, ten Standard NRFs (Categorical Exclusion determinations), 27 Internal NRFs, and seven amendments were prepared and approved. Categorical Exclusion determinations for nine Standard NRFs were posted on the Pantex website. A determination for the tenth Standard NRF was not received by the end of December 2013.

2.9 National Historic Preservation Act, Archaeological Resource Protection Act, and Native American Graves Protection and Repatriation Act

In October 2004, NPO, Pantex, the Texas State Historic Preservation Office (SHPO), and the President's Advisory Council on Historic Preservation (Advisory Council) completed execution of a new *Programmatic Agreement and Cultural Resource Management Plan* (PA/CRMP) (PANTEXj). This PA/CRMP ensures compliance with Sections 106 and 110 of the NHPA, providing for more efficient and effective review of Plant projects having the potential to impact prehistoric, World War II era, or Cold War era properties. In addition, the PA/CRMP outlines a range of preservation activities planned for the Plant's compliance program. The PA/CRMP provides for the systematic management of all archeological and historic resources at Pantex Plant under a single document.

Compliance with the Archaeological Resource Protection Act's requirements for site protection and collections curation is addressed in the PA/CRMP. Even though Native American mortuary remains or funerary artifacts have not been found at the Plant, compliance with the Native American Graves

Protection and Repatriation Act is also addressed in the plan. Both archeological and natural resources at Pantex Plant are closely concentrated around four playa lakes. These playa and floodplain areas have been reserved for comprehensive ecosystem management, resulting in preservation of many of the Plant's archeological sites.

Fulfilling the Plant's cultural resource management obligations under Section 106 of the National Historic Preservation Act, 44 projects were evaluated in 2013 under the PA/CRMP. Of these projects, 32 did not involve either National Register-eligible properties or possible adverse effects. For the remainder, design modifications were suggested and incorporated to avoid impacts to National Register-eligible properties.

2.10 Resource Conservation and Recovery Act

The TCEQ has been granted authority for administering and enforcing the Resource Conservation and Recovery Act (RCRA) program in Texas. The current permit for Industrial Solid Waste Management (Permit Number HW-50284) was renewed on October 21, 2003, by the TCEQ. This permit authorizes storage and processing of wastes in accordance with limitations, requirements, and conditions set forth in the permit.

2.10.1 Active Waste Management

The types of wastes generated at Pantex Plant include hazardous waste, universal waste, non-hazardous industrial solid waste, waste regulated by the Toxic Substance Control Act (TSCA), low-level radioactive waste, mixed low-level radioactive waste, and sanitary waste. Wastes generated from the operation, maintenance, and environmental cleanup of Pantex Plant in calendar year 2013 are summarized in Table 2.6. Overall, the amount of waste generated in 2013 increased 22.2 percent from 2012. This is due primarily to increased activity in the environmental restoration projects and deactivation and decommissioning of excess facilities and construction projects.

TABLE 2.6 - *Waste Volumes Generated at Pantex (in cubic meters)*

Waste Type	1993	2010	2011	2012	2013	Percent Increase or (Decrease) from 1993	Percent Increase or (Decrease) from 2012
Non-hazardous Industrial Solid Waste	10,885	6,045.0	7,931.7	6,221.2	7,910.9	(27.3)	27.2
Sanitary Waste	612	1,040.1	980.5	985.7	1,040.9	70.1	5.6
Hazardous Waste	369.6	541.4	828.9	540.1	519.9	40.7	(3.8)
Low-Level Waste	287	57.3	29.8	27.4	41.9	(85.4)	52.9
Mixed Waste	37.5	0.08	0.4	0.0	0.08	(99.8)	100
TSCA Waste	112.9	81.7	69.0	52.1	44.1	(60.9)	(15.4)
Universal Waste [a]	-	5.2	8.5	8.8	15.8	-	79.5
Total	12,304	7,770.8	9,848.7	7,835.3	9,573.6	(22.2)	22.2

[a] In 2001, Pantex began managing some Hazardous Waste under the Universal Waste Rules.

During 2013, Pantex Plant generated 519.9 cubic meters (m^3) of hazardous waste. Typical hazardous wastes generated at Pantex Plant included explosives-contaminated solids, spent organic solvents, and solids contaminated with spent organic solvents, metals, and/or explosives. Hazardous wastes were managed in satellite accumulation areas (less than 55-gallon waste accumulation sites), less than 90-day waste accumulation sites, or permitted waste management units. Some hazardous wastes, such as explosives, were processed on-site before the process residues were shipped off-site for final treatment and disposal. During the year, environmental restoration projects and deactivation and decommissioning of excess facilities and construction projects contributed 18.9 percent of the total hazardous waste generated. Hazardous wastes and residues from hazardous waste processing are shipped to commercial facilities authorized for final treatment and disposal or, as applicable, recycling.

During 2013, Pantex Plant generated 7,910.9 m^3 of non-hazardous industrial solid waste. Non-hazardous industrial solid wastes generated at the Plant were characterized as either Class 1 non-hazardous industrial solid waste or Class 2 non-hazardous industrial solid waste, as defined by Title 30 of the Texas Administrative Code, Chapter 335. Class 1 non-hazardous industrial solid wastes generated at Pantex were managed in a similar manner as hazardous waste, including shipment to off-site treatment and/or disposal facilities. Some Class 2 non-hazardous industrial solid wastes (inert and insoluble materials such as bricks, concrete, glass, dirt, and certain plastics and rubber items that are not readily degradable) were disposed in an on-site Class 2 non-hazardous industrial solid waste landfill. Other Class 2 non-hazardous industrial solid wastes, generally liquids, were shipped to commercial facilities for treatment and disposal.

The Pantex Plant's environmental restoration projects and deactivation and decommissioning of excess facilities and construction projects contributed 70.3 percent of the total non-hazardous industrial solid waste generated during 2013. In addition, during the year, Pantex Plant generated 1,040.9 m^3 of sanitary waste (cafeteria waste and general office trash). Sanitary wastes were also characterized as Class 2 non-hazardous industrial solid wastes and disposed of at authorized off-site landfills.

Pantex Plant generated 44.1 m^3 of waste regulated by TSCA, during 2013. These wastes include asbestos, asbestos-containing material, and materials containing or contaminated by polychlorinated biphenyls (PCBs). During the year, construction projects and deactivation and decommissioning of excess facilities contributed 86.9 percent of the total TSCA waste generated. All TSCA wastes were shipped off-site for final treatment and disposal.

During 2013, Pantex Plant generated 15.8 m^3 of waste that were managed as universal wastes. Universal wastes are defined as hazardous wastes that are subject to alternative management standards in lieu of regulation, except as provided in applicable sections of the Texas Administrative Code. Universal wastes include batteries, pesticides, paint and paint-related waste, and fluorescent lamps. During the year, construction projects contributed 1.5 percent of the total universal waste generated. These wastes are shipped off-site for final treatment, disposal, or, as applicable, recycling.

Pantex Plant generated 41.9 m^3 of low-level radioactive waste during 2013. The low-level radioactive wastes were generated by weapons-related activities.

Assembly and disassembly of weapons also results in some wastes that include both radioactive and hazardous constituents, which are referred to as "mixed waste." The hazardous portion of the mixed waste is regulated by the TCEQ pursuant to RCRA regulations. The radioactive portion is regulated pursuant to the Atomic Energy Act. During 2013, Pantex Plant generated 0.08 m^3 of waste that were managed as mixed waste.

2.10.2 Hazardous Waste Permit Modifications

On April 10, 2013 the Pantex Plant submitted an application to renew and amend Permits HW-50284 and CP-50284. On June 11, 2013, the TCEQ declared the application administratively complete. On June 27, 2013 the Pantex Plant published the required public notice of the Pantex Plant's intent to obtain an amendment and renewal of Permits HW-50284 and CP-50284. As of December 31, 2013 the Pantex Plant was awaiting the TCEQ to finish its technical review of the application.

2.10.3 Annual Resource Conservation and Recovery Act Inspection

In May of 2013, the TCEQ conducted its annual RCRA inspection of the active solid waste management units at the Pantex Plant. After inspecting approximately 80 active waste management units and an extensive review of the associated operational records, the TCEQ found no violations or areas of concern. The results of the TCEQ's inspection represent 19 consecutive years without violations or areas of concern noted for the management of solid waste at the Pantex Plant.

2.10.4 Release Site and Potential Release Site Investigation, Monitoring, and Corrective Action

Progress reports, required by Table VII of Compliance Plan CP-50284 (TCEQ, 2010) and Article 16.4 of the Pantex Interagency Agreement, were submitted to both the TCEQ and EPA in 2013. The annual report contained a full reporting of all monitoring information for 2013. Quarterly progress reports were submitted in 2013 in accordance with the schedule in the approved Sampling and Analysis Plan and Table VII of Permit CP-50284. These reports focused on the continued operation of the remedies and on monitoring results from key groundwater wells.

2.10.5 Underground Storage Tanks

The Plant operated five regulated underground Petroleum Storage Tanks (PSTs) during 2013. Of the five regulated underground storage tanks at Pantex, two are used for emergency generator fuel storage. Three other PSTs at the Plant are used for vehicle fueling. These tanks store unleaded gasoline, diesel, and a gasoline–ethanol mix (E-85).

2.11 Safe Drinking Water Act

The Plant operates a Non-community, Non-transient Public Drinking Water System, which is registered with the TCEQ. This category of systems identifies private systems that continuously supply water to a small group of people; i.e., schools and factories.

The Plant obtains its drinking water from the Ogallala Aquifer through five wells located at the northeast corner of the Plant. The water is disinfected on-site by electrolyzing salt and water to produce a mixture of hypochlorous acid, hypochlorite ion, and other chlor-oxygen species that behave like chlorine dioxide or ozone while offering a residual chlorine level. This disinfection method eliminated the storage and use of large amounts of chlorine gas at the Pantex Plant.

2.11.1 Drinking Water Inspection

The TCEQ did not conduct a Comprehensive Compliance Inspection of the Pantex Drinking Water System in 2013. On August 28, 2013, a TCEQ subcontractor conducted required water sampling for residual chlorine and disinfection by-products and nitrate/nitrite. No problems were noted in the sampling results.

2.11.2 Drinking Water System Achievements

On December 17, 2009, the TCEQ notified Pantex that its Public Water System (PWS) had achieved a "Superior Rating." Organizations receiving the Superior Public Water System Rating are recognized for their overall excellence in all aspects of operating a PWS. The Pantex Plant maintained its Superior Public Drinking Water System Rating during 2013.

2.12 Toxic Substances Control Act

The major objective of the TSCA is to ensure that the risk to humans and the environment, posed by toxic materials, has been characterized and understood before they are introduced into commerce. The goal is not to regulate all chemicals that pose a risk, but to regulate those that present unreasonable risk to human health or the environment. Of the materials regulated by TSCA, those containing asbestos, beryllium and materials and parts containing, contaminated by, or potentially contaminated by PCBs are of concern at the Pantex Plant.

As a user of chemical substances, Pantex complies with applicable regulations issued under the Act, refrains from using PCBs, except as allowed by EPA regulations, and refrains from using any chemical substance that Plant personnel know, or have reason to believe, has been manufactured, produced, or distributed in violation of the Act. As of December 31, 1996, all new parts and equipment that contain PCBs, used at Pantex Plant, have PCBs that are in concentrations of less than 50 parts per million.

2.13 Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act, which was enacted as part of the Superfund Amendment and Reauthorization Act of 1986 (SARA), requires that the public be provided with information about hazardous chemicals in the community; and establishes emergency planning and notification procedures to protect the public in the event of a release. In order to accomplish these goals, the Emergency Planning and Community Right-to-Know Act and Executive Order 12856 require that Pantex Plant file several annual reports with EPA (Table 2.7) and participate in Local Emergency Planning Committee activities. Pantex Plant remains in compliance with provisions of this statute.

TABLE 2.7 - *2013 Activities for Compliance with the Emergency Planning and Community Right-to-Know Act*

Requirement	Applicable	Comment
Planning Notification (SARA 302-303)	Yes	One chemical was stored at Pantex in quantities above the threshold planning quantities in 2013.
Extremely Hazardous Substance Notification (SARA 304)	Yes	One chemical defined as "Extremely Hazardous Substance" by SARA 304 was stored at Pantex in quantities above the threshold planning quantities in 2013.
Material Safety Data Sheet/Chemical Inventory (SARA 311-312)	Yes	This requirement was satisfied by the Texas Tier Two Report [a]. Eighteen chemicals were listed in the report for 2013.
Toxic Chemical Release Inventory Reporting (SARA 313)	Yes	A Toxic Chemical Release Inventory Report was required for calendar year 2013.

[a] Report submitted annually to the Chief, Hazard Communication Branch, Occupational Safety and Health Division, Texas Department of Health, the Local Emergency Planning Committee, and the local Fire Department.

2.14 Floodplains/Wetlands Environmental Review Requirements (10 CFR §1022)

Floodplain management is taken into account when surface water or land use plans are prepared or evaluated. The U.S. Army Corps of Engineers (USACE), Tulsa District, completed a floodplain delineation report in January 1995 (USACE, 1995), revising an earlier delineation. In calendar year 2013, all proposed activities at Pantex Plant were evaluated during the NEPA process for potential impacts on floodplains and wetlands and other criteria required by 10 CFR §1022.

To implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by Pantex's operations, a comprehensive Environmental Management System (EMS) has been developed. The Pantex EMS is a major component of the Integrated Safety Management System (ISMS). These integrated systems envelop all personnel that work at the Plant and all of the Plant's activities, products, and services and are the means by which DOE cost effectively meets or exceeds compliance with applicable environmental, public health, and resource protection requirements.

3.1 Environmental Management System

Figure 3.1 represents the Pantex EMS which is organized according to five core functions that are essential to planning and safely performing hazardous work. This system promotes the active protection of personnel doing work and the environment in which that work is performed. The ISM core functions are the framework which ensures work processes at the activity level, facility and site levels, methodically and formally assess hazards and implement appropriate controls to mitigate hazards and any potential negative consequences. As continuous improvement, Pantex has increased the level of operational awareness to the stringent tenets of safe operation developed by the Institute of Nuclear Power Operations.

FIGURE 3.1 - ***Work Activity Core Structure of the Pantex Integrated Safety Management System as Related to The Institute of Nuclear Power Operations***

On October 8, 2009, Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (EOa), went into effect. The Order stipulates the use of formal environmental management systems that are appropriately implemented and maintained for the purpose of achieving performance necessary to meet the goals of the Order. EO 13514 supplements EO 13423 (2007), *Strengthening Federal Environmental, Energy, and Transportation Management,* in providing a stable foundation for environmental sustainability. EO 13423, effective January 26, 2007, consolidated previous EOs to better establish direction for environmental management by the federal government.

Pantex has an EMS that meets the requirements of DOE Order 436.1 *Departmental Sustainability* (DOEh). The EMS provides for systematic planning, integrated execution, and evaluation of programs for: 1) public health and environmental protection, 2) environmental sustainability, 3) pollution prevention (P2), 4) recycling, and 5) compliance with applicable environmental protection requirements. It includes policies, procedures, and training to identify activities with significant environmental impacts, to manage, control, and mitigate the impacts of these activities, and to assess performance and implement corrective actions where needed. Environmental aspects and impacts are reviewed annually and measureable environmental objectives and specific targets are developed for implementation. The Plant's EMS is modeled on the International Organization for Standardization's (ISO) 14001, Environmental Management Systems – Requirements with Guidance for Use, 2004 (ISO, 2004).

Each year, significant environmental impacts associated with Plant operations are evaluated to determine potential goals for the following year. The objectives and associated specific targets are set to improve the management of identified environmentally significant aspects related to Pantex activities, products, and services. By adopting objectives, Pantex Plant commits to achieving the management goals and ensures that appropriate resources (technical, organizational, infrastructure, financial, human, and special skills) will be considered to accomplish the environmental targets. Appropriate authority and responsibility are assigned to each relevant function and level within the organization to meet the objectives. Table 3.1 represents the final status of Objectives and Targets for FY 2013.

TABLE 3.1 – *B&W Pantex Objectives and Targets for 2013*

Objective	Target(s)	Status/Comments
Reduce waste and conserve landfill space	Provide recycling training to departments that responded in the annual EMS electronic questionnaire as not recycling.	Provide recycling training presentations to five departments per quarter. TARGET MET
Reduce water usage from once through water cooled vacuum pumps	Complete PX-597 for replacement of vacuum pumps with most efficient options available (e.g., oil sealed, water sealed, etc.).	Receive estimates for pumps and have ready for funding call. TARGET MET
Increase energy awareness	Develop and initiate a Plant-wide energy awareness campaign to raise personnel awareness of energy use at Pantex.	Develop and implement energy awareness campaign. TARGET MET

3.1.1 EMS Accomplishments for 2013

In accordance with current Executive and DOE Orders, Pantex continues to implement and maintain a formal EMS using the ISO 14001 Standard as the platform for Site Sustainability Plan implementation. To meet the intent of EOs 13423 and 13514, the Pantex EMS has been the subject of required formal audits by qualified auditors outside the control or scope of the EMS on two occasions and has successfully been identified as conforming to ISO 14001. Pantex originally met requirements of having a formal EMS in place in FY 2005, and because of the requirement to renew every three years, FY 2008 was the initial renewal of the program. Upon successful completion of the FY 2011 audit, Pantex declared conformance in September of 2011, nine months prior to the June 2012 requirement date, becoming the first facility in the Enterprise to successfully declare EMS conformance. To be consistent with the "every three years" conformance audit, the next independent audit will be performed in FY 2014.

Opportunities for continuous improvement are the emphasis of regularly scheduled building environmental walk down surveillances. These surveillances take place at a minimum of two times per month and focus on EMS principles, energy and water conservation, environmental sustainability, recycling, safety, and P2. Special attention has been provided to assist DOE and Pantex subcontractors in the subcontractor lay-down yards to maintain compliance with EMS expectations.

The Presidential Migratory Bird Federal Stewardship Award Nomination Application for the Pantex Plant was submitted on November 13, 2013. Pantex was selected as the DOE 2013 nominee. DOE's Office of Environmental Management, Sustainability Support, and Corporate Safety Analysis selected the Pantex submittal as the one that exemplifies innovation and commitment to the conservation of migratory birds and their habitat.

Select accomplishments of the environmental programs at Pantex include but are not limited to:

- Pantex was selected as the U.S. Department of Energy's (DOE) 2013 nominee for the Presidential Migratory Bird Federal Stewardship Award. Pantex's program was selected as the one that exemplifies innovation and commitment to the conservation of migratory birds and their habitat.
- Pantex received a DOE EStar award for "Energy Savings Performance Contracts Leader".
- For the nineteenth consecutive year, no violations or areas of concern were noted during the annual Resource Conservation and Recovery Act (RCRA) comprehensive compliance investigation conducted by the Texas Commission on Environmental Quality.
- Pantex was extremely active in conducting environmental outreach initiatives. The initiatives included sponsoring public meetings to share status of environmental management activities including groundwater status meetings, Natural and Cultural Resource Program accomplishments, Earth Day activities, and Science Bowl Competition for area Middle Schools and High Schools.
- Pantex completed and the NPO Manager signed the determination for the Final Supplement Analysis (SA) for the Pantex Site-wide Environmental Impact Statement.
- The annual status review of the Water Quality Management Plan for Pantex was conducted on October 29, 2013 by representatives from the Texas State Soil & Water Conservation Board (Regional Office) and the Panhandle Natural Resources Conservation Office. The review concluded that Pantex is performing extremely well in managing its agricultural land.

3.1.2 Energy

Continued success in reducing energy use at Pantex is primarily realized from energy savings activities such as: (1) utilizing the Energy Management Control System (EMCS) to implement and maintain night, weekend and holiday setbacks; (2) installation of occupancy sensors to control lighting in areas in several facilities with low occupancy rates (conference rooms, break rooms, restrooms); (3) installation of new or retrofitted advanced meters that are integrated with a communication network and dedicated server that stores the meter readings for use with the U.S. EPA's Portfolio Manager building benchmarking system; (4) procurement of equipment such as Energy Star products that are more energy efficient and (5) continuous and retro-building commissioning. In 2013, Pantex Plant continued to use an alternate work schedule (9X80s) which has helped reduce energy consumption for a large number of administrative personnel.

EO 13423 mandated Pantex to reduce energy intensity by 30 percent by the end of FY 2015, relative to the baseline of energy use in FY 2003. At the end of FY 2013, the Pantex Plant had achieved a 12.6 percent reduction in energy intensity from the 2003 baseline, but has not yet reached the reduction goal. (See Figure 3.2 which illustrates the calculated annual energy intensity in each of the several years from

FY 2003 through FY 2013 and the annual target goal for reduction in intensity calculated by dividing the difference between the 2003 baseline (234,791 btu/sq.ft./yr.) and the mandated goal of 164,354 btu/sq.ft./yr. by 12 and subtracting from the previous year's target.).

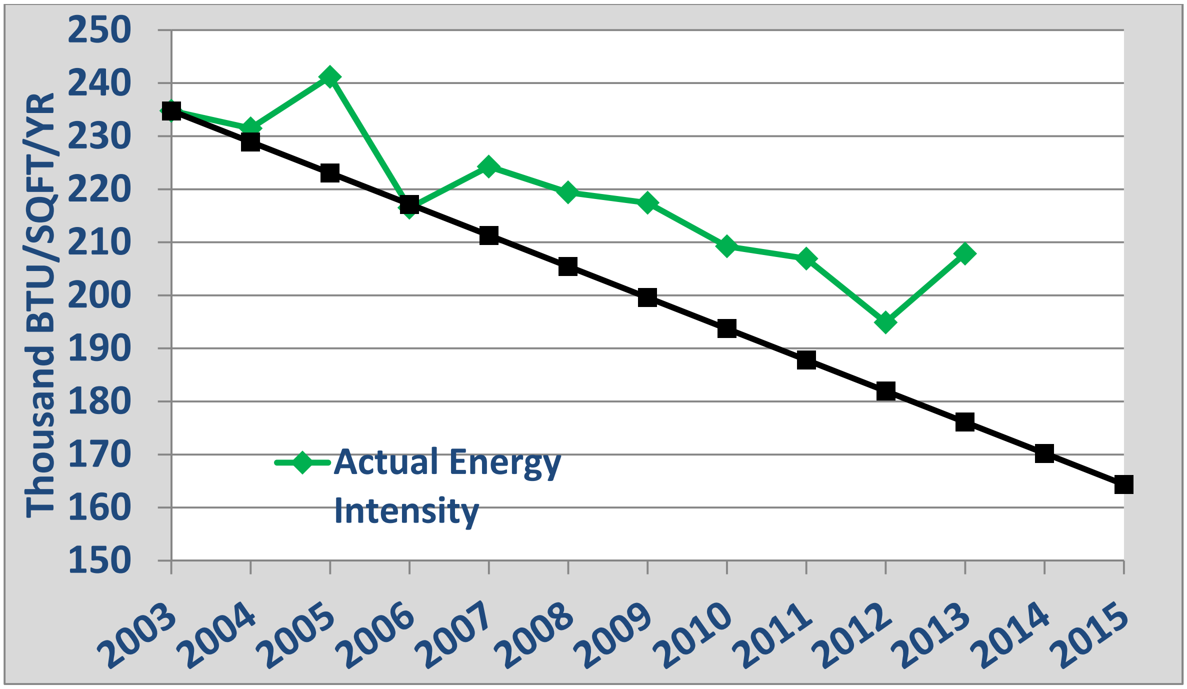


FIGURE 3.2 - *Energy Intensity vs. Required Target Reduction Rate*

EO 13514 expanded the energy reduction and environmental performance requirements of EO 13423 by setting requirements in several areas, including the management of Greenhouse Gases[4] (GHGs). DOE implementing guidance associated with the more recent Executive Order requires a 28 percent reduction of Scope 1 & 2 GHG emissions and 13 percent reduction of Scope 3 GHG emissions by FY 2020 from their respective 2008 baselines.

The largest component of the GHG emissions accredited to Pantex Plant are those generated through the purchase and use of electricity and natural gas and the use of petroleum fuels in fleet and other vehicles and equipment (Scope 2 GHG emissions). These emissions and Scope 1 GHGs (those from federally owned or controlled sources such as fugitive emissions from refrigerants and wastewater treatment operations) yielded more than 76,515 metric tons CO_2 equivalent (mTCO_2e) of GHGs in 2008. By reducing energy consumption over the years, Pantex has concurrently reduced the generation of GHGs. Since petroleum fuel use also generates noticeable amounts of GHGs, the Plant continues to improve operations of the Pantex fleet by reducing petroleum fuel use, using more hybrid vehicles for better gas mileage, using Alternative Fuel Vehicles (AFVs) and ensuring the fleet is the right size for the NNSA mission. During 2013, Pantex generated 70,125 mTCO_2e of Scope 1 and Scope 2 GHGs, which was a reduction of 8.2 percent since 2008.

A significant future reduction in the generation of Scope 2 GHGs is anticipated to occur after the completion of construction and system testing of the Pantex Renewable Energy Project (PREP) (see Figure 3.3), which will occur in CY 2014. Through production of electricity from a renewable source on-

[4] See the definition of this term and that for Scopes 1, 2, & 3 GHGs in the Glossary.

site, the Plant will significantly reduce GHG emissions associated with the purchase of power from non-renewable sources such as coal-fired generators. Pantex expects to avoid the emission of an estimated 36,300 $mTCO_2e$ per annum from the operation of the PREP.

FIGURE 3.3 – ***Pantex Renewable Energy Project (Under Construction)***

During 2013, Scope 3 GHG emissions (those from sources not directly owned or controlled by a federal agency but related to agency activities) totaled 22,370 $mTCO_2e$ (a reduction of 4.4 percent from the 2008 baseline). Pantex continues to evaluate the amount of GHG emissions generated by travel, energy, transportation and distribution losses, commuting, and other activities in order to reduce the emissions in this category.

The relative contribution of Scope 1, Scope 2 and Scope 3 GHG emissions to the total GHG emissions at Pantex is illustrated in Figure 3.4. The relative percentages have not varied greatly over the last several years. However, as initiatives to reduce energy use (and especially that generated from fossil fuels) mature, total GHG emissions and those from Scope 2 GHGs will be reduced.

3.1.3 Water

EO 13423 (2007) required Pantex, beginning in FY 2008, to reduce water intensity relative to the baseline of the Plant's water consumption in FY 2007(~128,500,000 gallons). The challenge was to focus on conservation awareness and life-cycle cost-effective measures to reduce annual use by two percent per year through the end of FY 2015 (16 percent). EO 13514 (2009) progressively challenged facilities to increase the goal by reducing an additional 10 percent by 2020, equating to a 26 percent reduction in intensity overall. During FY 2013, water consumption was approximately 102,000,000 gallons and that represents decreased consumption or water intensity of about 21 percent. When adjusting to address the concept of water intensity (water use per gross square foot) the result exhibits the efforts to reduce the Pantex footprint has been successful by showing a reduction of approximately 23 percent.

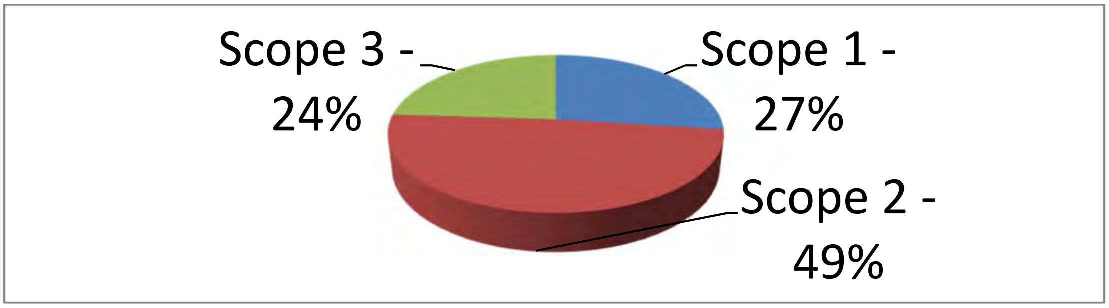
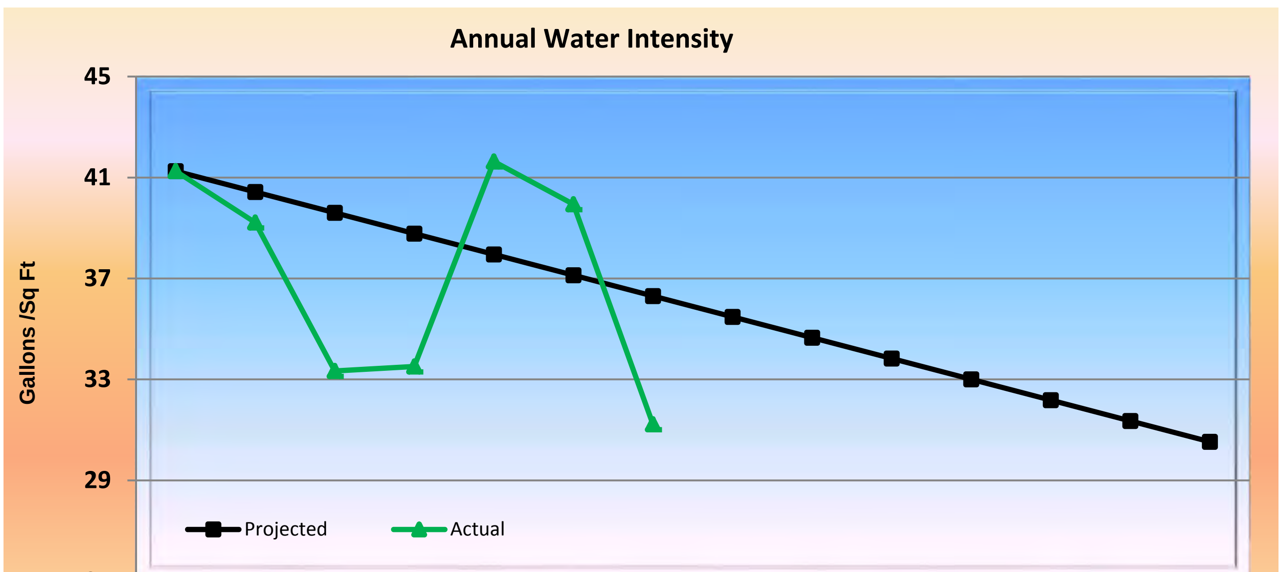


FIGURE 3.4 - *Scope Percentage of GHGs at Pantex in 2013*

Repair of leaking WWII vintage water lines, reconfiguration or replacement of equipment using inefficient water-cooled equipment, elimination of chlorine use in the water disinfection systems through permitting strategies and installation of a "mixed oxidant" system, along with general awareness of water use strategies assisted Pantex in reducing water intensity in FY 2013. Figure 3.5 provides the graphic status of Pantex water intensity compared to established goals.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Projected	41.2538	40.4288	39.6037	38.7786	37.9535	37.1285	36.3034	35.4783	34.6532	33.8281	33.0031	32.178	31.3529	30.5278
Actual	41.2538	39.2151	33.3357	33.5135	41.6376	39.9432	31.2215							

FIGURE 3.5 - *Water Target Compared to Actual Use*

3.1.4 Fuel

EO 13423 promotes the use of alternative fuels in comparison to petroleum fuel use in FY 2005. It has challenged industries to annually increase the use of alternative fuels by 10 percent measured relative to the prior year's alternative fuel usage, while reducing the fleet's total consumption of petroleum products by 2 percent annually through the end of FY 2015 (Figure 3.6). This reduction of petroleum products was extended to FY 2020 by EO 13514 (Figure 3.7). During FY 2013, the use of alternative fuel was impeded due to the breakdown of and required repairs on the fuel distribution system. The fuel system was repaired late in the year and it is anticipated that Pantex will continue to meet and exceed the goals for petroleum fuel reduction.

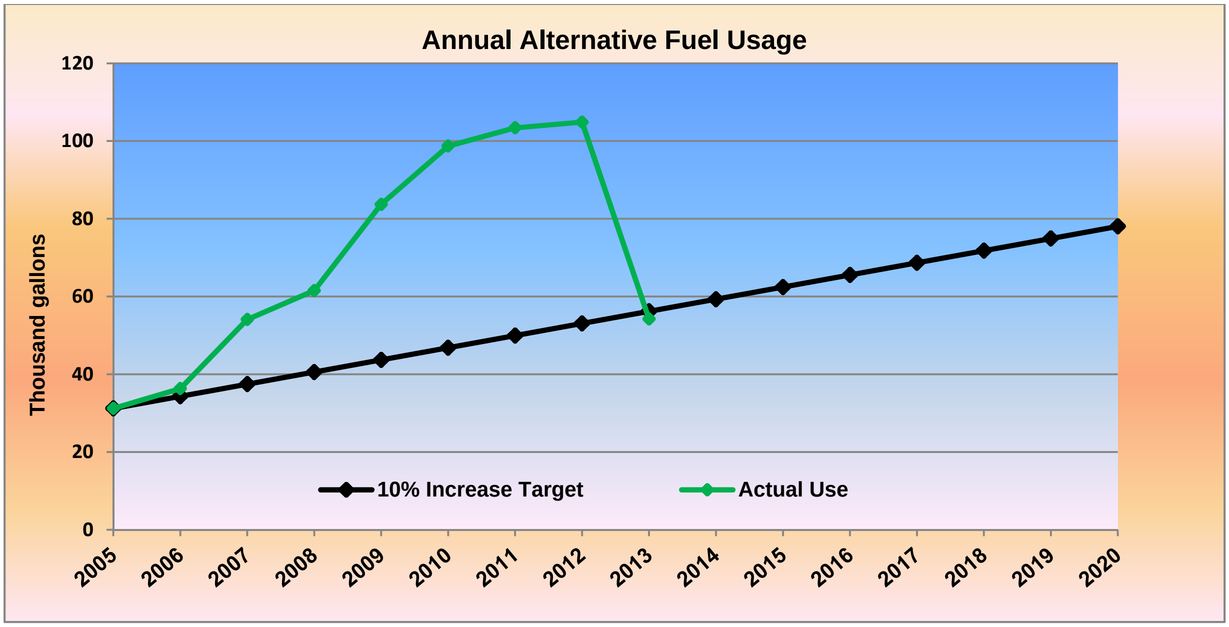


FIGURE 3.6 - *Alternative Fuel Use vs. Target Increase Rate*

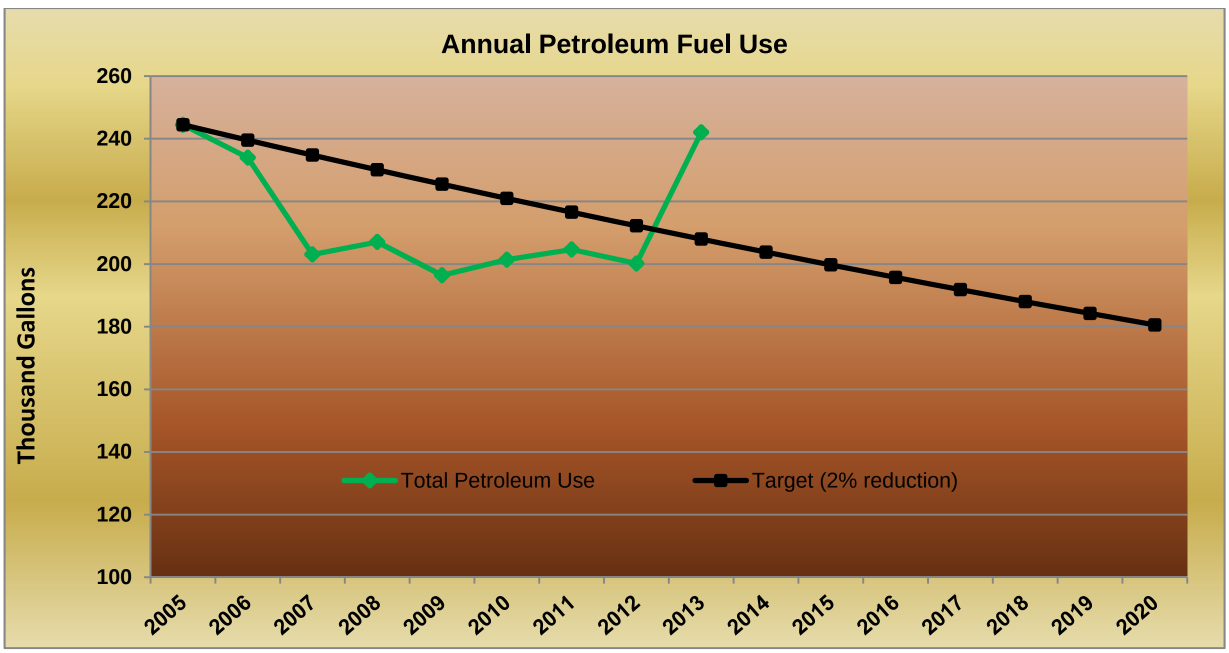


FIGURE 3.7 - *Petroleum Use vs. Target Reduction Rate*

3.2 Oversight

Federal Agencies: The results of compliance inspections and/or other oversight activities conducted by the U.S. Environmental Protection Agency (EPA) in 2013 are discussed in Chapter 2 of this document.

State of Texas: The results of compliance inspections conducted by various state agencies in 2013 are discussed in Chapter 2 of this document. An additional oversight mechanism was initiated in 1989 when the Secretary of Energy invited the host State of each DOE facility to oversee the evaluation of environmental impacts from facility operations. As a result, the DOE entered into a five-year Agreement in Principle with the State of Texas in August 1990, which was renegotiated in 1995, 2000, 2005 and 2010. The current agreement is in effect through September 30, 2015. It focuses on three activities: general cooperation with all state agencies, environmental monitoring and emergency management. Six state agencies are involved: the Governor's Office (acting through the State Energy Conservation Office), the Texas Attorney General's Office, the Texas Commission on Environmental Quality (TCEQ), the Texas Department of Public Safety-Division of Emergency Management, the Texas Department of State Health Services-Radiation Control, and the Texas Bureau of Economic Geology.

The agreement also provides for joint emergency planning with Carson, Armstrong, and Potter counties, and the City of Amarillo. A number of meetings between DOE and these agencies were held in 2013. In addition, DOE provided information to the State of Texas, as required, and the State conducted its own environmental sampling and research, and participated in joint emergency exercises and drills with Pantex Plant and local jurisdictions.

3.3 Pollution Prevention

Activities in support of the P2 Program are waste elimination, material substitution, waste minimization, recycling, and energy and water conservation. Pantex performs pollution prevention opportunity assessments (PPOAs) on Plant processes to identify new ideas for waste reduction. The team that performs the PPOA works with the owner of the process to implement the waste reduction recommendations. In 2013, 16 PPOAs were performed.

Efforts to reduce and eliminate waste from routine operations at Pantex Plant have resulted in significant waste reductions over the last 26 years. From 1987 to 2013, the Plant population and workload increased as the focus of the Plant's mission changed from weapons assembly during the Cold War to primarily dismantlement. Even with these increases, the P2 Program's efforts were successful in reducing the generation of hazardous waste by more than 99 percent.

In 2009, Executive Order (EO) 13514, Fe*deral Leadership in Environmental, Energy, and Economic Performance*, established P2 and Sustainable Environmental Stewardship goals that are to be demonstrated by DOE sites through the integration of EMSs. Goals set by EO 13514 include promoting pollution prevention and eliminating waste by:

- Minimizing the generation of waste and pollutants through source reduction;
- Diverting at least 50 percent of non-hazardous solid waste, excluding construction and demolition debris by the end of FY 2015;
- Diverting at least 50 percent of construction and demolition materials and debris by the end of FY 2015;
- Reducing printing paper usage and acquiring uncoated printing and writing paper containing at least 30 percent postconsumer fiber;

- Reducing and minimizing the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of;
- Increasing diversion of compostable and organic material from the waste stream;
- Implementing integrated pest management and other appropriate landscape management techniques;
- Increasing agency use of acceptable alternative chemicals and processes in keeping with the agency's procurement policies; and
- Decreasing agency use of chemicals where such decrease will assist the agency in achieving greenhouse gas reduction.

Pantex continues to make progress toward meeting the goals from EO 13514 to divert 50 percent of construction and demolition waste and 50 percent of Plant municipal solid waste from landfill disposal. For 2013, Pantex increased the diversion of municipal solid waste to 58 percent and the diversion of construction and demolition waste to 57 percent.

These goals have been incorporated into the P2 and EMS programs at Pantex. These programs have been effectively used to identify specific site wide environmental goals associated with pollution prevention and waste minimization. Pantex has continued an active recycling program, which reduces the waste disposal volumes and saves taxpayers' money. Results of ongoing recycling initiatives in 2013 are shown in Table 3.2.

TABLE 3.2 — *Pantex Plant Site-wide Recycling for 2013*

Recycled Material	2013 Totals	
	Pounds	Kilograms
Non-Suspension Scrap Metals	1,488,784	675,301
Office and Mixed Paper	86,960	39,444
Corrugated Cardboard	112,500	51,029
Batteries	140,192	63,590
Concrete	10,362,404	4,700,307
Tires/Scrap Rubber	19,400	8,800
Engine Oils	36,080	16,366
Computers & Other Electronics	14,343	6,506
Newspapers/Magazines/Phonebooks	16,148	7,325
Aluminum Cans	1,110	503
Plastic	22,990	10,428
Fluorescent Bulbs	5,285	2,397
Oil Filters	1,800	816
Total	**12,307,996**	**5,582,812**

In 2006, Pantex joined and became an ongoing partner of the EPA Federal Electronics Challenge (FEC) and pledged to make progress toward meeting all FEC criteria for environmentally responsible management of electronic equipment. The Pantex process for computer disposition meets the FEC criteria for recycling and reuse of computer equipment. Through these ongoing efforts Pantex has demonstrated an environmentally friendly approach to lifecycle management of electronic equipment while ensuring the protection of national security information from unauthorized disclosure. Pantex reused/recycled a total of 14,343 pounds of electronics during 2013.

3.4 Natural Resources

Flora and Fauna: As across most of the Southern High Plains, cultivation and other developments have reduced the acreage of native habitat at Pantex Plant. The remaining areas of near-native habitat at the Plant are small, and include wetlands and shortgrass prairie uplands, which are primarily around the playas.

A biological assessment of Pantex Plant, completed in 1996, addressed the impacts of continuing Plant operations on endangered or threatened species and species of concern that may occur in or migrate through the area. The assessment was approved by the U.S. Fish and Wildlife Service, and it concurred with the conclusion that continued Plant operations would not be likely to adversely affect any federally-listed threatened or endangered species (PANTEXb). Results of plant and animal sampling are also discussed in Chapters 11 and 12.

Flora: Most of the flora occurring on Pantex Plant was identified during field surveys conducted in 1993 and 1995 (Johnston and Williams, 1993; Johnston, 1995). The surveys focused on the remaining natural areas of the Plant. Many of the species found were not native and some of the native species were represented by only a few individuals. Conditions during the 2013 growing season were extremely dry. The on-site winter wheat crop produced an average yield from stored soil moisture on fallow ground from the previous year. No other crops were produced with all summer row crops failing to germinate. Native grasses on-site produced very little biomass for the year. Grazing did occur in select areas to help reduce fuel load for wild fire suppression.

Fauna (Mammals): At least 11 species (Table 3.3) of mammals were recorded at the Pantex Plant in 2013 during field activities, nuisance animal responses, fall spotlight surveys, and on trail cameras. The all-time mammal list for Pantex includes 45 species.

TABLE 3.3 — *Mammals Identified at Pantex Plant During 2013*

Common Name	Scientific Name	Playa 1	Playa 2	Playa 3	Pantex Lake	East Property	Other Area
Black-tailed jackrabbit	*Lepus californicus*		X		X	X	X
Black-tailed prairie dog	*Cynomys ludovicianus*		X	X	X		X
Bobcat	*Lynx rufus*		X		X		X
Cottontail	*Sylvilagus spp.**		X		X		X
Coyote	*Canis latrans*				X	X	X
Feral Cat	*Felis catus*						X
Mule deer	*Odocoileus hemionus*	X	X				X
Pronghorn	*Antilocapra americana*				X	X	X
Striped skunk	*Mephitis mephitis*						X
White-tailed deer	*Odocoileus virginianus*				X		
Yellow-faced pocket gopher	*Cratogeomys castanops*						X

* Desert (*S. audubonii*) and eastern (*S. floridanus*) cottontails could occur on the Plant and, thus, the "at least 11 species".

In 2013, a survey of black-tailed prairie dog (*Cynomys ludovicianus*) colonies conducted with the assistance of Global Positioning System (GPS) equipment revealed that the colonies occupied about 163.1 hectares (403 acres) at Pantex. Figures 3.8 and 3.9 show the locations of prairie dog colonies on the Plant site. Only a few areas of operational concern were treated with aluminum phosphide to remove prairie dogs. These included landfill caps west of Zone 4 and in the Surface Danger Zone (SDZ) area associated with the Weapons Tactical Training Facility.

Spotlight surveys for nocturnal species have been conducted since 2000. These are conducted during three evenings during October, November, and December. The 24-mile survey route traverses the DOE and Texas Tech properties, and includes scans of the Pantex Lake property. All mammal species observed, other than bats and small rodents are recorded. Nocturnal animals observed in 2013 were black-tailed jackrabbits (*Lepus californicus*), bobcats (*Lynx rufus*), cottontails (*Sylvilagus spp.*), coyotes (*Canis latrans*), and mule deer (*Odocoileus hemionus*); all species commonly observed at Pantex.

Fauna (Birds): Migratory birds are an important part of Pantex Plant's natural resources. A bird checklist for Pantex Plant compiled by Seyffert (1994) indicates the species and their abundances expected at the Pantex Plant area during various seasons of the year, based on habitat types and knowledge of migrations through the local area. The *Integrated Plan for Playa Management at Pantex Plant and Wildlife Management at Pantex* (PANTEXf) provides for monitoring of birds across the Plant. The all-time bird list for Pantex includes 202 species.

Fifty-eight species of birds were recorded at Pantex during 2013 (Appendix B). Observations of a northern oriole (*Icterus galbula bullocki*) and western tanager (*Piranga ludoviciana*) were first sightings at Pantex. The number of waterbird species (shorebirds, wading birds, waterfowl) increased slightly between 2012 and 2013, with the most noticeable difference being observed at Playa 1. This playa captured storm water during the middle to late part of the summer.

Accomplishments under EO 13186: As in 2012, Pantex was the DOE/NNSA's sole-allotted nomination for the 2013 Presidential Migratory Bird Federal Stewardship Award, which included elements of management, outreach, and research. Pantex continued to promote bird conservation through public outreach, such as presentations and the Purple Martin Banding and Outreach Program. Pantex personnel served on the DOE Migratory Bird Working Group, and assisted with the drafting of the new MOU, annual reporting associated with EO 13186, and nominations associated with the 2013 and 2014 Presidential Migratory Bird Federal Stewardship Award.

A multifaceted project continued on the effects of wind energy development on migratory birds through a contract with West Texas A&M University. The project surveys plots for wintering and migrating raptors, as well as plots of a variety of habitat types during the breeding season for other migratory birds and their nests. It also includes radio- and satellite-tracking of Swainson's hawks (*Buteo swainsoni*). Another twelve Swainson's hawks were captured and equipped with Platform Transmitter Terminal (PTT)/satellite transmitters, which allow for year-round tracking of the birds in relation to turbine fields, nesting territories, fall migration, and wintering areas. Four years of pre-monitoring have been accomplished for all but the Swainson's hawk work, which has just completed its third field season. A presentation on the Swainson's hawk project was given at the Annual Meeting of the Texas Chapter of The Wildlife Society, Houston. One manuscript related to birds was written and published in the Purple Martin Conservation Association's, *Purple Martin Update/Quarterly Journal*.

Fauna (Reptiles and Amphibians): In 2013, eleven species of reptiles and amphibians were recorded at Pantex during field activities, research projects, and nuisance animal responses (Table 3.4). The all-time list of amphibians and reptiles at Pantex includes 29 species.

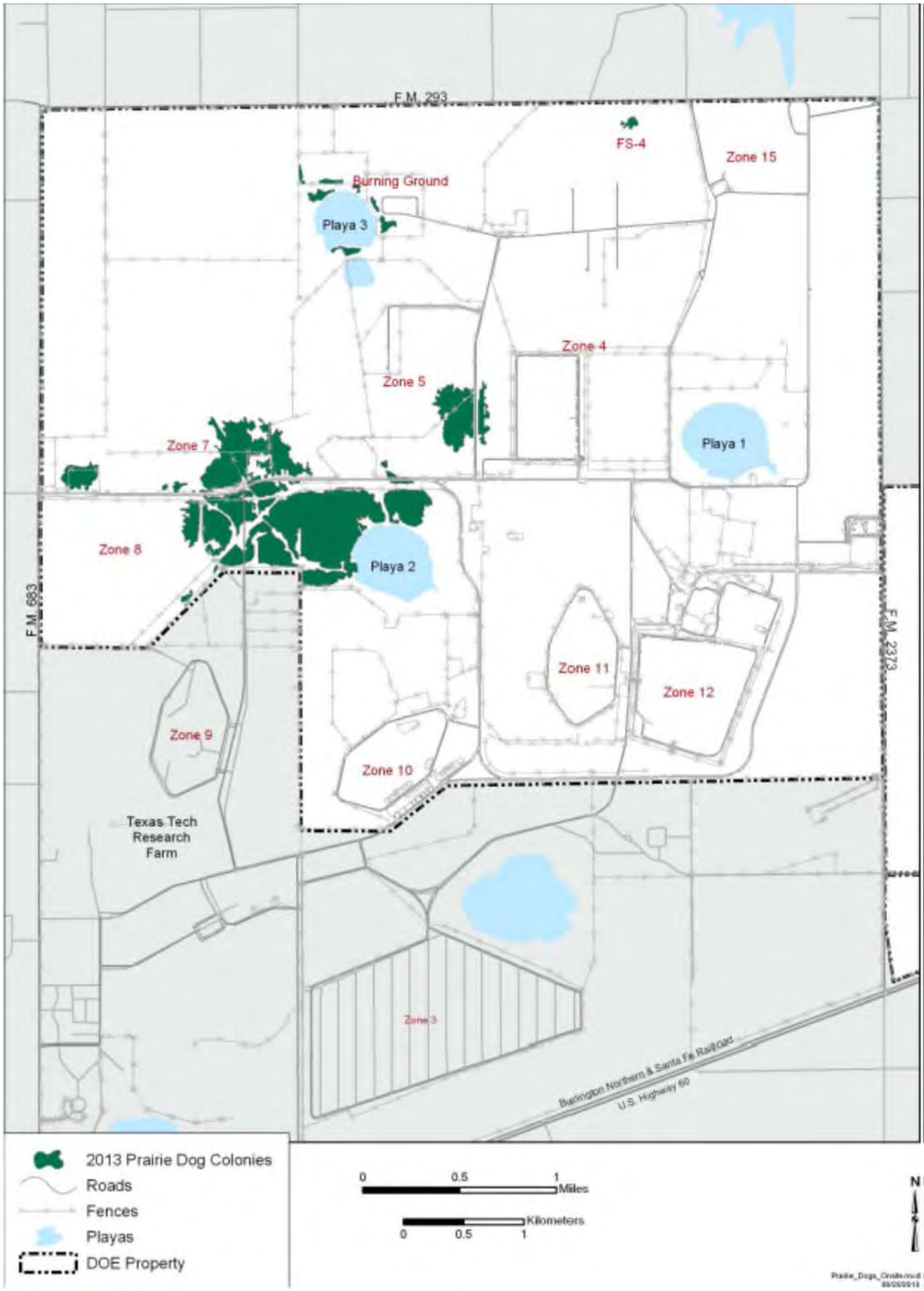


FIGURE 3.8 — *Locations of Prairie Dog Colonies at Pantex Plant*

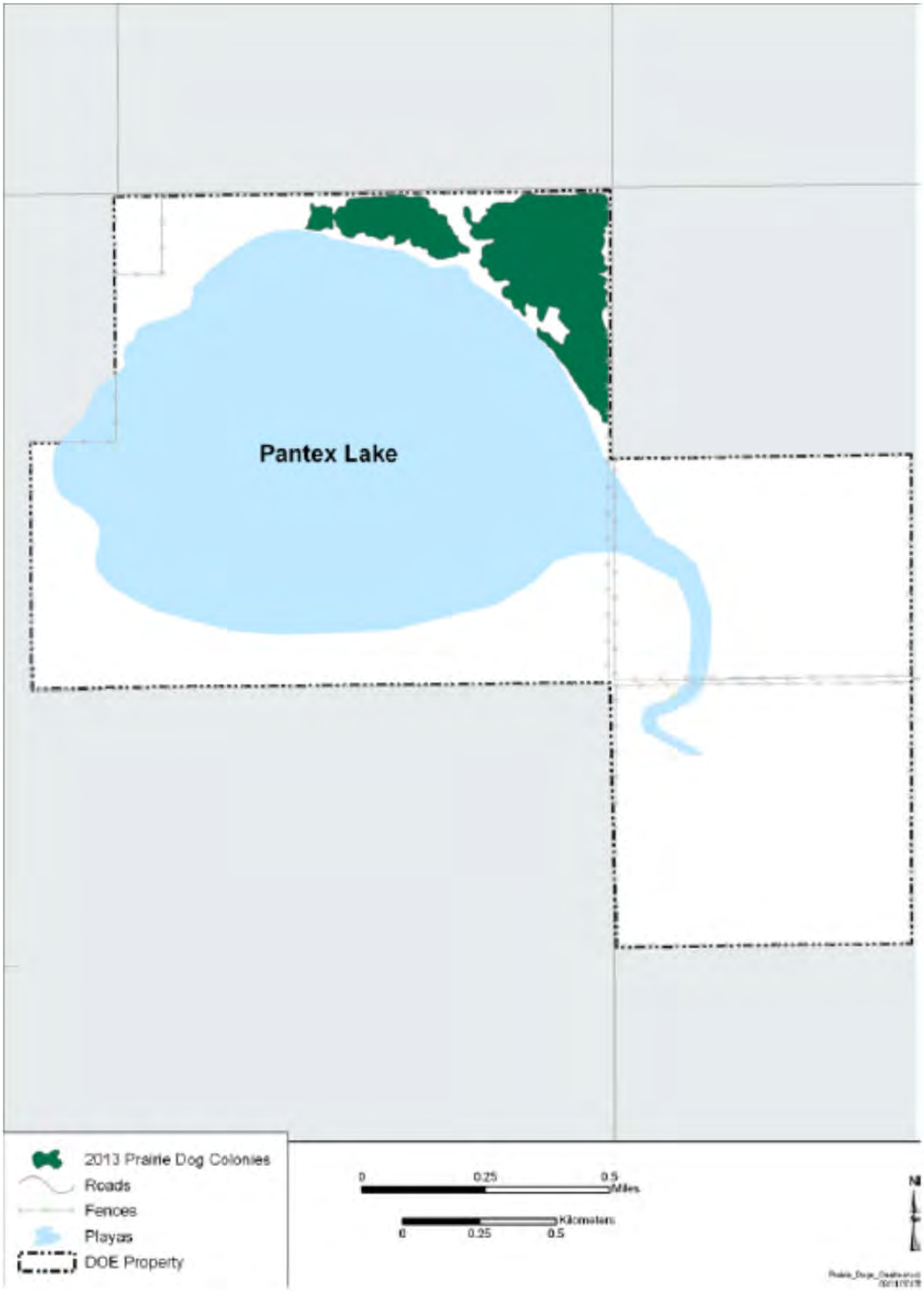


FIGURE 3.9 — *Location of the Prairie Dog Colonies at Pantex Lake*

TABLE 3.4 — *Reptiles and Amphibians Identified at Pantex Plant During 2013*

Common Name	Scientific Name	Playa 1	Playa 2	Playa 3	Pantex Lake	East Property	Other Area
Bullsnake	*Pituophis melanoleucus sayi*						X
Checkered garter snake	*Thamnophis marcianus marcianus*						X
Common king snake	*Coluber constrictor flaviventris*						X
Great plains skink	*Eumeces obsoletus*						X
Lined snake	*Rana blairi*						X
Milk snake	*Lampropeltis triangulum gentilis*						X
Ornate box turtle	*Tarrapene ornate ornata*						X
Plains hognose snake	*Heterodon nasicus nasicus*						X
Prairie rattlesnake	*Crotalus viridis viridis*						X
Texas horned lizard	*Phrynosoma cornutum*		X				X
Yellow mud turtle	*Kinosternon flavescens flavescens*					X	

Active Cooperative Studies with Universities:

Biological and Nuisance Aspects of Bobcats at Pantex
A subcontract was secured with WTAMU for FY08-FY14 to evaluate biological and nuisance aspects of bobcats at Pantex. WTAMU provides traps and supplies, as well as support with sedating, marking, data collection/interpretation, and retrieval of trail cam photos; while Pantex personnel conduct the trapping of the bobcats. Trapping is conducted several times per year. Trail cams are utilized in conjunction with scent stations and other locations, as a tool to determine presence of marked and unmarked cats that do not carry radio-collars. Several nearby private landowners are also cooperating, allowing access for trapping, radio-tracking, and trail cam installation. Any captured bobcats are marked with unique combinations of ear tags, and adults are equipped with GPS radio-collars. Blood samples are collected and DNA analyzed for parental relationships. Genetic analysis for relatedness, among cats, is underway, and results are forthcoming.

In 2013, four individual bobcats were captured on and in the vicinity of Pantex. Two of these captures were males, while two were females. Of the cats, three were juveniles. Along with the adult captured in 2013, an additional three cats collared in the previous year continued to be tracked in 2013 (Figure 3.10). Eighteen bobcats have been collared since 2009. Home range sizes for females averaged 27,576 acres or 43 square miles, and the males averaged 28,189 acres or 44 square miles. One male's home range approached 160 square miles in size. Data from simultaneously-collared cats continue to demonstrate that members of the same sex show avoidance of each other's home ranges, although there is some degree of overlap, especially for females known to be related. Male home ranges are generally larger and overlap with several females, although they generally show higher fidelity to the range of a particular female. Pantex bobcats also show use of anthropogenic structures such as buildings, culverts and tree rows.

Assess Impacts of Wind Turbine Generators to Wildlife and Habitat at Pantex Plant
A subcontract was secured with WTAMU for FY09-FY14 to conduct pre-, post-, and control-site monitoring associated with the *Pantex Renewable Energy Project*. The multi-year study is based on recent criteria published in Wildlife Society journals, but exceeds the recommended duration of both pre- and post-monitoring. The emphasis includes bat and bird mortality at turbines and associated infrastructure, and response of Swainson's hawks (*Buteo swainsoni*) and other birds to wind farm development. Due to the year-round data gathering capability of PTT/satellite transmitters, Swainson's hawk ecology is being studied year-round.

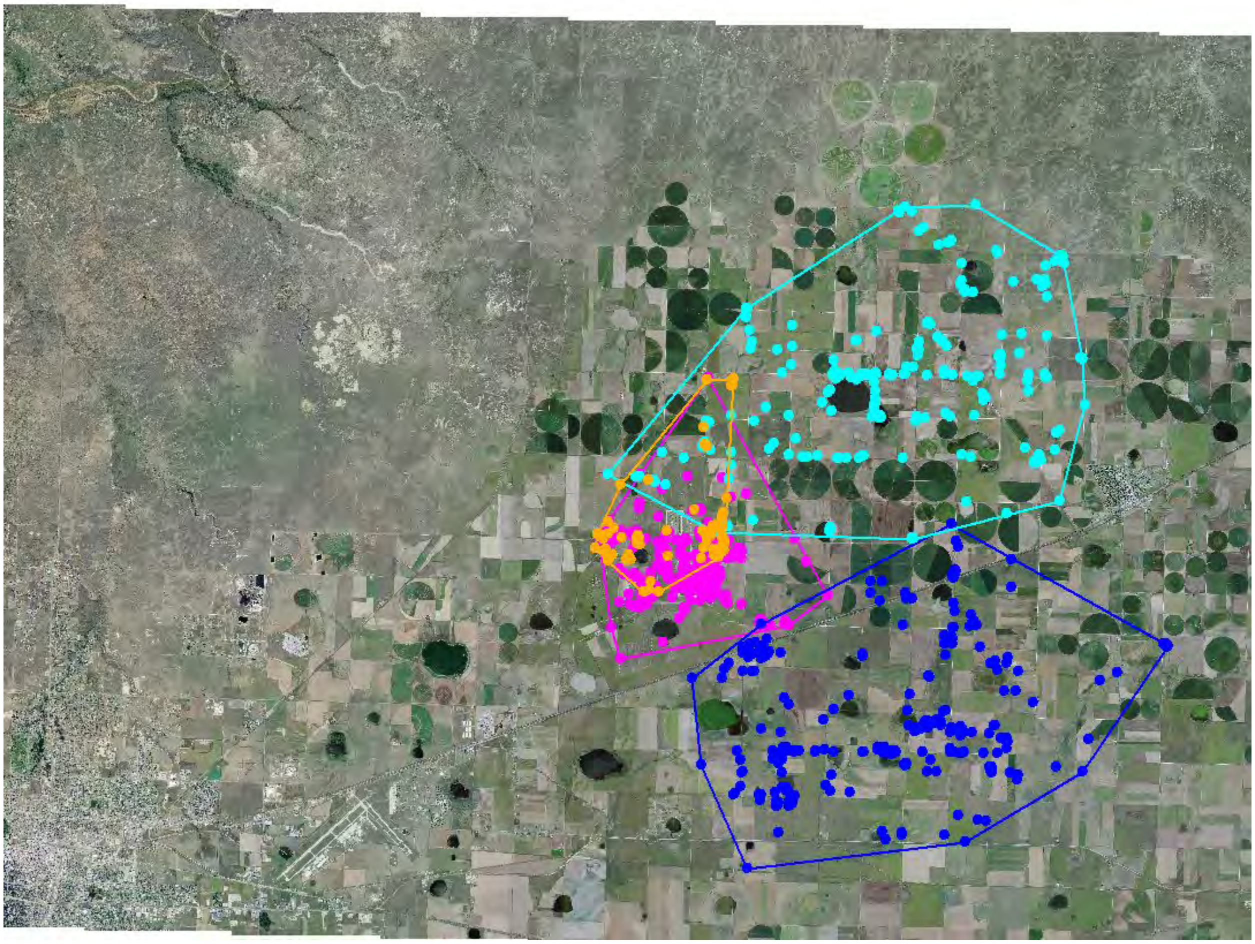


FIGURE 3.10 - *Locations and Home Ranges of all Bobcats Tracked at Pantex in 2013*

Raptor surveys were conducted during the spring, winter, and fall, and surveys for other birds and their nests were conducted during spring and summer. Location and monitoring of Swainson's hawk nests, and trapping and marking of hawks, continued in and around the proposed and existing turbine fields, as well as radiating outwards to include hawks that would likely be unassociated with turbine fields. Ten of the 12 PTT-marked hawks returned to their nesting territories and an additional twelve were marked in 2013. By mid-December, all 20 of the surviving hawks had arrived in Argentina. Data are being analyzed, including those related to the main objectives pertaining to wind energy development, and those related to general biology of Swainson's hawks. At the conclusion of the study, information will be incorporated into applicable documents, as well as shared with the outside natural resource community.

Nuisance Animal Management: Nuisance wildlife problems in the areas of health, safety, and interferences with operations continued at Pantex Plant in 2013. Feral cats, stray dogs, feral pigeons and 13 species of wildlife were documented in nuisance situations. One striped skunk was trapped and delivered to the Amarillo Animal Control Facility to be euthanized, while an additional 11 were euthanized on-site by Security. Sightings of feral cats in 2013 were limited to a cat that was commonly observed between Buildings 12-70 and 12-132. In the vicinity of the PIDAS beds, cottontail rabbits and black-tailed jackrabbits are routinely controlled by the Pantex Security Department. In 2013, 207 rabbits were harvested. Feral pigeons, swallows, and house sparrows nesting around doorways, walkways, and air intakes cause both nuisance conditions and health concerns. Nixalite® wire was previously installed on walls and on nesting surfaces to discourage birds from these areas of concern, and smooth plastic strips were installed beneath overhangs of some buildings to prevent swallows from nesting over doorways. A sky-blue paint is being tested on several buildings with a history of swallow issues, and thus far the technique shows much promise. In 2013, 41 pigeons were harvested by Security.

3.5 Cultural Resources

Cultural resources identified at Pantex Plant include archeological sites from prehistoric Native American use of Plant land; standing structures that were once part of the World War II-era Pantex Ordnance Plant (1942-1945); and buildings, structures, and equipment associated with the Plant's Cold War operations (1951-1991). In addition, many artifacts and historical documents have been preserved which are valuable sources for interpreting prehistoric and historic human activities at the Plant. Some of these cultural resources are eligible for inclusion in the *National Register of Historic Places* (*National Register*); thus, requiring protection and preservation under the National Historic Preservation Act (NHPA) and related Cultural Resource Management (CRM) requirements. The Plant's CRM program ensures compliance with all applicable state and federal requirements.

The goal of the CRM program is to manage the Plant's cultural resources efficiently and systematically, taking into account both the Plant's continuing mission and historic preservation concerns. This goal is achieved through coordination with the Plant's project review process for compliance with the National Environmental Policy Act, and through consultation with the Texas State Historic Preservation Office (SHPO) and the President's Advisory Council on Historic Preservation (Advisory Council). In October 2004, DOE, Pantex Plant, the Texas SHPO, and the Advisory Council completed execution of a *Programmatic Agreement and Cultural Resource Management Plan for Pantex Plant* (PA/CRMP) (PANTEXj). This PA/CRMP ensures compliance with Section 106 of the NHPA, providing for more efficient and effective review of Plant projects having the potential to impact prehistoric, World War II era, and Cold War era properties, objects, artifacts and records. In addition, the PA/CRMP outlines a range of preservation activities planned for the Plant's compliance program. The PA/CRMP provides for the systematic management of all archeological and historic resources at Pantex Plant under a single document. No changes were made to the program in 2013.

Archeology: The Pantex Plant lies within the southern Great Plains archeological province; specifically, within the High Plains Ecological Region of the Texas Panhandle. Approximately half of the DOE-owned and -leased land at Pantex Plant has been systematically surveyed for archeological resources and based upon those surveys, a site-location model was developed. In 1995, a 960-hectare (2,400-acre) survey confirmed that prehistoric archeological sites at Pantex Plant are situated within approximately 0.4 kilometer (0.25 mile) of playas or their major drainage locations. Conversely, such sites do not occur in interplaya upland areas (Largent, 1995).

The 69 archeological sites identified at Pantex Plant consist of 57 Native American prehistoric sites represented by lithic scatters of animal bone artifacts and 12 Euro-American farmstead sites represented by foundation remains and small artifact scatters. In consultation with the SHPO, Pantex determined that the 12 historic sites are not eligible for inclusion in the *National Register*. Pantex and the SHPO concluded that two of the 57 prehistoric sites (41CZ66 and 41CZ23) are potentially eligible for the *National Register*, but that additional field work would be required to make a final eligibility determination. Pantex will continue to protect these two sites and monitor them on a regular basis, as though they are eligible. If additional features are exposed and found, excavation will proceed if they cannot be adequately protected in-situ. These exposed features will be analyzed, mapped, collected, and excavated by archeological methods. All archeological reports, records, photographs, maps and artifacts will be archived at the Plant in accordance with applicable federal regulations. In addition, 22 of the prehistoric sites are protected within playa management units surrounding the four DOE-owned playas.

In the fall of 1996, Plant personnel monitoring for erosion discovered a number of large bones belonging to a bison. An emergency excavation was completed under the supervision of a qualified archeologist. Today the bison bones have been placed in a permanent exhibit within the Pantex Visitor Center.

World War II: In 1942, the U.S. Army Ordnance Department chose this site for construction of a bomb-loading facility. The 16,000-acre industrial Pantex Ordnance Plant, designed and constructed in only nine months, sprang up in the middle of a traditional rural farming and ranching community, bringing with it great social and demographic change. It was constructed by the U.S. Army Corps of Engineers and operated by the Certain-teed Products Corporation to produce bombs and artillery shells.

The World War II-era historical resources of Pantex Plant consist of 118 standing buildings and structures, all of which have been surveyed and recorded. In consultation with the SHPO, Pantex has determined that these properties are not eligible for inclusion in the *National Register* within a World War II context. The World War II era buildings and structures have been preserved to some extent through survey documentation, photographs, individual site forms, and oral histories.

On-going preservation activities include updating historical displays in the Visitor Center located in Building 16-12. The World War II exhibit includes world events from the beginning of the fundamental activities for tactical and thermonuclear weapons that were developed and proved, to the creation of physical infrastructure of the nuclear weapon complex that lead to the growth of the stockpile and its impact on Pantex. Pantex collaborated with the Panhandle Plains Museum in Canyon, Texas on an exhibit focusing on women's contributions during WWII. Part of the exhibit includes the WWII Pantex Women Ordnance Workers (WOW). See Figure 3.11.

The Records Operation Center continues to identify, maintain and store historical records and a variety of different media for preservation purposes. Pantex is working with the National Archives to redefine the historical retention schedule and identify historical records. A new storage area for unclassified records and small artifacts has been obtained. Collections include facility maps, aerial maps and additional Cold War as built drawings, as well as Plant layout plans of former zones. In addition, a collection of Cold War-era photographs, written material and other items have been collected and stored.

Cold War: The NHPA typically applies only to historic properties that are at least 50 years old unless they are of "exceptional importance" (National Park Service [NPS] Bulletin 15, 1991). However, 69 buildings that were constructed during World War II and used during the Cold War are eligible for inclusion in the *National Register* under the Cold War context. Many properties at Pantex Plant are associated with the Cold War arms race and are of exceptional importance. As a final assembly, maintenance, surveillance, and disassembly facility for the nation's nuclear weapons arsenal, Pantex Plant lies at the very heart of Cold War history.

The period of Cold War operations at Pantex Plant date from 1951, when the Plant was reclaimed by the Atomic Energy Commission (AEC) as part of the expanding nuclear weapons complex, to the September 1991 address to the nation by then-President, George H.W. Bush directing the dismantlement of a portion of the nation's nuclear weapon stockpile; thereby, changing the Pantex mission from one of nuclear weapon assembly to one of disassembly. The Cold War-era historical resources of Pantex Plant consist of approximately 650 buildings and structures and a large inventory of process-related equipment and documents. The historical resources of this period are among the Plant's most significant, and offer a valuable contribution to the nation's cultural heritage.

FIGURE 3.11– *Woman Ordnance Worker*

Ten buildings designated for in-situ preservation were specifically listed in the "Pantex Plant, FY 2012-2021 Ten Year Site Plan." (PANTEXe). This critical planning document helps guide and shape infrastructure decisions including both new construction and demolition for the foreseeable future. As stated, "This plan identifies a range of preservation activities including; as the cornerstone, preservation in-situ of ten mission-related buildings." Historical equipment tooling, trainers and other components were acquired and have been inventoried and moved into a historical facility until funding can be obtained for a classified museum. These projects strengthen continued use of the historical facilities, which confirms Pantex' s pledge for implementing preservation activities.

An Advisory Committee for decisions regarding the preservation of Cold War artifacts has been developed and includes a step by step work instruction on how to preserve Pantex artifacts with historical significance. This committee will help to determine historical significance.

Preservation activities continue through identification and evaluation of facilities by maintaining the Pantex Visitor Center and railcar displays, collection of artifacts and records, monitoring archeological sites, educational outreach as well as other preservation activities.

3.6 Educational Resources and Outreach Opportunities at Pantex Plant

Pantex employees continued public outreach efforts and P2 education during 2013. Pantex partnered with local communities to help expand their recycling efforts including the ongoing partnership with the City of Panhandle in which Pantex provides cardboard, magazines, newspapers and phonebooks. The City of

Panhandle includes these materials with city wastes that are sold to recyclers, with the revenue from these sales being reinvested into the city's recycling program. This win-win partnership supports the community's recycling efforts while saving Pantex disposal costs.

Pantex scientists continued to donate their time and talent to area schools by speaking to students about science careers and helping stimulate student's interest in science, math and engineering. Pantex supports area schools with speakers and displays for science fairs and career days, and encourages students to stay in school and obtain higher education. Pantex staff provided several presentations to school, community, and professional groups on a variety of topics including backyard wildlife, Texas horned lizards, bobcats, and wildlife management and research at Pantex.

3.7 Environmental Restoration

Historical waste management practices at the Plant resulted in impacts to on-site soil and perched groundwater. These historical practices included disposal of spent solvents in unlined pits and sumps, and disposal of high explosive (HE) wastewater and industrial wastes into unlined ditches and playas. As a result, HEs, solvents, and metals were found in the soil at Solid Waste Management Units (SWMU) at Pantex and in the uppermost (perched) groundwater beneath the Pantex Plant. Pantex and regulatory agencies identified 254 units for further investigation and cleanup. Investigations that identified the nature and extent of contamination at SWMUs and associated groundwater were submitted to the TCEQ and EPA in the form of RCRA Facility Investigation Reports. Those investigation reports closed many units through interim remedial actions and no further active controls were necessary for those units. Other units were evaluated in human health and ecological risk assessments to identify further remedial actions necessary to protect human health and the environment. Figure 3.12 depicts the location and status of the units. The 16 units still in active use will be closed in accordance with CERCLA and RCRA permit provisions when they become inactive and are determined to be of no further use.

Those units requiring further remedial actions were assessed in a corrective measures study to identify and recommend final remedial actions. A detailed summary of actions for the 254 units can be found in the Pantex Site-Wide Record of Decision (ROD), (Pantex Plant and Sapere, 2008). The final approved remedial actions are detailed in the ROD.

On-going remedial actions focus on:

- Cleanup and removal of perched groundwater to protect the underlying drinking water aquifer;
- Removal of soil gas and residual non-aqueous phase liquid (NAPL) in the soil at the Burning Ground for future protection of groundwater resources,
- Institutional controls to protect workers, control perched groundwater use, and control drilling into and through perched groundwater, and
- Maintenance of soil remedies (ditch liner and soil covers) for groundwater protection.

Environmental Restoration Milestones:

During 2013, Pantex completed several milestones under the continued long-term stewardship of environmental units. Long-term stewardship includes the long-term operation and maintenance (O&M) of the remediation systems, monitoring of the systems to ensure that cleanup goals established in the ROD and Compliance Plan will be met, maintenance of soil remedies and institutional controls, and reporting of that information to regulatory agencies and the public. Remedial Action systems at Pantex are depicted in Figure 3.13 and the Major Milestones for the 2013 Remedial Actions are shown in Figure 3.14.

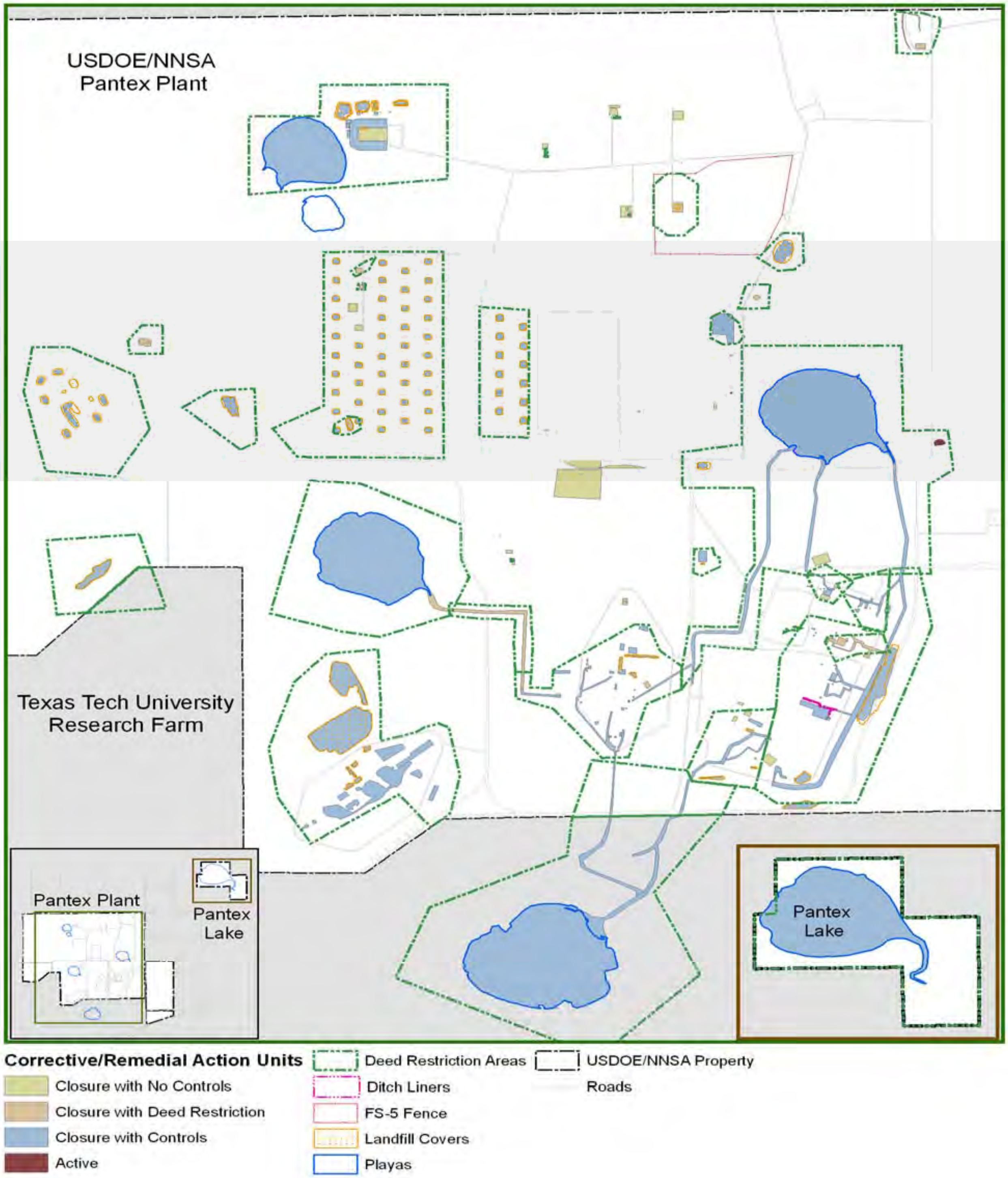


FIGURE 3.12 —*Location and Status of Solid Waste Management Units*

Groundwater Remedies:	Soil Remedies:
2 Pump & Treat Systems	Ditch Liner
• Playa 1 Pump and Treat	Soil Covers on Landfills
• Southeast Pump and Treat	Fencing at FS-5 to control use/access
2 In-Situ Bioremediation (ISB) Systems	Institutional Controls
• Zone 11 ISB	Soil Vapor Extraction System
• Southeast ISB	Institutional Controls
Institutional Controls	

FIGURE 3.13 - ***Remedial Actions at Pantex***

- 98 percent of treated perched groundwater was beneficially used in 2013;
- >1 Billion gallons of treated water removed, treated, and beneficially used since startup of the Pump and Treat Systems;
- >700 lbs of high explosives and hexavalent chromium removed from groundwater in 2013;
- >11,000 lbs of contaminants removed from groundwater since startup of Pump and Treat Systems;
- >520 lbs of volatile organics removed from Burning Ground soils by SVE System in 2013;
- >17,000 lbs of volatile organics removed from Burning Ground soils since startup of SVE System; and
- Five-Year Review of Remedial Actions completed and approved by TCEQ and EPA.

FIGURE 3.14 – *Major Milestones for 2013 Remedial Actions*

Pump and Treat Systems. The pump and treat systems were installed to address contamination in areas where there is generally greater than 15 ft. of saturation in the perched groundwater. These systems are designed to remove and treat groundwater to achieve contaminant mass reduction and reduction in the saturated thickness of the perched aquifer. Reduction in saturated thickness will significantly reduce the migration of contaminants both vertically and horizontally so that natural breakdown processes can occur over time. To achieve the remediation goals, the pump and treat systems treat the extracted water to remove contaminant mass from the water before the effluent is sent to the Wastewater Treatment Facility (WWTF) and irrigation system for beneficial reuse, although the SEPTS retains the capability for injection back into the perched zone when necessary. The SEPTS has been operating since 1995 when it was started as a treatability study. It has been expanded with more extraction wells and the capacity to treat boron and hexavalent chromium to continue to address the southeastern portion of the groundwater plumes. Construction of the Playa 1 Pump and Treat System (P1PTS) was started in late 2008, and the system became fully operational in January 2009.

To reach the goal of reducing saturated thickness, the Pump and Treat Systems have a goal of operating 90 percent of the time and at 90 percent of treatment capacity. Performance of the Pump and Treat Systems for 2013 is depicted in Figure 3.15. Both systems exceeded the operational goal of 90 percent. Although the systems operated consistently, treatment throughput was below goal due to reduced flow while repairs were made to the WWTF, irrigation system, or system

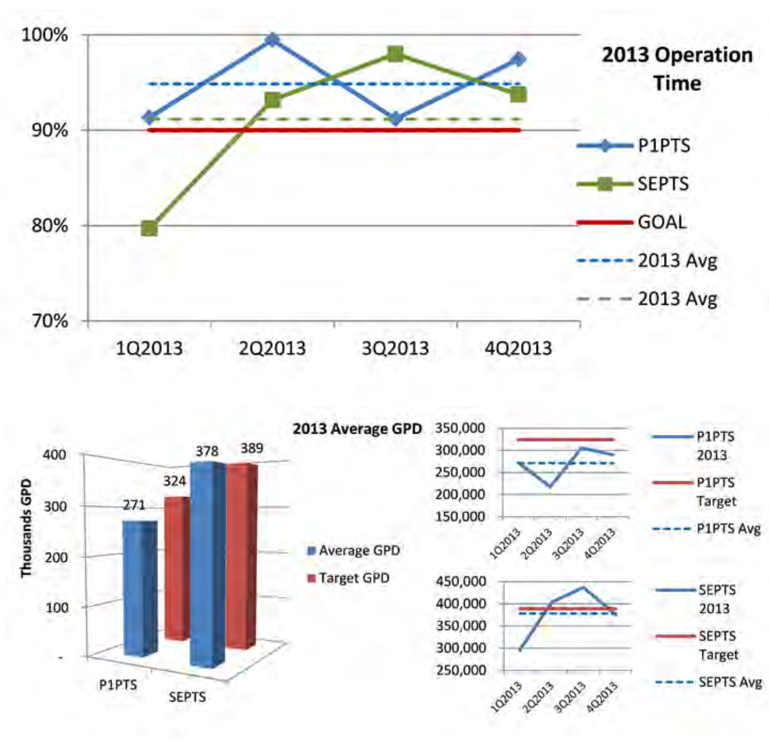


FIGURE 3.15 - *Pump and Treat Systems Performance*

wells. As depicted in Figure 3.15, P1PTS operated 97 percent of the year with an average gallon per day (gpd) throughput over 271,000 gpd. SEPTS operated 94 percent of the year, with an average throughput near 378,000 gpd. Overall, the systems have operated efficiently to treat contamination and reduce saturated thickness. Pantex reached a significant goal in 2013 with the removal of over one billion gallons of treated groundwater (see Figure 3.16). Pantex has treated more than 1.8 billion gallons since the startup of the pump and treat systems.

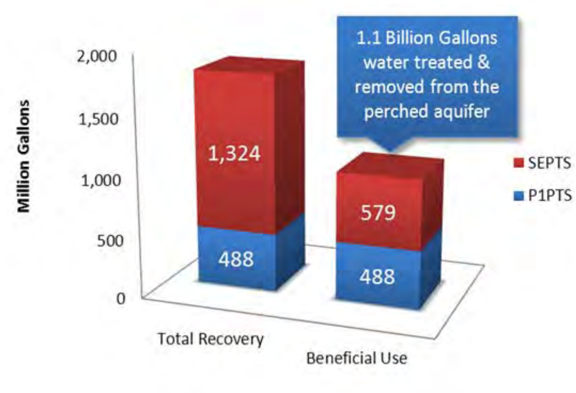
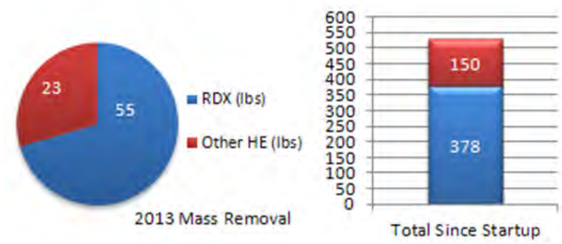
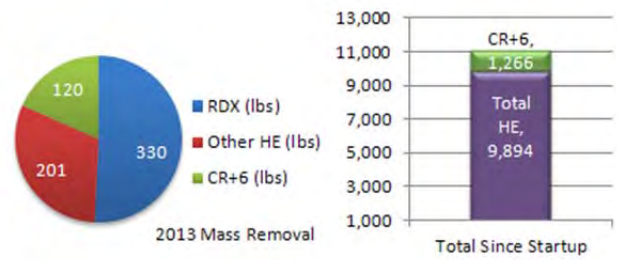


FIGURE 3.16 - *Pump and Treat Recovery*

In addition to removing impacted water from the perched aquifer, the pump and treat systems remove contaminant mass from the groundwater that is extracted from the aquifer. The P1PTS primarily removes the high explosive RDX and the SEPTS primarily removes RDX and hexavalent chromium (Cr^{+6}). Figure 3.17 provides the mass removal for HEs and chromium for 2013, as well as totals since startup of the systems. The SEPTS has been operating longer, and the greatest concentrations of HEs are found in the SEPTS extraction well field, so mass removal is much higher at that system.



P1PTS Mass Removal



SEPTS Mass Removal

FIGURE 3.17 - *Pump and Treat Systems Mass Removal*

ISB Systems: Two ISB systems (Zone 11 ISB and Southeast ISB) are in operation at Pantex. These systems are designed with closely spaced wells to set up a treatment zone in areas of the perched groundwater to control plumes migrating to Texas Tech University property south of Zone 11 or where the area is sensitive to vertical migration of COCs to the underlying aquifer and pump and treat technology is not effective. Amendment is injected into the treatment zone to provide a food source for naturally occurring bacteria that break down the COCs. Monitoring wells were installed downgradient of the groundwater flow from the treatment systems to monitor whether the system is effectively degrading the COCs. Injection of amendment is currently scheduled every 12 months for the Zone 11 ISB and every 18 months for the Southeast ISB. A discussion of treatment zone effectiveness and downgradient performance monitoring well information is included in Chapter 6.

As part of the O&M of the ISB systems, both ISB systems received an amendment injection during 2013. Sampling results indicated the food sources at both ISB systems were declining before injection. Injection was completed in September 2013 at the Southeast ISB and July 2013 at the Zone 11 ISB.

Burning Ground SVE: An SVE system was installed and has been operating at the Burning Ground since February 2002. After a large-scale system remediated a significant area at the Burning Ground, a small-scale activated carbon system was installed in late 2006 after the large-scale system became inefficient at continued removal of remaining soil gas and residual NAPL. The current system, consisting of a small-scale catalytic oxidizer and wet scrubber, was installed in early 2012 to replace the activated carbon system. The current system continues to focus on treating residual soil gas and NAPL at a single well (SVE-S-20) where soil gas concentrations continue to remain high. As depicted in Figure 3.18, the SVE system removed over 529 lbs. of volatile organics during 2013.

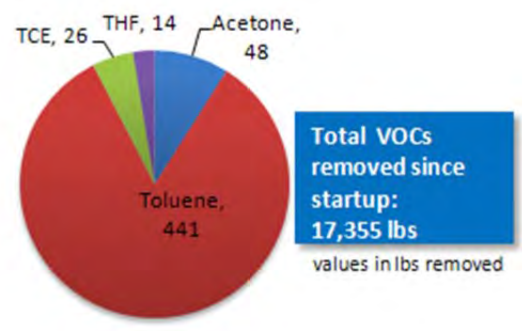


Figure 3.18 – *2013 SVE Mass Removal*

Soil Remedies and Institutional Controls: Institutional controls are required as part of the long-term stewardship of soil remedial action units at Pantex. Deed restrictions have been placed on all soil units with the exception of the active units. All SWMUs at Pantex are restricted to industrial use. To support the deed restrictions, Pantex maintains long-term control of any type of soil disturbance in SWMUs to protect human health and to prevent spread of contaminated soils. Pantex also regularly inspects and maintains soil covers on landfills to prevent infiltration of water into the landfill contents and migration of impacted water to groundwater.

First Five-Year Review: The five-year review was conducted to ensure that Remedial Actions for soils and groundwater at the Pantex Plant are protective of human health and the environment. The five-year review focused on:

- Evaluating the implementation and performance of the RAs,
- Determining if the RAs are, or will be, protective of human health and the environment,
- Determining what corrective measures are required to address any identified deficiencies, and
- Evaluating whether there are opportunities to optimize the long-term performance or reduce life-cycle costs of the RAs.

The overall conclusion of the review was that soil and groundwater remedies are currently performing as designed and expected. The institutional controls and soil remedies are actively preventing contact with soil and groundwater while active remedies decrease concentrations of contaminants in soil and groundwater to provide long-term protection of human health and the environment. Some deficiencies were noted that require Pantex to gather additional information to assess the active remedies and the areas that are outside the influence of the remedies. Pantex must also develop and implement plans to correct deficiencies to ensure continued long-term protection of human health and the environment. Pantex completed many of the actions during 2013 as recommended in the five-year review. Pantex has taken the following actions during 2013 in relation to the noted issues or deficiencies in the five-year review:

- An additional extraction well was installed for the P1PTS to allow sustained design pumping rates when other wells need repair.
- Two monitoring wells were installed to assess the water and contaminant movement into western end of the Southeast ISB.

- Based on studies and evaluations conducted in the area where plumes extend beyond the western end of the Zone 11 ISB, Pantex has recommended expansion of the ISB. Pantex plans to begin expansion in 2014.
- Pantex has updated their LTM Design and Sampling and Analysis Plan to include additional sampling in newly installed wells and existing wells where needed.
- Pantex developed a formal well maintenance program to ensure continued representativeness of sampling. That well maintenance plan will be implemented in 2014.

Long-Term Groundwater Monitoring

Pantex transitioned to the LTM network in July 2009. The groundwater monitoring network was developed to evaluate the effectiveness of the remedial actions. The evaluation is conducted to ensure that the remedial system is effective in stabilizing plumes and meeting cleanup goals, detecting any new COCs from source areas or in the drinking water aquifer, and to evaluate the presence and amount of natural attenuation that may be occurring in the groundwater plumes (see information box). The monitoring information collected is evaluated and reported in annual and quarterly progress reports and is summarized in Chapter 6 of this report. The quarterly and annual reports can be found at www.pantex.com.

Monitoring Data Evaluation

Plume Stability
- Determine if COC concentrations stabilize or decline outside pump and treat systems and at source areas
- Perform capture zone analysis in pump and treat areas

Response Action Effectiveness
- Determine if COC concentrations decline at treatment systems
- Determine if water levels decline

Uncertainty Management
- Identify any new contamination from remedial action units

Early Detection
- Identify COCs entering the drinking water aquifer

Natural Attenuation of COCs
- Identify degradation products in areas outside the influence of treatment systems

3.8 Environmental Monitoring

DOE Order 458.1 *Radiation Protection of the Public and Environment,* requires the performance of monitoring that is integrated with the general environmental surveillance[5] and effluent monitoring[6] program to: assess impacts and characterize exposures and doses to individual members of the general public, to the population, and to biota in the vicinity of the Pantex Plant; detect, characterize and respond to releases from DOE activities; and demonstrate compliance with applicable regulatory and permit limits. The monitoring program with its constituent planning, implementation and assessment phases was designed based upon the system described in the USEPA's *EPA QA/G-1*, *Guidance for Developing Quality Systems for Environmental Programs*. (EPAb) to ensure the use of a consistent system for collecting, assessing, and documenting environmental data of known and documented quality in order to meet the purposes described above. Another document which was useful in continuous improvement of the design of the Pantex monitoring program was NCRP Report No. 169 published by the National Council on Radiation Protection and Measurements (NCRP, 2010). Although this document specifically addresses radiological effluent monitoring and surveillance, the authors of the report note that many of the concepts described are appropriate for nonradiological contaminants that must also be monitored.

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[5] Environmental surveillance refers to measurements performed throughout the environment where it is assumed that a particular substance (sometimes referred to as a "contaminant") is well-mixed in the environment and the concentration of the substance in a collected sample is representative of its actual concentration in the environment.

[6] Effluent monitoring refers to the collection and analysis of samples at or before their entry into the environment.

Planning for the environmental monitoring program begins with the development of (or revision of previously existing) monitoring requirements by the various environmental subject matter experts (for environmental media including but not limited to air, water, soil, and biota) by a process based upon that described in *USEPA QA/G4, Guidance for Data Quality Objective Process*. This process requires subject matter experts to consider several factors including the purpose of the monitoring program, the trend of historical results from previous sampling, the predominant wind direction, and the presence of a sufficient quantity of a target species for analysis when planning sample collection locations and frequencies for the various environmental media. Specification of sampling locations and frequencies by a regulatory body (such as TCEQ or EPA) in a permit issued to the Pantex Plant has also been used in the development of certain monitoring programs. When feasible, sample plans included taking samples at the same geographical location for several environmental media to allow an individual media scientist to compare results from the other media and determine the usability of his/her data. Even though sample plans had been developed, in some instances analysis results were not available due to drought conditions, electrical power failures or laboratory errors. The number of sampling locations for monitoring of these various pathways during calendar year 2013 are shown in Table 3.5. It should be noted that, due to the minimal number of points where measurable quantities of radiological and non-radiological contaminants can be directly measured and compared to some risk-based standard, the majority of sampling locations are best characterized as “surveillance” locations.

TABLE 3.5 — *Number of Environmental Media Sampling Locations in 2013*

Media	Surveillance	Effluent	On-site	Off-site [a]
Air	13	0	4	9
Ambient External Radiation (TLDs[b])	17	0	5	12
Drinking Water	0	32	32	0
Fauna [c]	10	0	9	1
Groundwater	207	0	156	51
Soil/Sediment	14	0	14	0
Surface Water	4	8	12	0
Vegetation (crops, native species)	37	0	26	11
Wastewater [d]	0	2	2	0
TOTAL	**302**	**42**	**260**	**84**

[a]Includes fence line and “background” control locations.
[b]Thermoluminescent dosimeters
[c] On-site number includes one sampling location at Pantex Lake.
[d] Environmental samples are also collected at other sample locations such as the WWTF influent and WWTF lagoon as a “best management practice” to identify trends. Neither of these sample locations can be characterized as “surveillance” or “effluent” sampling locations as described above.

The implementation of these plans begins with the collection of samples by technicians using procedures contained within an "Environmental Sampling and Analysis Manual". In addition to procedures common to all environmental media (such as those associated with completion of sampling "logs" and "Chain-of-Custody forms"), the aforementioned manual contains procedures specific to the several different environmental media. These several specific procedures are based upon the "collection" protocols included in several different national consensus standards[7]. The majority of the analyses of Pantex environmental samples are accomplished by independent laboratories under a Scope of Work which requires the analysis of Pantex samples by protocols which are equivalent to those in consensus standards[8].

Several data assessment processes were employed by Pantex to verify that the data collected for all of the monitoring programs met the specified data acceptance criteria. These processes included evaluation of sampling quality assurance; laboratory technical performance and quality assurance; and data verification and validation. Media-specific descriptions, as well as the results of the monitoring program for samples collected during 2013, are contained in Chapters 4-12 of this report. Chapter 13 contains a discussion of the program used to ensure that the environmental monitoring data meet the appropriate data quality requirements.

[7] Examples of consensus standards include "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association with the assistance of other similar organizations and "Methods of Air Sampling and Analysis" compiled by an intersociety committee including the Air and Waste Management Association, the American Chemical Society, the Health Physics Society and other similar organizations.

[8] A limited number of analyses including those for preliminary analysis of certain water samples are performed on-site. In addition Radiation Safety Department personnel perform analyses of the environmental TLDs discussed in Chapter 4.

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Monitoring results for the environmental radiological pathways in 2013 indicated levels below relevant standards, similar to results from previous years and consistent with background conditions.

4.1 The Scope of the Program

This chapter summarizes radiological emissions from normal Plant operations. There were no emissions due to unplanned releases during the reporting period. This section would evaluate these releases in the unlikely event an unplanned incident were to occur.

During 2013, Pantex Plant's environmental radiological monitoring program was conducted according to U.S. Department of Energy (DOE) Order 458.1, *Radiation Protection of the Public and the Environment* (DOEi). The program involved measuring radioactivity in environmental samples in addition to calculating the potential radiological dose to the off-site public. The program monitored for the principal radionuclides associated with Plant operations: tritium (^{3}H), uranium^{234} (^{234}U), uranium^{238} (^{238}U), and plutonium^{239} (^{239}Pu) in air, groundwater, drinking water, surface water, flora, and fauna samples. The radionuclides ^{234}U, ^{238}U, and ^{239}Pu emit primarily alpha particles.[9] Tritium emits beta particles and gamma radiation emissions from these radionuclides were also monitored and evaluated.

Based on the 2013 operational data, Pantex emitted a dose to the maximally exposed member of the general public of 7.00x 10^{-6} mrem. This dose is significantly below the U.S. Environmental Protection Agency (EPA) maximum permissible exposure limit to the public of 10 mrem/yr as well as the DOE Public Dose Limit of 100 mrem/yr. The regulatory limits are purposely set at levels well below those known to cause any adverse effects on the public and/or the environment. The monitoring and analysis results demonstrate that no adverse effects occurred from Plant operations in 2013.

4.2 Radiological Units and Reporting

Radiological results are reported in units that are specific to different types of exposure and nvironmental media (i.e., air, water, etc.). For example:

- Individual measurements of the concentration of a radionuclide in an environmental medium are in a form similar to X ± Y units of activity per unit of representative sampling volume or mass. In this form, Y represents the "counting error"[10] associated with the measurement X. For example, a typical individual measurement of the concentration of a radionuclide in ambient air or in an aqueous medium would be reported as 1.30 ± 0.83 pCi/mL[11] of sampled air or water. A typical individual measurement of the concentration of a radionuclide in a solid medium (e.g. soil, plant matter) would be reported as 0.48 ± 0.77 pCi/g dry weight. In both instances the measurement has usually been "background corrected" by subtracting the naturally occurring radionuclides and

[9] The alpha energies of ^{233}U (4.82 MeV and 4.78 MeV) and ^{234}U (4.77 MeV and 4.72 MeV) are very similar. Alpha-pectroscopy techniques used to perform analyses cannot distinguish between the two isotopes. Accordingly a single analysis result will indicate both isotopes in the "pair" as $^{233/234}$U. Similarly, the alpha energies of ^{239}Pu (5.16 MeV and 5.11 MeV) and ^{240}Pu (5.17 MeV and 5.12 MeV) are not distinguishable by alpha-spectroscopy and analysis will indicate both isotopes in a single analysis result as $^{239/240}$Pu.

[10] Derivation of this term is beyond the scope of this document. This topic, as well as other radiological and statistical topics, are discussed in reports by the National Council on Radiation Protection and Measurements (NCRP) in several reports (NCRPa, NCRPc, NCRPd), in health physics texts (Bevelacqua, 1999), and in statistics texts (Gilbert, 1987).

[11] The reader should note that various prefixes, e.g., milli (m), micro (μ), can be used to modify the "base units" of radiation measurement, e.g., rem, Sievert (Sv), Curie (Ci), Roentgen (R). These various prefixes are related as indicated in the "Scientific Notation Used for Units" section of the "Helpful Information" table located on the inside back cover. Thus, for example, 0.00125 mCi could also be written as 1.25 x 10^{-3} mCi or 1.25 x 10^{-6} Ci, or even as 1.25 μCi.

cosmic radiation detected by laboratory instrumentation from the raw sample measurement. For this reason, negative values may occur when the laboratory's background measurement is larger than the raw measurement of radioactivity in a particular sample.

- Individual doses from airborne emissions of radionuclides and from gamma radiation are reported in millirem per year (mrem/yr)[12] or millisievert per year (mSv/yr).[13]
- Population dose[14] is reported in person-rem per year or person-sievert per year.
- Exposure rates are reported in microroentgen per hour (μR/hour).

4.3 Radiological Emissions and Doses

4.3.1 Doses to Members of the Public

DOE Order 458.1 requires radiological activities to be conducted in a manner so that the exposure of members of the public to ionizing radiation from all DOE sources and exposure pathways shall not cause, in a year, a total effective dose greater than 100 mrem (1 mSv). At the Pantex Plant, demonstration of compliance with this limit is documented by a combination of measurements and calculations including the comparison of concentrations of radioactive material in air and water to "Derived Concentration Standards" (DCS) listed in DOE-STD-1196-201, *DOE Derived Concentration Technical Standard* (DOEk).[15]

4.3.1.1 External Radiation Pathways

DOE Order 458.1 requires that evaluations to demonstrate compliance with the aforementioned dose limit consider several exposure pathways including direct external radiation from sources located on-site, external radiation from airborne radioactive material, and external radiation from radioactive material deposited on surfaces off-site. At Pantex, external gamma radiation is measured at several locations at or near the site to determine the magnitude of doses from these pathways. As will be discussed in Section 4.6 below, the results of these measurements are of the same magnitude as those measured at a background or control location in Bushland, Texas, 35 miles west of the Plant. Accordingly, DOE radiological activities at Pantex do not cause any dose above that due to background radiation and thus do not contribute significantly to the exposure of members of the public to ionizing radiation.

4.3.1.2 Air Pathway

DOE Order 458.1 further requires that internal doses[16] to members of the public from inhalation of airborne effluents be evaluated using the EPA's CAP-88 model (or another EPA-approved model or method) to demonstrate compliance with applicable subparts of 40 CFR 61, *National Emission Standards*

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[12] The reader should note that various prefixes, e.g., milli (m), micro (μ), can be used to modify the "base units" of radiation measurement, e.g., rem, Sievert (Sv), Curie (Ci), Roentgen (R), Gray (Gy). These various prefixes are related as indicated in the "Scientific Notation Used for Units" section of the "Helpful Information" table located on the inside back cover. To afford comparison with the dose limits established in DOE Order 458.1, doses will be reported as indicated.

[13] The Système Internationale unit for dose equivalent analogous to the rem is the Sievert (Sv). One Sievert is equivalent to 100 rem and 1 millisievert (mSv) is equivalent to 100 mrem.

[14] The summation of the product of the calculated effective dose equivalent for the average exposed individual in each of the sectors illustrated in Figure 1.6 multiplied by the number of people living in that sector.

[15] The DCS values listed in the technical standard represent the concentration of a given radionuclide in either air or water that would result in a member of the public receiving an effective dose of 100 mrem following continuous exposure for one year for each of the following pathways: ingestion of water, air contact, and inhalation. The DCS values were derived in accordance with dose limitation systems recommended by the International Commission on Radiological Protection (ICRP) in its several publications (ICRP, 2007) and used by the EPA, the Nuclear Regulatory Commission, and other regulatory bodies including DOE in establishing standards for radiological protection.

[16] Internal doses to organs or tissues of an organism which are due to the intake of radionuclides by ingestion, inhalation, or dermal absorption (NCRPd).

for Hazardous Air Pollutants. Compliance with the limit for emissions to the airborne pathway of radionuclides other than radon established by the EPA in 40 CFR 61.92 is demonstrated at the Pantex Plant by calculating the effective dose equivalent received by the maximally exposed individual (MEI)[17] member of the general public by the use of the CAP-88-PC (EPAb) model.

Since 1994, the meteorological data used in this modeling effort have been obtained from the meteorological tower at Pantex Plant. Sensors at the tower automatically record average wind speed and direction, and several other parameters, every 15 minutes. Information about average tropospheric mixing height is obtained from the Amarillo National Weather Service station at the Rick Husband International Airport. The source term for releases to air was calculated based on process knowledge of the releases of radionuclides from the routine operations at Pantex (e.g., calibration of radiation detection instrumentation, sanitization[18] of components at the Burning Ground and Firing Sites, etc.), the number of operations conducted during the year, and other modifying factors. In estimating the emissions, conservative assumptions concerning the form of the radioactive material and the presence or absence of engineering controls such as High-Efficiency Particulate Air (HEPA) filters were made to maximize the potential emissions. A very small percentage (5.40E-10 percent) of these calculated emissions is due to emissions of ^{238}U and other radionuclides from various routine Plant activities, while the balance is due to emissions of ^{3}H.[19] These emissions are summarized in Table 4.1 below.

TABLE 4.1 — *Pantex Radiological Atmospheric Emissions in Curies (Bq)*

Tritium	Total Uranium	Total Plutonium	Total Other Actinides	Other
2.36E-02 (8.72E+08)	1.27E-11 (0.47)	None	1.38E-14 (5.12E-04)	None

Based on the results of the CAP-88-PC modeling, the maximally exposed individual for 2013 (located approximately 2,500 meters [1.55 miles] east-southeast [ESE] of Building 12-42) would have received a dose of 7.00 x 10^{-7} mrem (7.00 x10^{-9}mSv). This dose is equivalent to 7.00 x 10^{7} percent of the DOE Public Dose Limit for all pathways and is 7.00 x 10^{-5} percent of the effective dose equivalent standard specified in 40 CFR 61, Subpart H. Based upon the same CAP-88-PC modeling results, the collective population dose equivalent received by those living within 80 kilometers (50 miles) of Pantex Plant would have been 8.05 x 10-6 person-rem/year (8.05 x 10^{-8} person-sievert/year) in 2013. The majority of this collective population dose equivalent is contributed by ^{3}H. Monitoring results for the air pathway are discussed in detail in Chapter 5.

4.3.1.3 Water Pathway

In addition to promulgating the dose limit mentioned above, DOE Order 458.1 requires operators of DOE facilities discharging or releasing liquids containing radionuclides from DOE activities to conduct such activities in such a manner as to: protect groundwater resources; not cause private or public drinking water systems to exceed the drinking water maximum contaminant limits outlined in 40 CFR 141, *National Primary Drinking Water Regulations*; and comply with other limitations as applicable. Current

[17] The MEI is a person who resides near Pantex Plant, and who would receive, based on theoretical assumptions about lifestyle, the maximize exposure to radiological emissions and therefore, the highest effective dose equivalent from Plant operations.

[18] See the definition of this term in the glossary.

[19] The overwhelming majority (99.9 percent) of these emissions arose from activities conducted within the southern portion of Zone 12. The balance of the emissions arose from sanitization activities conducted at the Burning Ground and Firing Sites.

Pantex Plant policy does not allow the discharge of radioactive material in liquid effluent discharges to groundwater (or to sanitary sewers), thus eliminating any future potential impact to groundwater from those sources. Compliance with 40 CFR 141.66 maximum contaminant level (MCL) limitations for individual radionuclides potentially released from Pantex activities, with the exception of tritium, is demonstrated by comparing measured concentrations of radionuclides in drinking water to four percent of the DCS values for ingested water.[20] The results of these measurements as well as those for other water monitoring programs did not indicate releases to any water pathway and thus no contribution to the total effective dose from Pantex activities during 2013.

4.3.1.4 Other Pathways

The Pantex Plant has considered doses which might arise from radioactive materials ingested with food from terrestrial crops, animal products, and aquatic food products (including plant as well as animal species). The results of the faunal monitoring measurements[21] and monitoring of native vegetation and crops[22] did not indicate releases to either pathway from Pantex activities during 2013.

As will be discussed in more detail below, the current program concerning the release of property containing residual material has been designed to ensure that such releases are "as low as reasonably achievable" (ALARA). Public doses from this pathway are negligible.

4.3.1.5 Public Doses from All Pathways

The dose equivalent received by the maximally exposed individual during 2013, the 2013 collective population dose, and the 2013 natural background population dose are tabulated in Table 4.2. Because there were no releases from Pantex Plant to the water pathway or any other pathway, the indicated dose is representative of all pathways; including the air pathway.

TABLE 4.2 — *Pantex Radiological Doses in* 2013

Dose to Maximally Exposed Individual from Pantex Operations (mrem) (mSv)	Percent of DOE 100-mrem Limit	Estimated Population Dose from Pantex Operations (person-rem)(person-Sv)		Population within 80 km (50 miles)	Estimated Background Radiation Population Dose at Pantex Plant (person-rem)
7.00×10^{-7} (7.00×10^{-9})	7.00×10^{-7}	8.05×10^{-6}	8.05×10^{-8}	296,000	29,600

4.3.2 Protection of Biota

While DOE Order 458.1 contains no specific limits for radiation doses to aquatic animals, terrestrial plants, and terrestrial animals, it requires the use of DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOEa) or equivalent methodologies, to demonstrate that radiological activities are conducted in a manner that protects these populations from adverse effects due to radiation and radioactive material released from DOE operations. This requirement

[20] The current average annual concentration of tritium tabulated in 40 CFR 141.66 which is assumed to produce the same four mrem dose equivalent is 20,000 pCi/L (or 2.0×10^{-5} μCi/mL) equal to one percent of the ingested water DCS for tritiated water listed in DOE-STD-1196-2011[DOEk].

[21] See Chapter 11

[22] See Chapter 12

has the effect of limiting the dose to 1 rad/day (10 mGy/day) for aquatic animals and terrestrial plants and to 0.1 rad/day (1 mGy/day) for terrestrial animals[23].

During 2013, due to ongoing drought conditions, there was limited precipitation at the several Playa locations where samples were taken in previous years for the collection of surface water and/or sediment samples. In 2013, Pantex was able to collect a single water sample analyzed for ^{3}H, ^{234}U, ^{238}U, and $^{239/240}$Pu. To implement the aforementioned standard, the radionuclide concentrations obtained were entered into the calculation tool (RAD-BCG) provided by the DOE with the standard and compared to biota concentration guide (BCG) limits for aquatic and terrestrial systems in the technical standard. Estimated concentrations of the indicated radionuclides in the sediment were obtained by multiplying the measured aqueous concentrations by isotope-specific solid/solution distribution coefficients tabulated for the measured radionuclides in the standard. The value for each radionuclide was automatically divided by the BCG for that radionuclide to calculate a partial fraction for each nuclide for each medium. Partial fractions for each medium were added to produce a sum of fractions.

The dose limit for aquatic animals would not be exceeded if the sum of fractions for the water medium plus that for the sediment medium is less than 1.0. Similarly, the dose limits for both terrestrial plants and animals would not be exceeded if the sum of fractions for the water medium plus that for the soil medium is less than 1.0. The maximum site concentrations for each medium, applicable BCGs, partial fractions, and sums of fractions are illustrated in Tables 4.3a and 4.3b. As the sum of fractions for the aquatic system and the terrestrial system are 5.16 x 10-3 and 2.88 x 10-6 respectively, applicable BCGs were met for both evaluations. It can, therefore, be concluded that populations of aquatic and terrestrial biota on and near the Pantex site are not being exposed to doses in excess of the existing DOE dose limits.

TABLE 4.3a — *Evaluation of Dose to Aquatic Biota in 2013*

Nuclide	Water Concentration (pCi/L)	BCG (Water) (pCi/L)	Partial Fraction (Water)	Sediment Concentration (pCi/g)[a]	BCG (Sediment) (pCi/g)	Partial Fraction (Sediment)	Sum of Fractions (Water & Sediment)
Hydrogen-3	43.90	2.65E+08	1.66E-07	4.39E-05	3.74 E+05	1.17E-10	1.66E-07
Uranium-234	0.61	2.02E+02	3.02E-03	3.05E-02	5.27 E+03	5.79E-06	3.03E-03
Uranium-238	0.46	2.23E+02	2.06E-03	2.30E-02	2.49 E+03	9.24E-06	2.07E-03
Plutonium-239	0.01	1.87E+02	5.36E-05	2.00E-02	5.86 E+03	3.41E-06	5.70E-05
Sum of Fractions			5.14E-03			1.84E-05	5.16E-03

[a] In both Tables 4.3a and 4.3b, the sediment/soil concentration values are estimated and are the product of an isotope–specific solid/solution distribution coefficient and the concentration of the isotope in the water sample.

[23] These dose limits have been developed and/or discussed by the NCRP (in *Effects of Ionizing Radiation on Aquatic Organisms*, Report No. 109 [NCRPb]) and the International Atomic Energy Agency (IAEA) (in *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standard*, Technical Report Series No. 332) (IAEAa).

TABLE 4.3b — *Evaluation of Dose to Terrestrial Biota in 2013*

Nuclide	Water Concentration (pCi/L)	BCG (Water) (pCi/L)	Partial Fraction (Water)	Soil Concentration (pCi/g)[a]	BCG (Soil) (pCi/g)	Partial Fraction (Soil)	Sum of Fractions (Water & Soil)
Hydrogen-3	43.90	2.31 E+08	1.90E-07		1.71 E+05		1.90E-07
Uranium-234	0.61	4.04 E+05	1.51E-06		5.13 E+03		1.51E-06
Uranium-238	0.46	4.06E+05	1.13E-06		1.58 E+03		1.13E-06
Plutonium-239	0.01	2.00 E+05	4.99E-08		6.12 E+03		4.99E-08
Sum of Fractions							2.88E-06

4.3.3 Dose Comparisons

The calculated doses to the public and to the environment from Plant operations discussed above are minute when compared to those from naturally occurring sources and those from other man-made sources such as medical treatments and consumer products (TV, smoke detectors, etc.)[24]. The estimated total average annual effective dose equivalent to any individual member of the U.S. population from ubiquitous[25] background (formerly known as natural background) sources is 3.11 mSv[26] (311 mrem) (NCRPd). A comparison of the dose rates from several sources is illustrated in Figure 4.1. The Pantex doses are several orders of magnitude smaller than the smallest doses illustrated.

4.4 Release of Property Containing Residual Radioactive Material

DOE Order 458.1 provides requirements for the release of potentially contaminated materials from the Pantex Plant to the public. The order distinguishes real property (land and structures) from personal or non-real property (any materials not land and structures) in its discussion of such releases. To implement the requirements of the Order, DOE requires that the property that has been or is suspected of being contaminated with radioactive material be adequately surveyed (radiologically characterized) to ensure that the property meets pre-approved DOE Authorized Limits prior to release to the public. In indicating the methodology by which such Authorized Limits may be approved, DOE Order 458.1 specifically indicates that previously approved guidelines and limits (such as those developed for compliance with DOE Order 5400.5) may continue to be applied and used as Pre-Approved Authorized Limits until they are replaced or revised by Pre-Approved Authorized Limits issued under the new Order. The release of materials and equipment from radiological areas to controlled areas within the Plant as well as the release of the property from the controlled area to the public is controlled with the consistent and appropriate application of one set of release criteria based upon the surface activity guidelines established in DOE Order 5400.5. Table 4.4 indicates the DOE 5400.5 and; therefore, the Pantex release limits.

[24] A detailed report on exposures from these and other types of radiation sources can be found in NCRP Report No. 160 "Ionizing Radiation Exposure of the Population of the United States" (NCRPd).

[25] The external components of ubiquitous radiation include radiation from space incident on the earth's atmosphere and radiation from radionuclides in the environment (primarily the earth).

[26] This includes approximately 0.33 mSv (33 mrem) from external radiation from space (primarily cosmic-rays that strike the upper atmosphere); 0.21mSv (21mrem) from external terrestrial radiation sources; 0.29mSv (29mrem) resulting from the ingestion of radionuclides into the body; and 2.28mSv (228mrem) from inhalation of radionuclides (such as radon) into the body.

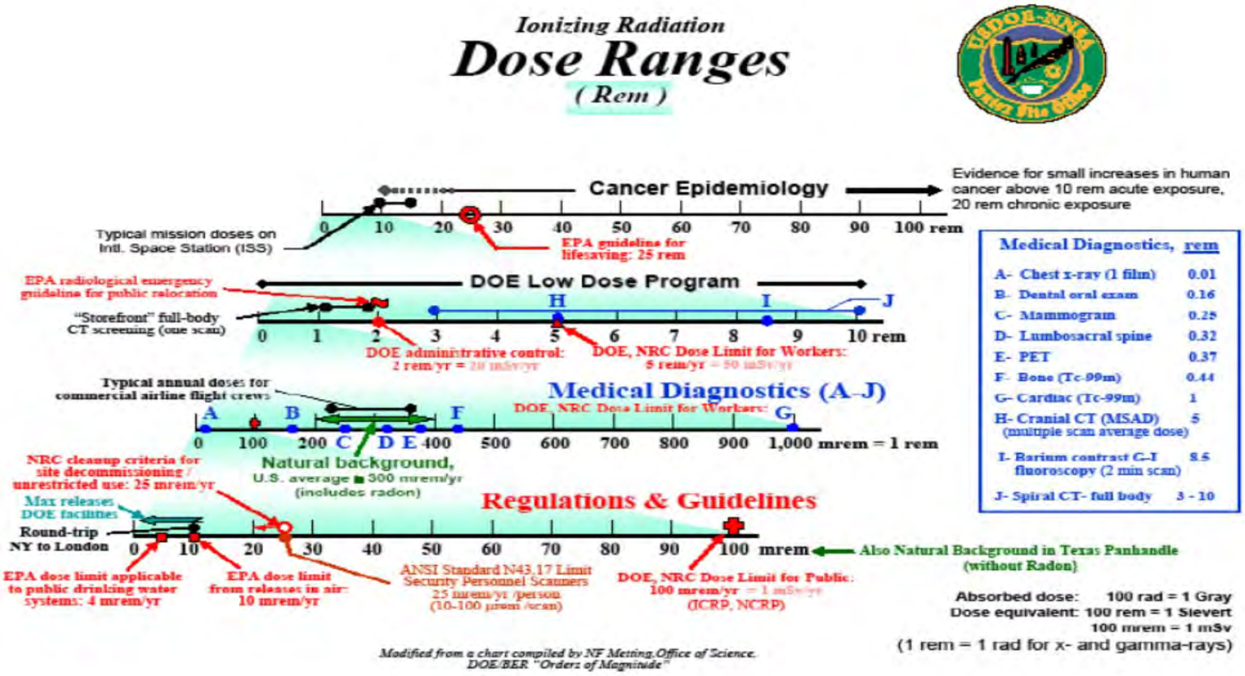

FIGURE 4.1 – *Comparison of Ionizing Radiation Dose Ranges*

TABLE 4.4 — *Surface Activity Limits -Allowable Total Residual Surface Activity (dpm/100 cm^2)*

Radionuclides	Average	Maximum	Removable
Group 1 - Transuranics, I-125, I-129, Ac-227, Ra-226, Ra-228, Th-228, Th-230, Pa-231	100	300	20
Group 2 - Th-natural, Sr-90, I-126, I-131, I-133, Ra-223, Ra-224, U-232, Th-232	1,000	15,000	200
Group 3 - U-natural, U-235, U-238 and associated decay products, alpha emitters	5,000	15,000	1,000
Group 4 - Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000	15,000	1,000
Tritium (applicable to surface and subsurface)	NA	NA	10,000

Since 1993 the Pantex Plant's release process, as stated in the *Pantex Radiological Control Manual* (PRCM) (PANTEXk), requires the Radiation Safety Department's (RSD's) evaluation of any materials exiting a radiological area to ensure criteria for unrestricted release. To release material from Pantex Plant in general requires:

- RSD approval for material that is to be excessed;
- PX-4008, "Waste Operations Department Scrap Metal Disposition Form," for disposition of any scrap metal (in compliance with Secretary Richardson's moratorium on recycling certain metals);
- PX-2643, "Material Evaluation Form," for release of all waste;
- PX-691, "Shipment Request," for release of outbound non-weapon shipments; and/or
- PX-2189, "Radiation Safety Material Clearance," for components and other items not covered by one of the preceding methods.

Following these processes resulted in no releases of personal property with surface contamination in excess of the indicated levels.

DOE Order 458.1 also requires that independent verification be performed by personnel independent of contractor personnel conducting property clearance activities. At Pantex, a Waste Characterization Official (WCO) who is independent from organizations producing, accumulating, transporting, or performing radiological characterizations and/or surveys of weapons components and certain categories of mixed low-level waste destined for burial at the Nevada National Security Site, performs the independent verification.

The volume of radiological waste generated at Pantex during 2013 is discussed in Chapter 2. As there were no releases of real property containing residual radioactive material during 2013, those values represent the quantities of property released from the Pantex Plant in 2013.

4.5 Unplanned Releases

No unplanned releases of radioactive material occurred at Pantex Plant during 2013.

4.6 Environmental Radiological Monitoring

4.6.1 Environmental Dosimetry

The environmental dosimetry program uses thermoluminescent dosimeters (TLDs) to measure gamma radiation on and around Pantex Plant. This program has been conducted at several locations in parallel with monitoring conducted by the Texas Department of State Health Services (TDSHS) since the early 1980s. Figure 4.2 shows the locations of the Plant's dosimeters during 2013.

During 2013, Pantex Plant and TDSHS co-sampled at nine locations: one on-site, seven along the perimeter fence, and one off-site. The Plant also monitored independently at four other locations on-site and four off-site or perimeter locations while TDSHS monitored independently at four other off-site or perimeter locations. Pantex Plant's TLDs are generally placed at the same locations where Pantex Plant operates air monitors, as discussed further in Chapter 5. Pantex Plant's TLDs are analyzed and replaced at the end of each calendar quarter. The data provide the cumulative radiation exposure at each location over approximately 90 days of uninterrupted deployment they receive while exposed to the environment at the various locations.

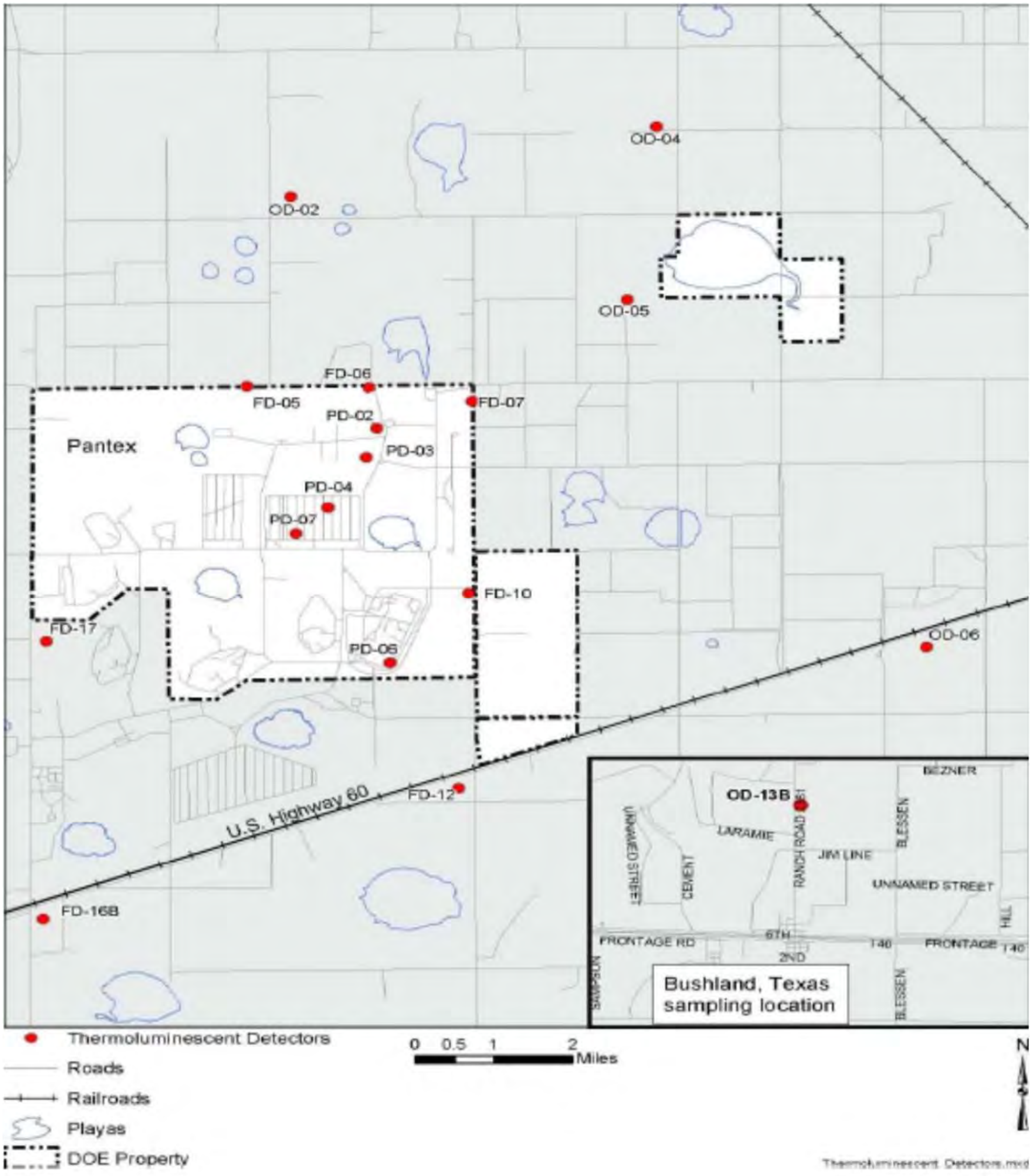

FIGURE 4.2 - ***Locations of Pantex Plant Thermoluminescent Dosimeters***

Table 4.5 lists results for 2013 and reflects the dose that an individual would have received at the TLD location if the person were present continuously for a full quarter. The average quarterly dose for all on-site locations during 2013 was approximately 19.9 mrem. The equivalent average annual dose is 79.5 mrem/year (0.80 mSv/year). The average quarterly dose at the TLD monitoring locations which are located in the direction of the predominant wind direction at the Pantex Plant was 21.0 mrem (equivalent to 84.0 mrem/year or 0.84 mSv/year), while the quarterly dose at upwind locations averaged 21.0 mrem (equivalent to 83.8 mrem/yr or 0.84 mSv/year). The average of quarterly measurements at no location exceeded the quarterly average dose of 23.0 mrem (equivalent to 92.0 mrem/year or 0.92 mSv/year) measured at the background or control location at Bushland, Texas, for the same period. All of the measured doses are similar to those obtained during previous years, and the equivalent average annual doses are of the same magnitude as the sum of the external components of ubiquitous background.[27]

TABLE 4.5 — *Environmental Doses Measured by Thermoluminescent Dosimeters in 2013 in millirem*[28]

Location	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Avg. Qtr
On-site					
PD-02	17.0	19.0	20.0	20.0	19.0
PD-03	18.0	17.0	17.0	20.0	18.0
PD-04	20.0	22.0	22.0	N/S[b]	21.3
PD-06 [a]	22.0	20.0	22.0	24.0	22.0
PD-07	19.0	18.0	19.0	20.0	19.0
"Upwind"					
FD-02	19.0	19.0	19.0	22.0	19.8
FD-12 [a]	20.0	22.0	22.0	24.0	22.0
FD-16B [a]	19.0	19.0	19.0	22.0	19.8
FD-17[a]	20.0	22.0	23.0	24.0	22.2
OD-06	19.0	22.0	20.0	23.0	21.0
"Downwind"					
FD-06 [a]	24.0	22.0	22.0	23.0	22.8
FD-07 [a]	20.0	20.0	20.0	20.0	20.0
OD-02	19.0	20.0	20.0	22.0	20.2
OD-04 [a]	19.0	20.0	22.0	23.0	21.0
OD-05	20.0	20.0	N/S[b]	23.0	21.0
Control					
OD-13B	22.0	22.0	23.0	25.0	23.0
Blank Correction	2.0	2.0	2.0	2.0	

[a] Locations co-sampled with TDSHS.
[b] Dosimeter was damaged during the exposure period.

[27] Although on the average, these sources are of approximately equal magnitude, soil concentrations of the principal sources of terrestrial radiation are variable (NCRPb). Accordingly, due to slightly higher soil concentrations of these sources, the indicated sum in the Texas Panhandle is slightly higher than the national average and is approximately 1 mSv/yr (100 mrem/yr).
[28] All measurements have been "blank corrected." This is accomplished by measuring the residual doses on dosimeters which have been stored in a location where they receive no exposure during the same period as those dosimeters which have been deployed at the indicated locations. The residual dose (the blank correction for each quarter) which was subtracted from the raw data of the deployed dosimeters is indicated in the table.

4.7 Conclusions

None of the doses measured is distinguishable from the external components of ubiquitous background radiation levels during the past five years in the Texas Panhandle (about 100 mrem). The environmental radiological monitoring program at Pantex Plant continues to provide information that supports the hypothesis that current Plant operations do not have a detrimental effect on the quality of the environment at or near the Pantex. Pantex Plant's monitoring results for the environmental radiological pathways in 2013 indicated levels below relevant standards, similar to results from previous years and consistent with background conditions.

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All radiological air monitoring indicated results were not distinguishable from background.

5.1 The Scope of the Program

Monitoring and sampling to detect possible airborne emissions of radiological material or hazardous pollutants at Pantex Plant is conducted at on-site and off-site locations as a part of an environmental surveillance program. The monitoring program at Pantex Plant has been described in several documents (e.g., the *Environmental Information Document* [PANTEXc]). Some Pantex Plant operations are sources or potential sources of airborne emissions. Monitoring of ambient air[29] for releases of airborne emissions from Pantex Plant facilities has historically been done at fixed remote locations, primarily because of the lack of discrete release points at the facilities.

During current operations at Pantex Plant, various radioactive materials including tritium, plutonium, uranium, and miscellaneous sources (e.g., thorium, cobalt and cesium) may be present in the components of nuclear weapons being managed. However, in normal operating situations, the nature of the work at Pantex Plant and the physical form of the material are such that there is very little potential for the public, the environment, or Pantex Plant personnel to be affected by releases of radioactive materials as a result of Plant operations. As shown in Table 4.1, most of the small numbers of radionuclide releases during normal operations at Pantex Plant are tritium releases. Very small amounts of tritium escape as gas or vapor during normal operations, although some tritium vapor continues to be released into the atmosphere from the area of the accidental release that occurred in 1989. This incident is described in the *Environmental Information Document* (PANTEXc).

5.2 Routine Radiological Air Monitoring

5.2.1 Collection of Samples

During 2013 air monitors were operated according to the schedule shown in Table 5.1, wherein several monitors were operated continuously (the four on-site locations as well as the control location), others operated less frequently, and a few were not operated at all during the year. See Figures 5.1 and 5.2 for the location of all air monitoring stations.

A total of 17 air monitoring stations were used to monitor for radionuclides in the air in 2013. Four on-site monitoring stations designated as PA-AR-XX (for Plant air) in the tables and as PA on the figures, are placed near the several operating areas where radiological material is used and/or stored. Stations PA-AR-03 and PA-AR-04 are located near the firing sites where testing and sanitization of nuclear weapons components contaminated with tritium are conducted. Station PA-AR-04 is adjacent to the north fence of Zone 4 East. Since the predominant wind direction is from the south-southwest, this station is also used to monitor ambient air near the shipping and receiving operations conducted in Zone 4. Station PA-AR-06 is located near an area where operations involving the disassembly of nuclear weapons, the calibration of portable radiation detection instruments, and the packaging of radiological waste occur. Station PA-AR-07 is located near areas where shipping and receiving operations are conducted in Zone 4.

The 17 available fence line radiological monitoring stations designated as FL-AR-XX (for Fence line), are located along the Plant perimeter (as it existed prior to the purchase of property east of FM 2373 in the latter part of 2008) in the principal compass directions and in directions where residences are located.

[29] Ambient air monitoring refers to the monitoring of air at remote locations where it is assumed that the material (either radioactive material or hazardous pollutants) being measured and compared to some risk-based standard is well mixed in the atmosphere and that any concentration present represents what might be inhaled by an individual.

TABLE 5.1 — 2013 *Schedule for Air Sampling and Analysis*

Location	Month										
	1	2	3	4	5	6	7	8	9	10	11	12
On-site												
PA-AR-03	X	X	X	X	X	X	X	X	X	X	X	X
PA-AR-04	X	X	X	X	X	X	X	X	X	X	X	X
PA-AR-05	X	X	X	X	X	X	X	X	X	X	X	X
PA-AR-06	X	X	X	X	X	X	X	X	X	X	X	X
Fence line												
FL-AR-01												
FL-AR-02	X			X			X			X		
FL-AR-03	X			X		X			X			X
FL-AR-04		X			X		X			X	X	
FL-AR-05												
FL-AR-06			X			X	X		X		X	X
FL-AR-07												
FL-AR-08												
FL-AR-09		X			X			X			X	
FL-AR-10												
FL-AR-11			X			X			X			X
FL-AR-12B[a]							X					
FL-AR-13	X			X						X		
FL-AR-14		X			X							
FL-AR-15			X			X			X			X
FL-AR-16	X			X			X			X		
FL-AR-17												
Off-site												
OA-AR-02	X			X		X		X		X		X
OA-AR-04												
OA-AR-05		X	X		X			X	X		X	X
OA-AR-06												
Control												
OA-AR-13B	X	X	X	X	X	X	X	X	X	X	X	X

The concerns of the Texas Department of State Health Services and other stakeholders were considered in establishing the locations. The fence line samplers at the southern end of the Plant are located south of U.S. Highway 60. These locations were chosen for convenient access, to avoid the collection of dust generated by activities on the railroad (which is located adjacent to the southern boundary of the Plant), and to better represent air quality near actual residences. Ten of these stations were operated at various times during 2013.

Five off-site air monitoring stations designated as OA-AR-XX surround Pantex Plant (Figure 5.2). Stations OA-AR-02, OA-AR-04, OA-AR-05, and OA-AR-06 are about 8 kilometers (5 miles) from the center of Pantex Plant. The fifth off-site station, designated as OA-AR-13B, is a control station and is located upwind at Bushland, Texas. Three of the five off-site stations (including the control station) were used in monitoring activities in 2013.

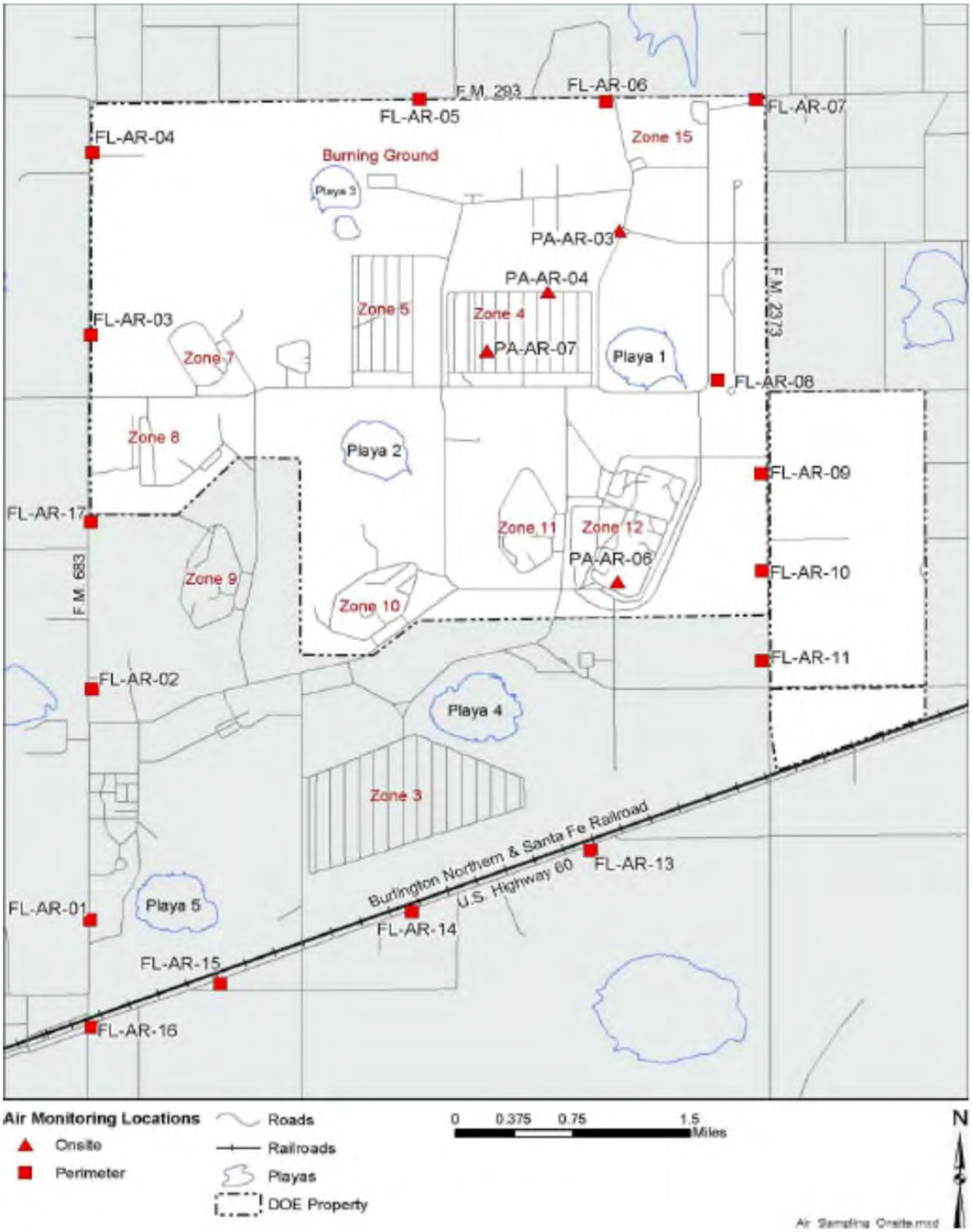

FIGURE 5.1 — ***Locations of On-site and Fence Line Air Monitoring Stations***

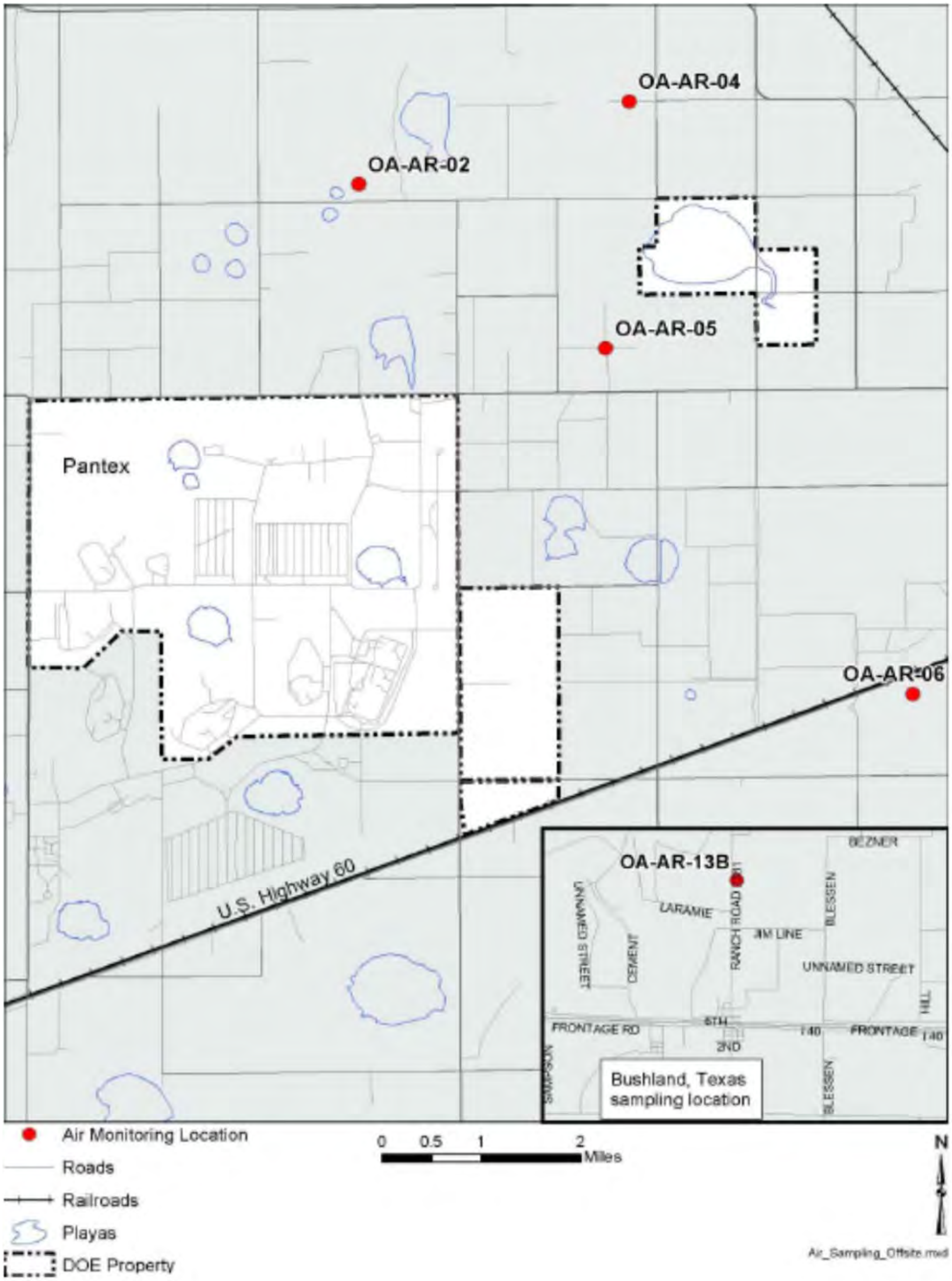

FIGURE 5.2 — *Off-site Air Sampling Stations*

The air monitoring schedule shown in Table 5.1 was designed to reduce costs associated with environmental monitoring while still ensuring that any hypothetical releases of radiological material to the atmosphere from Pantex Plant operations could still be adequately characterized[30]. Several fence line monitoring stations (those designated as FL-AR-03, -04, and -06 in addition to those designated as OA-AR-02, and -05) are located in the downwind direction of the predominant wind at the Pantex Plant (the expected direction in which hypothetical releases of radiological material from Pantex would be expected to travel) and were operated more frequently than those located opposite the predominant wind direction (i.e., those located upwind from the Pantex Plant). Monitoring stations designated as FL-AR-02, -09, -11, -13, -14, and-16 are included in the latter category.

Each monitoring station was equipped with a high-volume air sampler and a low-volume air sampler (Figure 5.3). At far-left in this figure is a container for the co-located thermoluminescent dosimeters (TLD) discussed in Chapter 4. The high-volume sampler is located on the left and a "doghouse" containing the low-volume sampler is on the right. The samplers (when operated) ran continuously, and filters or silica gel samples were collected from the samplers on a weekly basis. Operational characteristics of the samplers, such as the length of the sample collection period (known as the "run time"), the beginning and ending flow rates, and other parameters were recorded by the sampling technicians at the initiation and/or at the completion of the sampling activity.

FIGURE 5.3 – *Typical Air Monitoring Site*

The high-volume samplers operated at a flow rate of approximately 1.13 cubic meters per minute (40 ft^3 per minute [ft^3/min or more commonly cfm]). During sampling, particles were collected on 20 × 25-centimeter (8 × 10-inch) filters. Each air filter sample included particulate matter from about 11,400 cubic meters of air (~ 403,000 ft^3). Weekly samples for a given month were combined as one sample for later analysis for ^{234}U, ^{238}U, and ^{239}Pu by a radiological analysis laboratory.

Nominal airflow through the low-volume air samplers was much smaller than that for the high-volume samplers, being 42.5 liters per minute (1.5 $ft.^3$/min). Each low-volume sampler contained silica gel within the "U-tube" illustrated in Figure 5.4. The silica gel acted as a desiccant, removing water vapor from air as it flowed through the sampler. The silica gel samples were collected at the same time as the individual

[30] This schedule is modified annually in a manner to ensure that each location other than the four on-site locations and the control location, is scheduled for sample collection at least once every three years.

filters were collected from the high-volume samplers. Any tritiated water vapor present in the sampled air was recovered and quantified during analysis of the silica gel by a radiological analysis laboratory.

FIGURE 5.4 – *Low-Volume Sampling Apparatus*

5.2.2 Sample Analysis Results

All analytical results obtained from the laboratory were converted to concentrations in air by dividing the quantity of radionuclide collected in the sample by the volume of air sampled. This quantity was calculated using the operational characteristics recorded and (when necessary) temperature, pressure, and relative humidity data obtained from the meteorological tower described in Chapter 1.

Table 5.2 summarizes values for the several analytes in four categories of monitoring stations (on-site, upwind, downwind, and control [or background]). The values indicated are: the mean and the standard deviation; the maximum value and its associated counting error; the historical background[31] and the Derived Concentration Standard (DCS)[32] for comparison. Pantex collected and analyzed approximately 96 percent of the planned samples at the on-site, upwind, and Bushland control locations and 84 percent at downwind locations. Intermittent power losses or motor failures, and laboratory errors and/or quality problems (See Chapter 13) resulted in less than 100 percent sample analysis.

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[31] This parameter is the upper confidence limit (UCL) for a population consisting of all data for the specified radionuclide from the control location during the period from 2008-2012. UCL = x-bar + sK, where x-bar is the mean of the population, s is the standard deviation and K is a statistical parameter (approximately equal to 3) tabulated for specific numbers of samples, and the percent confidence that a user of the data is willing to accept (usually 95 percent) for statistical conclusions drawn from the data. When used to compare non-control results to the "historical background", a user will have 95 percent confidence that any single analysis result from a non-control location which is greater than the derived value is "different than background".

[32] DOE-STD-1196-2011 (DOEk) lists several values of DCS for air inhalation for each radionuclide based upon the chemical form or the absorption class of the isotope. Since information concerning the chemical form is not available, the most restrictive (i.e. smallest in magnitude) of the several values is used in accordance with guidance in the technical standard.

TABLE 5.2 —*Concentrations of Radionuclides in Air[a] for 2013 at (a) On-site Locations; (b) Upwind Locations; (c) Downwind Locations; and (d) Background Location*

a.

Radionuclide	Number of Samples Analyzed/Planned	Mean ±Std. Dev.	Max ± Counting Error	Historical Background	DCS
^{3}H	186/196	6.74 ± 23.12	211.20 ± 00.01	13.49	140,000
$^{233/234}U$	42/48	11.69 ± 4.95	24.59 ± 5.31	85.21	400,000
^{238}U	42/48	10.23 ± 4.74	26.46 ± 5.80	89.72	470,000
$^{239/240}Pu$	42/48	0.35± 0.45	0.83 ± 0.98	1.03	34,000

b.

Radionuclide	Number of Samples Analyzed/Planned	Mean ±Std. Dev.	Max ±Counting Error	Historical Background	DCS
^{3}H	117/122	1.47 ± 3.99	11.69 ± 8.33	13.49	140,000
$^{233/234}U$	34/36	14.33 ± 5.45	30.71 ± 5.44	85.21	400,000
^{238}U	34/36	12.82 ± 5.16	26.33 ±5.01	89.72	470,000
$^{239/240}Pu$	34/36	0.16 ± 0.63	0.66 ± 0.81	1.03	34,000

c.

Radionuclide	Number of Samples Collected/Planned	Mean ±Std. Dev.	Max ±Counting Error	Historical Background	DCS
^{3}H	144/172	1.02 ± 4.38	8.49 ± 8.08	13.49	140,000
$^{233/234}U$	29/36	13.13 ± 5.43	22.61 ± 4.00	85.21	400,000
^{238}U	29/36	29.71 ± 9.65	22.23 ± 3.98	89.72	470,000
$^{239/240}Pu$	29/36	0.21 ± 0.35	0.71 ± 1.39	1.03	34,000

d.

Radionuclide	Number of Samples Collected/Planned	Mean ±Std. Dev.	Max ±Counting Error	Historical Background	DCS
^{3}H	48/49	0.93 ± 4.95	13.45 ± 9.99	13.49	140,000
$^{233/234}U$	12/12	16.78 ± 5.02	22.45 ± 4.76	85.21	400,000
^{238}U	12/12	15.29 ± 4.55	33.21 ± 6.08	89.72	470,000
$^{239/240}Pu$	12/12	0.14 ± 0.24	0.72 ± 0.97	1.03	34,000

[a] Units in all tables are x 10^{-13} :Ci/mL for ^{3}H measurements and x 10^{-18} :Ci/mL for α-emitting radionuclides ($^{233/234}U$, ^{238}U, and $^{239/240}Pu$).

As in previous years, relatively high values of tritium at PA-AR-06 during 2013 occurred during periods of rapid changes in barometric pressure with the highest value (21.12 ± 0.01 pCi/mL) recorded on November 1, 2013. These measurements likely result from continued off-gassing from soils near Cell 1 (the location of the unplanned release of tritium which occurred in 1989) during these pressure fluctuations or from calibration or dismantlement activities in the vicinity of the monitor. The measurements, however, are much less than those measured during the first few years after the 1989 release.

5.2.3 Data Interpretation

The maximum measurements for the α-emitting radionuclides ($^{233/234}$U, ^{238}U, and $^{239/240}$Pu) during the year occurred during late spring and early summer. Because of the low levels of precipitation during these months and into August, and the high winds in the Texas Panhandle, increased re-suspension of dust into the atmosphere was occurring. Because the relative maxima were observed to be occurring both upwind and downwind from Pantex Plant, it is likely that many of the maximum measurements represent the collection of increased quantities of naturally occurring radioactive material during these periods.

A review of the ratio of the mean values of the concentrations of $^{233/234}$U and ^{238}U in each of the four categories of locations shows good correlations between the calculated means. The fact that the ratio of the activities of ^{234}U and ^{238}U is not much different from unity indicates radiological equilibrium between the two radionuclides and is another indication of the absence of any anthropogenic discharges of uranium during Pantex operations.

Figure 5.5a provides a graphical comparison of the tritium sampling data expressed as a percentage of the most restrictive tritium DCS (1.40E-08 µCi/mL) for the several categories of monitoring stations (on-site [PA], upwind [Up], downwind [Down], and control [or background {Bkgd}]). Figures 5.5b-d provides similar comparisons for the $^{233/234}$U, ^{238}U and $^{239/240}$Pu data respectively[33]. Inspection of the comparisons indicates that all results are generally equivalent (i.e., results from areas affected by Pantex operations are not distinguishable from background) and that no radiological concentrations in ambient air during 2013 exceeded the applicable DCS for the radiological materials analyzed.

5.3 Conclusions

Results indicate that the air monitoring program at Pantex Plant continues to provide information that supports the hypothesis that current Plant operations do not have a detrimental effect on the quality of the environment at or near Pantex Plant.

[33] In these several "boxplots" presenting the data, the 25th percentile (equal to that value greater than 25 percent of the data points after all data points have been sorted into numerical order) and the 75th percentile (equal to that value greater than 75 percent of the data points) are represented by the bottom and top of the "box" respectively. The line across the interior of the "box" is the mean value of the data points. The "tails" at the bottom and top represent data points between the lower limit of confidence and the 25th percentile and between the 75th percentile and the upper limit of confidence respectively, while any "asterisk" represents an "outlier" -- a data point which is less than the lower level of confidence or greater than the upper level of confidence and is not likely to be representative of the "population" sampled.

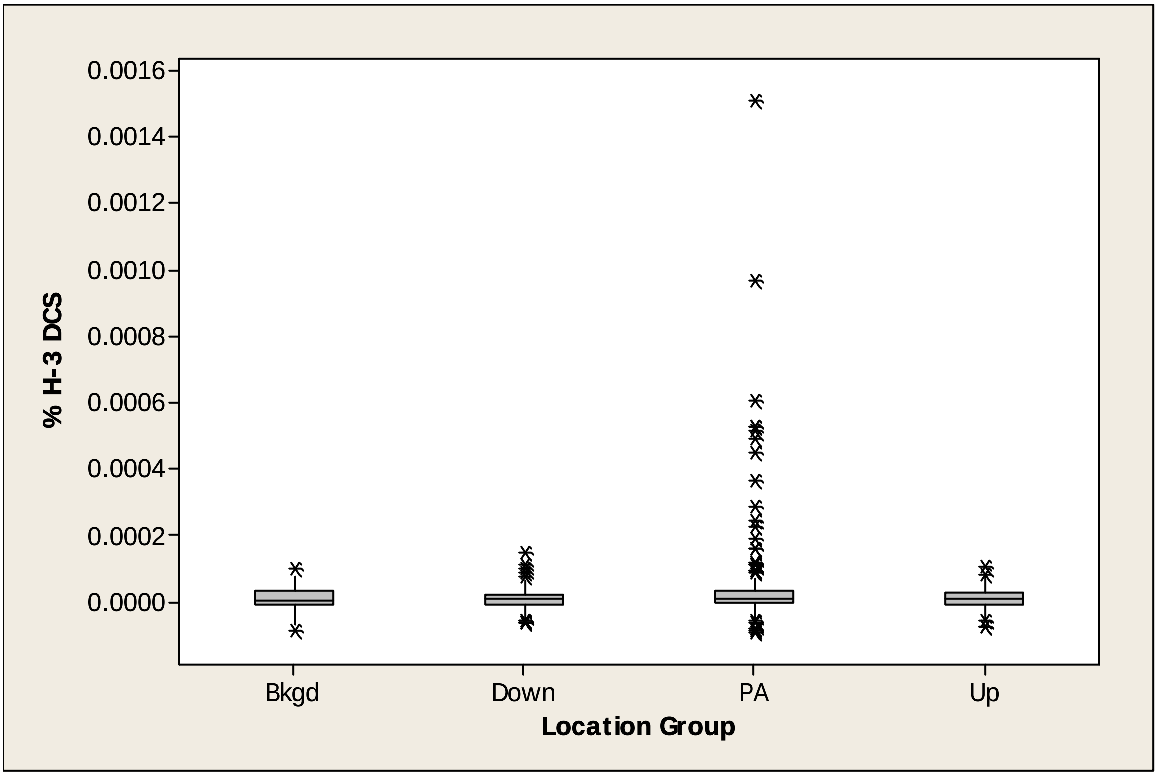


FIGURE 5.5a - ***Comparison of "Normalized" Tritium Data by Location***

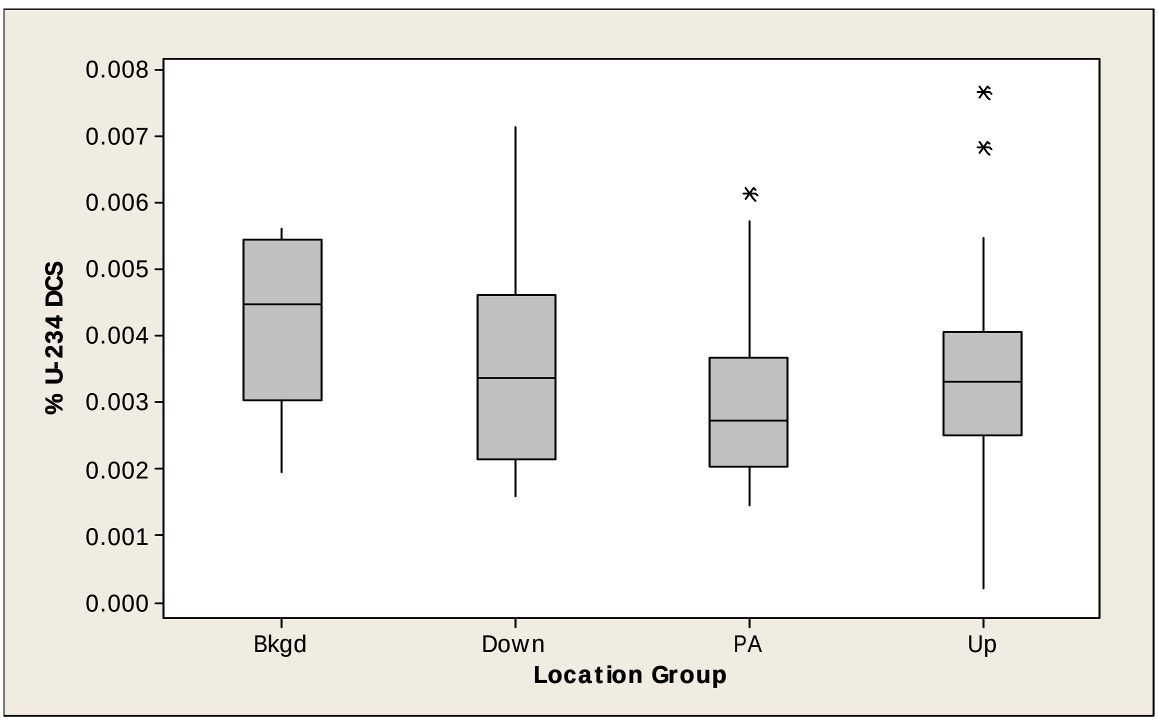


FIGURE 5.5b - ***Comparison of "Normalized"*** ^{234}***U Data by Location***

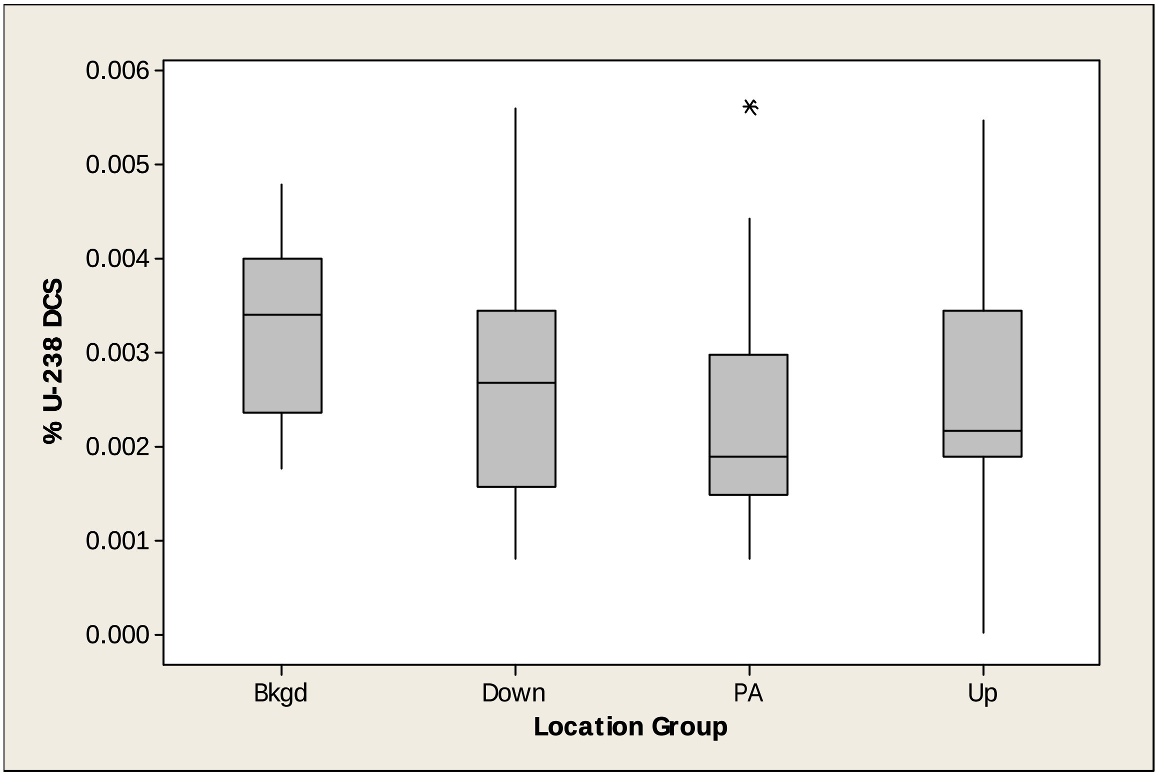


FIGURE 5.5c - ***Comparison of "Normalized" ^{238}U Data by Location***

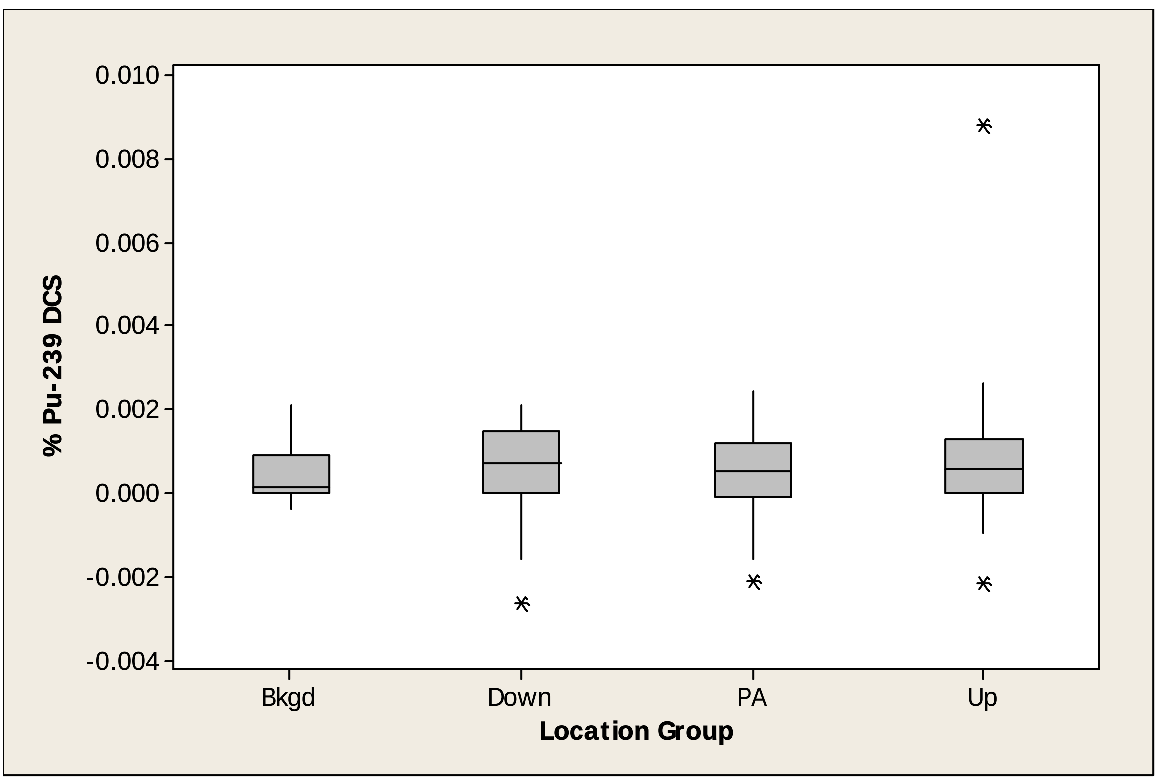


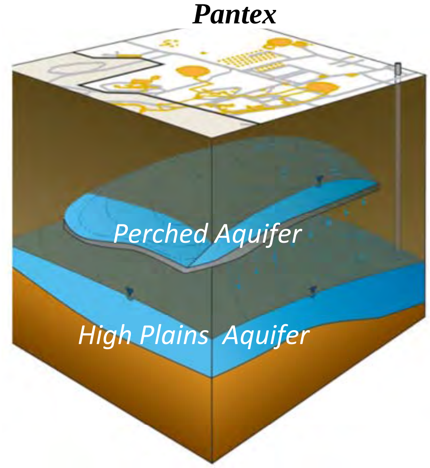
FIGURE 5.5d - ***Comparison of "Normalized" ^{239}Pu Data by Location***

Groundwater monitoring at Pantex Plant began in 1975, when the first investigative wells were installed. Pantex completed its investigations in 2005 with the identification of contaminant plumes in the perched groundwater beneath Pantex Plant, Texas Tech University (TTU) property (south of Pantex) and to the east of Pantex. Monitoring wells in the perched groundwater are being used to monitor two remedial actions: two pump and treat systems, with 71 operating extraction wells and three injection wells; and two in-situ bioremediation (ISB) systems one of which is located southeast of the Pantex Plant on TTU property and the other located south of Zone 11 consisting of 74 treatment zone wells. Groundwater data collected in 2013 demonstrated that current remedial actions continue to progress toward cleanup of perched groundwater contaminants.

6.1 Groundwater at Pantex

Groundwater beneath the Pantex Plant and vicinity occurs in the Ogallala and Dockum Formations at two intervals (Figure 6.1). The first water-bearing unit below the Pantex Plant in the Ogallala Formation is a discontinuous zone of perched groundwater located at approximately 200 to 300 feet below ground surface and 100 to 200 feet above the drinking water aquifer. A zone of fine-grained sediment (consisting of sand, silt, and clay) that created the perched groundwater is found between the perched groundwater and the underlying drinking water aquifer. The fine-grained zone acts as a significant barrier to downward migration of contaminated water. The perched groundwater ranges in saturated thickness from less than a foot at the margins to more than 75 feet beneath Playa 1. Perched groundwater is formed by surface water in the playas that initially migrates down to the fine-grained zone. It then flows outward in a radial manner away from the playa lakes and is then influenced by the regional south to southeast gradient. The largest area of perched groundwater beneath Pantex is associated with natural recharge from Playas 1, 2, and 4, treated wastewater discharge to Playa 1, historical releases to the ditches draining Zones 11 and 12, and storm water runoff that drains to the unlined ditches and playas. Two hydraulically separate, relatively small, perched zones occur around Playa 3 (near the Burning Ground in the north central portion of the Plant) and near the Old Sewage Treatment Plant in the northeast corner of Pantex.

Figure 6.1 - *Groundwater beneath Pantex*



The second water-bearing zone, the High Plains Aquifer (also known as and referred to herein as the Ogallala Aquifer), is located below the fine-grained zone in the Ogallala and Dockum Formations. The Ogallala Aquifer is a primary drinking and irrigation water source for most of the High Plains. The groundwater surface of the Ogallala Aquifer beneath the Plant is approximately 400-500 feet below ground surface with a saturated thickness of approximately one to 100 feet in the southern regions of the Plant and approximately 250 to 400 feet in the northern regions. In the vicinity of the Plant, the primary flow direction of the Ogallala Aquifer is north to northeast due to the influence of the City of Amarillo's well field located north of the Plant.

Historical operations at Pantex Plant resulted in contamination of the larger perched groundwater area, and the contaminant plume has migrated past the Plant boundaries and beneath the adjacent property to the south and east. Most of the impacted property to the east was purchased in 2008 to allow better access for monitoring and control of perched groundwater. The primary contaminants of concern (COCs) in the perched aquifer are the explosives RDX and TNT and related breakdown products, perchlorate, boron, hexavalent chromium, and trichloroethene (Figure 6.2). With the exception of one domestic well north of Pantex Plant, no public or private water supply wells are completed in the perched groundwater in the immediate vicinity of Pantex Plant. The domestic well north of the Plant is in an area that has not been impacted by historic operations. Perched groundwater is not used for industrial purposes at Pantex, although the treated perched groundwater is routed through the Wastewater Treatment Facility (WWTF) and is beneficially used for subsurface irrigation of crops.

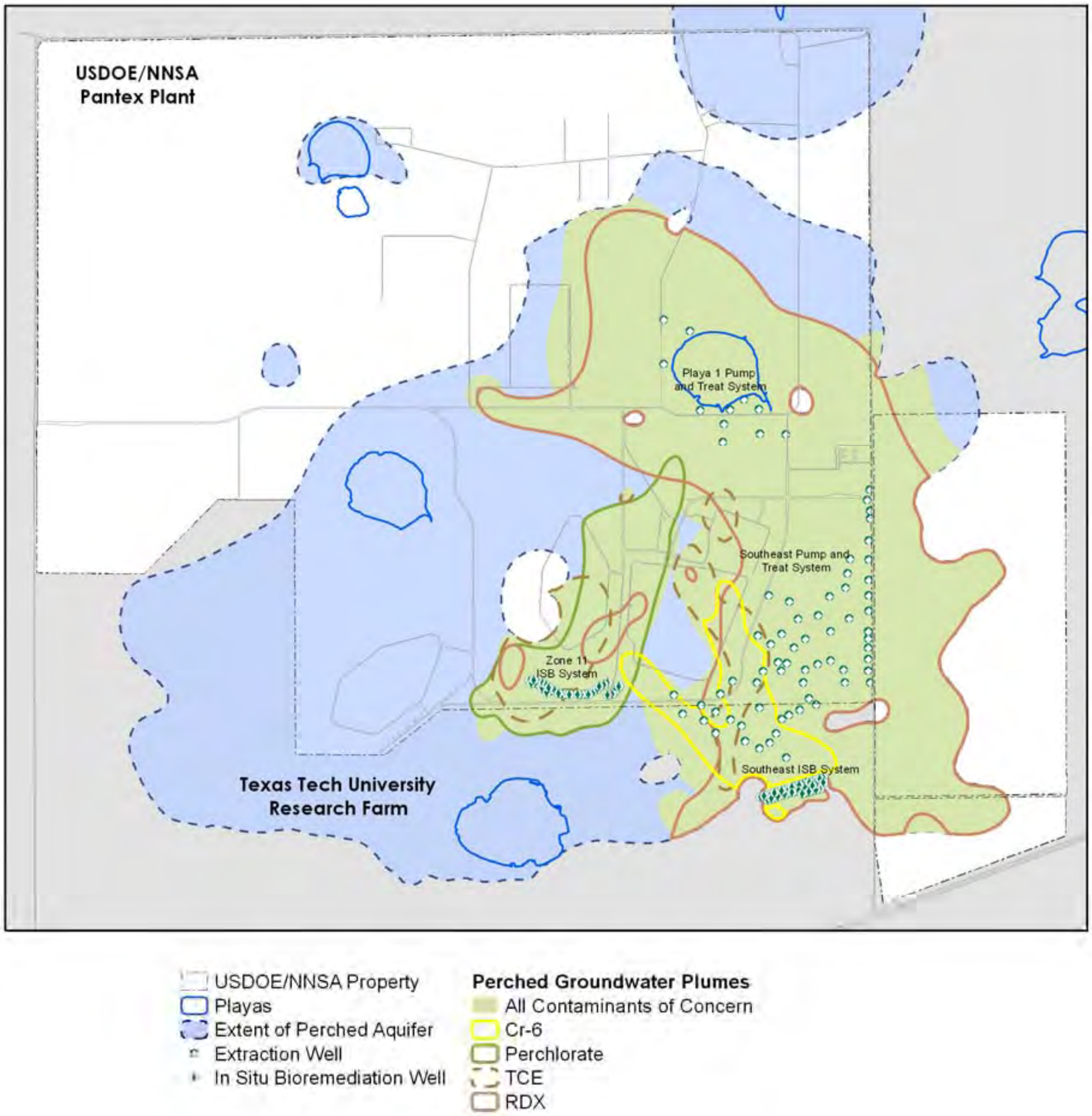


FIGURE 6.2 — *Perched Groundwater Plumes and Remediation Systems*

Because concentrations of contaminants in the perched groundwater beneath the Plant's property and off-site to the south and east currently exceed drinking water standards, the water is not safe for domestic or industrial use. On-site use of perched groundwater is restricted by Pantex Plant. TTU and one off-site property owner to the east have placed a deed restriction on their property to control use of perched groundwater and restrict drilling through the perched groundwater in areas that are impacted.

6.2 Long-Term Monitoring (LTM) Network

The purpose of the LTM network is to ensure that Remedial Action Objectives (RAOs) are being achieved. The RAOs and the corresponding LTM Network Monitoring Objectives are provided in the highlight box below.

Remedial Action Objectives	LTM Network Monitoring Objectives
❖ Reduce risk of exposure to perched groundwater through contact prevention ❖ Achieve cleanup standard for perched COCs ❖ Prevent growth of perched groundwater contaminant plumes ❖ Prevent COCs from exceeding cleanup standards in the drinking water aquifer	❖ Remedial action effectiveness ❖ Plume stability ❖ Uncertainty management ❖ Early detection ❖ Natural attenuation of COCs

To ensure that the RAOs are achieved, wells and monitoring information were chosen with respect to specific objectives developed for the LTM network. The objectives are applied to perched and drinking water aquifer wells, as appropriate. Pantex developed an *LTM System Design Report* (PANTEXh) and a *Sampling and Analysis Plan (SAP)* (PANTEXm) to detail the LTM network and monitoring. The network monitoring information is evaluated quarterly, annually, and on a 5-year basis, with evaluations increasing in detail and complexity for each type of report.

6.3 The Scope of the Groundwater Monitoring Program

Groundwater is monitored at Pantex Plant in accordance with requirements of the Texas Commission on Environmental Quality (TCEQ) Compliance Plan CP-50284 (TCEQ, 2010). Pantex is also subject to requirements in the Interagency Agreement (IAG), signed jointly by the U.S. Environmental Protection Agency (EPA) and TCEQ, and issued effective in 2008. The *LTM System Design Report* and a new *SAP*, approved by the EPA and TCEQ in July 2009, identified the final monitoring well network and the parameters to be monitored. A revised Field Sampling Plan (Part I of the SAP) was submitted in 2011 and approved in 2012, documenting slight changes to the monitoring network. As recommended in the first Five-Year Review, an update to the LTM System Design Report and revised SAP will be submitted to the TCEQ and EPA in 2014. Table 6.1 summarizes the number of wells sampled in 2013 by function that are currently used in monitoring of the remedial actions and the total number of analytes assessed.

TABLE 6.1 — *Summary of Well Monitoring in 2013*

Well Type	Drinking Water Aquifer		Perched Groundwater	
	# Wells	# Analytes Assessed	# Wells	# Analytes Assessed
Long-Term Monitoring Well	30	1,301	88	5,012
Parked Wells	1	--	65	--
Pump & Treat Extraction Well	--	--	70	1,155
In Situ Bioremediation Injection Well	--	--	19	1,877
Total	31	1,301	242	8,044

6.4 Remedial Action Effectiveness and Plume Stability

The purpose of the remedial action evaluation is to determine the effectiveness of remedial measures, indicate when remedial action objectives for perched groundwater have been achieved, and validate groundwater modeling results or provide data that can be used to refine modeling. The expected conditions for the remedial action effectiveness wells are that, over time, indicators of the reduction in volume, toxicity and mobility of constituents will be observed. These indicators include stable or decreasing concentrations of constituents or declining water levels in areas where pump and treat remedies have been implemented.

The purpose of plume stability wells is to determine if impacted areas (plumes) of perched groundwater are expanding and affecting uncontaminated perched groundwater and to monitor the changes occurring within the perched groundwater plumes. The expected conditions for the plume stability wells are that, over time, a reduction in the toxicity and mobility of constituents will be observed.

6.4.1 Pump and Treat Systems

The two pump and treat systems are designed to remove and treat perched groundwater, provide hydraulic control of plume movement away from Pantex, and reduce its saturated thickness to lessen the potential for impacted perched groundwater to migrate to the drinking water aquifer below it. The systems were designed to remove and treat perched groundwater and reuse the treated water for beneficial use. The Southeast Pump and Treat System (SEPTS) was originally designed for injection of the treated water back into the perched zone. However, this injection capability was used sparingly in 2013 at times when the WWTF and irrigation system could not accept treated effluent.

The pump and treat systems' operation and throughput were variable in 2013. The Playa 1 pump and treat system (P1PTS) met operational goals overall in 2013. System downtime was due to short plant shutdowns for maintenance, power losses, or other short-term issues. The longest shutdown was in July which was due to calcium carbonate fouling problems after a GAC change-out. System throughput was affected by operational time, which reduced flow to the WWTF, and operational issues with individual extraction wells. The SEPTS did not meet operational goals early in the year due to mechanical failures and freezing temperature effects on the irrigation system. System throughput was affected by operational time, as well as operational issues with individual extraction wells. However, the system met or exceeded operational goals in the spring, summer, and fall months.

During the long operational history of the SEPTS, much of the treated water has been injected back into the perched zone, as the system was not originally designed to meet the remedial goal of reducing saturated thickness in the perched aquifer. Pantex has focused on beneficial reuse of the water, to the extent possible, since the subsurface irrigation system operation began in May 2005. Despite some continued limited injection of treated water (approximately 2 percent injected in SEPTS injection wells in 2013), water levels are continuing to decline in the areas downgradient of the pump and treat systems, with declines exceeding 1 ft./yr. in many wells as depicted in Figure 6.3.

It is also important to note that, for the second consecutive year, all wells considered to be under the influence of a remedial action (near or downgradient from a pump and treat system) are exhibiting short-term decreasing water level trends. In addition, all wells located in Zone 11 and Zone 12, which were generally not considered to be under the influence of the pump and treat systems, are exhibiting decreasing trends in water levels. These observations indicate the systems are effective in reducing perched water levels and will assist with plume stability. The wells demonstrating an increasing trend were far outside the influence of the pump and treat systems or are in ISB injection wells, which may not be representative of overall perched groundwater elevation trends.

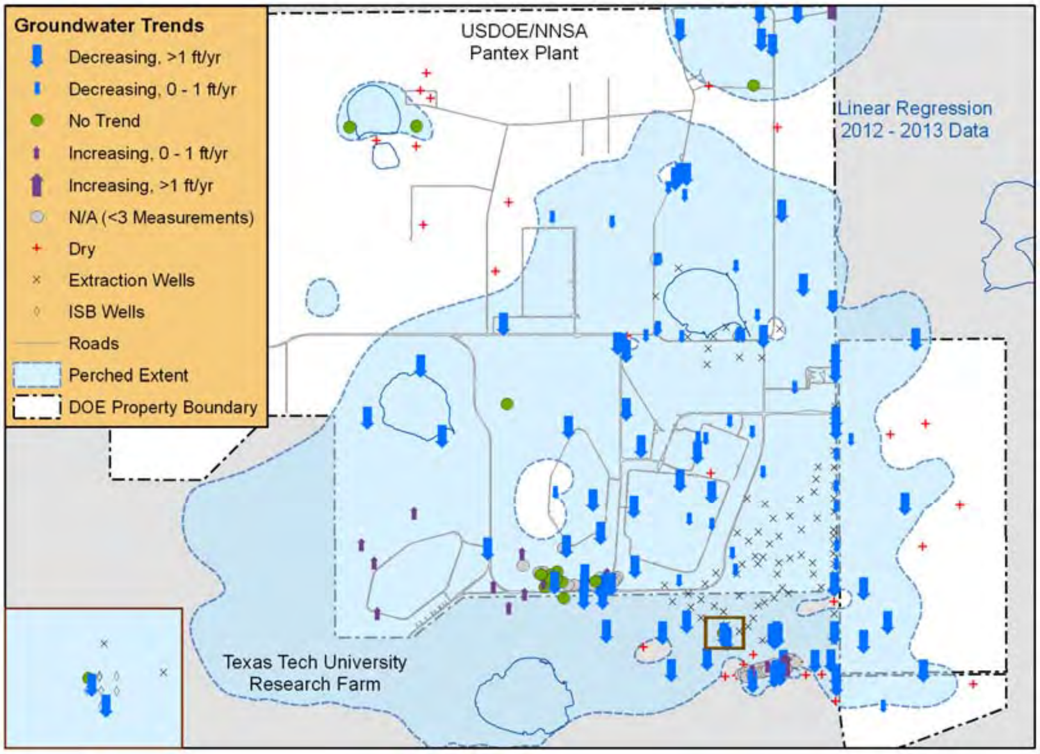


FIGURE 6.3 – ***Water Level Trends in the Perched Aquifer***

Plume stability is also evaluated to determine if the center of mass is still moving in the perched groundwater. Major perched aquifer COCs (RDX, hexavalent chromium, TCE, and perchlorate) were included in this evaluation. Because the RDX plume has expanded to the perched extent, the entire plume was not evaluated, but rather the two 1,000 µg/L plume "hot spots" associated with the two source areas and affected by the remedial actions were evaluated. As depicted in Figure 6.4, the COC plumes had similar general shapes from 2012 to 2013, with the following notable exceptions:

- The eastern TCE plume has expanded significantly to the south, primarily due to data collected in newly installed monitoring well PTX06-1166.
- All plumes exhibit slight variations at their boundaries, likely due to minor variations in concentration over time, additional data from newly constructed or sampled wells, and the low values defining the plume boundaries. In addition, some plume expansion is likely due to advection, dispersion, and groundwater gradients.

Concentration trends of individual monitoring points are also evaluated to assess the remedial action effectiveness and plume stability. To represent the current impact of the remedial action systems on concentrations, the RDX trends were calculated since remedial actions began in 2009 and are depicted in Figure 6.5. A summary of concentration trends are as follows:

- RDX concentration trends indicate that RDX is decreasing or does not demonstrate a trend at the source areas (Playa 1 and the ditch along the eastern side of Zone 12). This condition is expected as the source areas are predicted to continue contributing to the perched for up to 20 years, but at much lower concentrations than in the past.

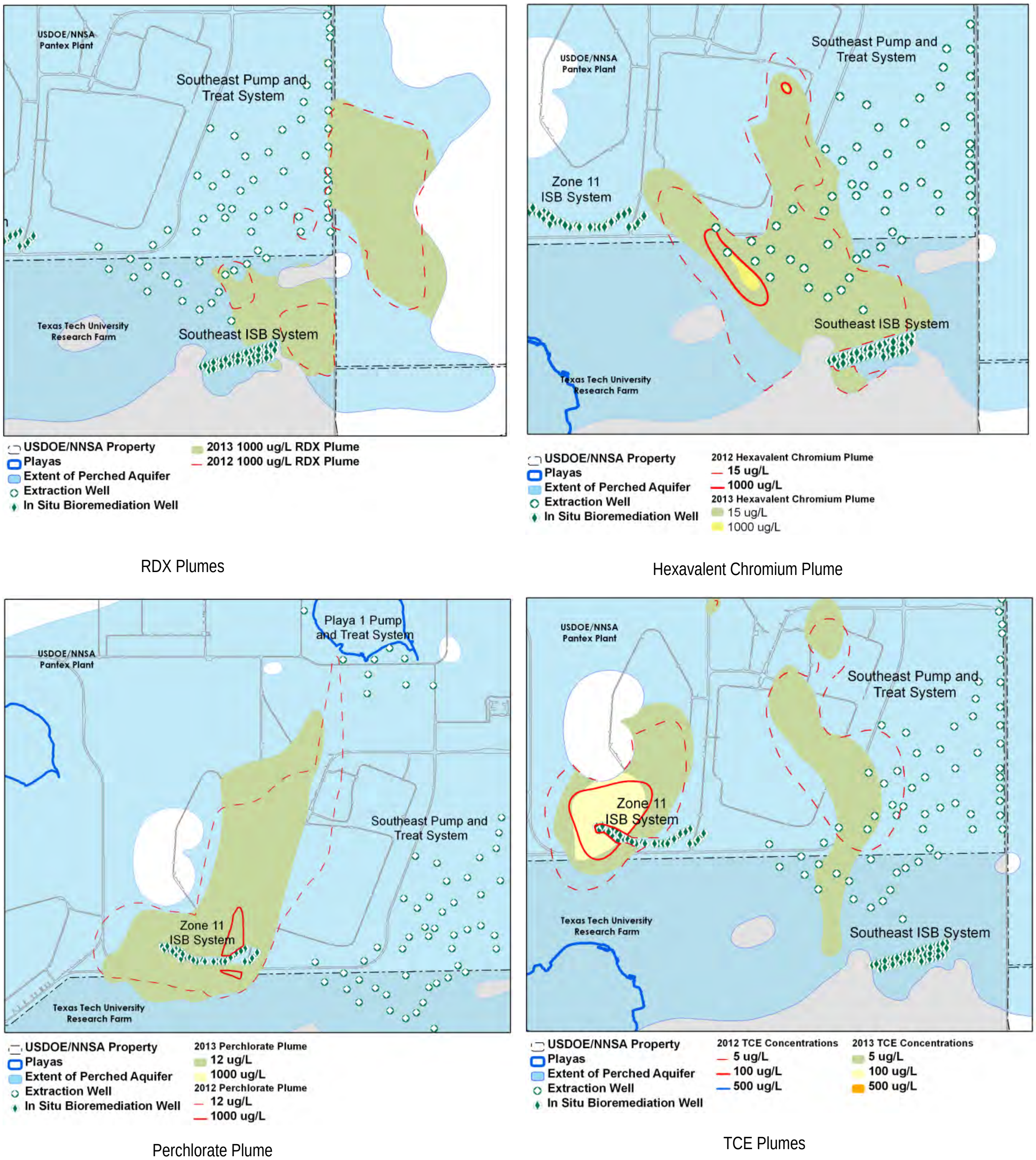


FIGURE 6.4 – ***2012 - 2013 Plume Movement - Perchlorate, Hexavalent Chromium, RDX, and TCE***

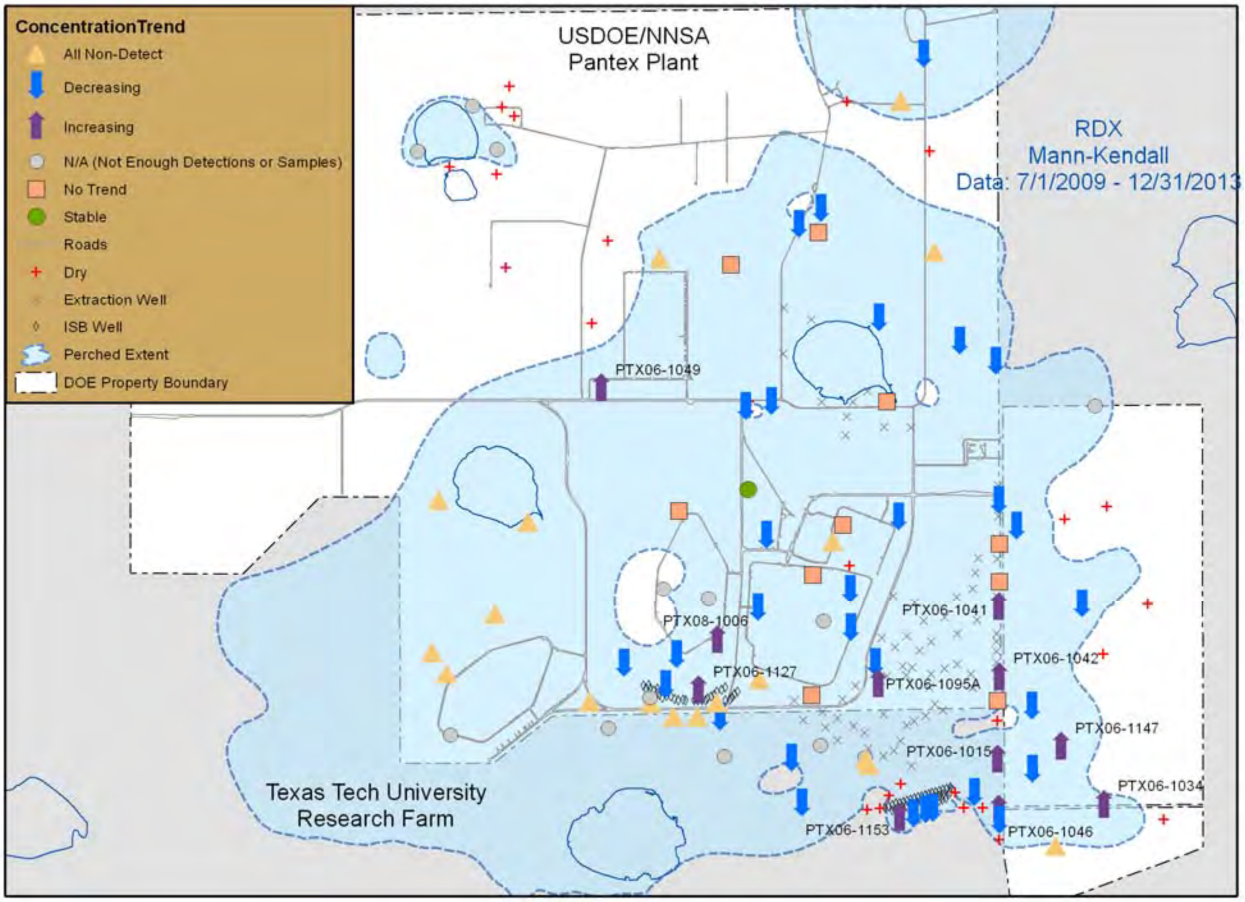


FIGURE 6.5 –***RDX Concentration Trends in the Perched Aquifer***

- The SEPTS has affected the plume as the majority of COC concentrations are declining or not demonstrating a trend along the outer margins of the system. Two wells installed along the eastern edge of the extraction well field (PTX06-1041 and PTX06-1042) are exhibiting increasing trends in RDX, but are under the direct influence of extraction wells. Both long-term and short-term trends do not indicate increasing concentrations and these variable trends may be due to affected water from the east being pulled back into the well field or other unknown effects of pumping.
- Several wells located in the far southeast lobe of perched groundwater (PTX06-1015, PTX06-1034, PTX06-1046, and PTX06-1147) are exhibiting increasing trends in RDX. This area has been identified as a region that is not currently under the effect of a remedial action. Short-term trends calculated for these wells are either decreasing or no trend, suggesting possible plume stabilization in the region.
- The Southeast ISB has had some effect on wells to the south on TTU property as three down-gradient wells are exhibiting decreasing trends. PTX06-1153 is exhibiting an increasing RDX trend and is discussed in greater detail in Section 6.4.2. This is a key area for declining concentrations because portions of that area are potentially more sensitive to vertical migration to the deeper drinking water aquifer.
- Two wells installed south of Zone 11 and north of the Zone 11 ISB system (PTX08-1006 and PTX06-1127) are exhibiting increasing RDX trends. These wells are outside the influence of the pump and treat systems, but affected groundwater in this area should be treated by the Zone 11 ISB system.

- PTX06-1095A is within the influence of the SEPTS well field, but is also located within 25 – 50 feet downgradient of the PRB pilot study wells PTX06- PRB01A and PTX06-PRB02. The increasing trend is likely due to the PRB losing treatment effectiveness and concentrations returning to baseline conditions.
- PTX06-1049 is exhibiting an increasing trend in RDX, which is likely due to radial expansion of affected water from Playa 1. This well is outside the influence of the remedial actions and is discussed further in Section 6.5.1.

Concentration trends for the remaining major COCs (perchlorate, TCE, and hexavalent chromium) are discussed in the 2013 Annual Progress Report (PANTEXa). Areas outside the influence of the remedial action systems are also monitored for HE and TCE breakdown products to gather data regarding natural attenuation and will be evaluated over time to determine the rate of these processes.

6.4.2 In Situ Bioremediation Systems

The in-situ bioremediation systems treat the impacted groundwater as it moves through the bioremediation zone with the goal of reducing concentrations below the groundwater protection standard (GWPS) established in the CERCLA Record of Decision (ROD). This is achieved by injecting amendment and nutrients to stimulate resident bacteria. With complete reduction, the resident bacteria will reduce the COCs to less harmful substances. Table 6.2 summarizes the treatment zone and downgradient conditions for each of the ISB systems. The conditions indicate that a reducing zone has been established at both ISB systems. The mild to strong reducing conditions found are expected for each ISB treatment zone. However, stronger reducing conditions may be required for the complete breakdown or reduction of TCE.

TABLE 6.2 –*ISB System Performance*

	Treatment Zone Wells		Downgradient Performance Monitoring Wells	
System	**Reducing Conditions**	**Food Source Available**	**Primary Contaminate of Potential Concerns (COPCs) Reduced?**	**Degradation Products of COPCs Reduced?**
Zone 11 ISB	Mild - Strong	Yes	Perchlorate and TCE in 3 of 3 wells	No[1]
Southeast ISB	Mild – Strong[2]	Yes	RDX and Hexavalent Chromium in 3 of 4 wells	Yes

Mild conditions = 0 to -50 millivolts (mV) - Strong Conditions = Oxidation-Reduction Potential (ORP) < -50 mV and sulfate and nitrate reduced, indicating conditions are present for methanogenesis.

[1]Cis-1,2-dichloroethene concentrations increased in one downgradient well while vinyl chloride (final breakdown compound) remained at low concentrations.

[2]One ISB injection well, PTX06-ISB014, was exhibiting oxidizing conditions in 2013.

The Southeast ISB was installed in 2007, with initial injection completed by March 2008. A total of four injection events have been conducted at the Southeast ISB, with the fourth event complete by September 2013. The system was installed with 42 treatment zone wells and six performance monitoring wells. Pantex monitors eight treatment zone wells and six in-situ performance monitoring (ISPM) wells (see Figure 6.6 for wells that are sampled). This system has established an adequate reducing zone for the contamination that is present, based on geochemical conditions monitored at the treatment zone and results of monitoring.

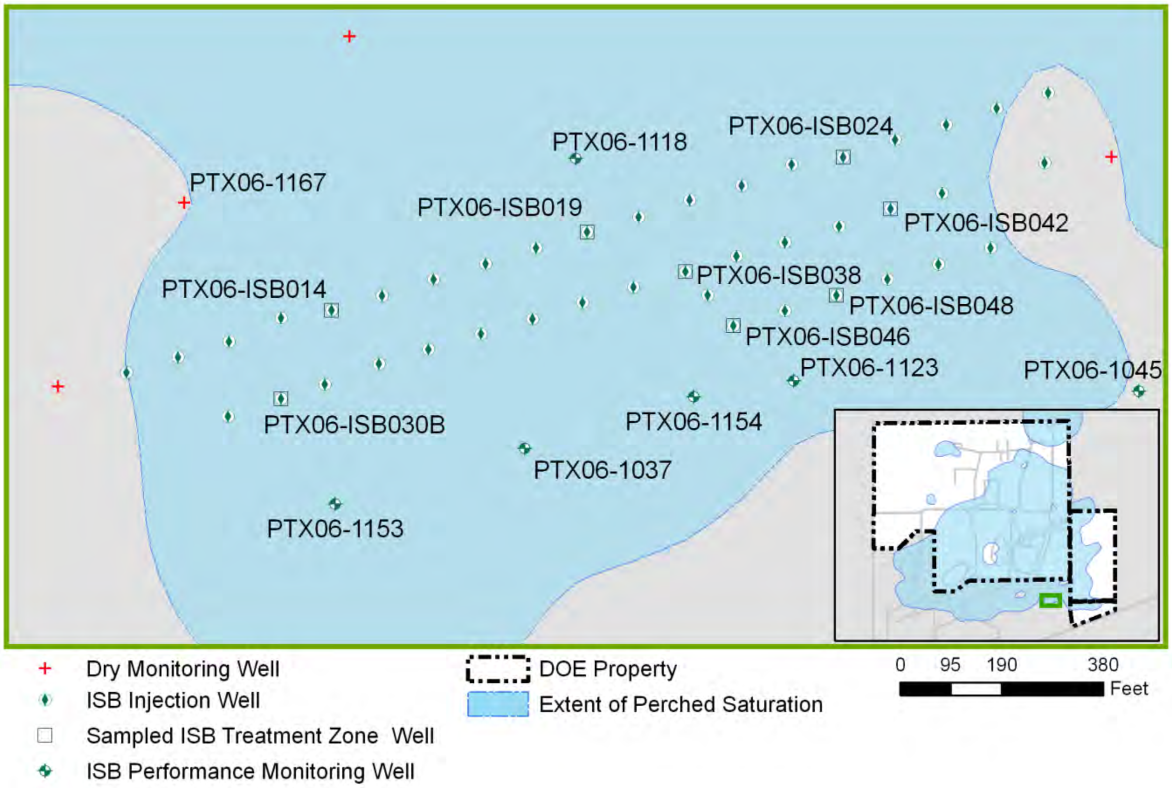


FIGURE 6.6 – ***Wells Sampled at Southeast ISB***

Three of the downgradient monitoring wells for this system demonstrate that RDX has been reduced to concentrations near or below the GWPS of 2 µg/L. Hexavalent chromium concentrations are below the GWPS (100 ug/L) in those monitoring wells. One downgradient well (PTX06-1153) has hexavalent chromium present in concentrations above the GWPS and RDX concentrations persisting over 200 ug/L. Based on review of previous data, this well may be partially influenced by the treatment zone. PTX06-1153 initially indicated similar conditions for nitrate, sulfate, and ORP; but, nitrate, sulfate and ORP have elevated during 2012 and COC concentrations have not declined. Pantex installed an additional monitoring well north of the west end of the treatment zone (PTX06-1167) in order to assist in determining groundwater flow patterns and contaminant mass flux moving into this region of the ISB system. The well was dry when installed in August and dry conditions continued through 2013. However, air rotary drilling methods used when installing this well have been shown to push groundwater away from the well in cases of thin saturation, resulting in temporary dry conditions observed in the well. Additionally, Pantex injected amendment into historically dry ISB wells upgradient of PTX06-1153 in order to ensure adequate amendment distribution in this area.

Pantex will continue to monitor wells in the area to determine groundwater flow patterns, mass flux, and treatment conditions in the western side of the treatment zone. If PTX06-1167 continues to indicate dry conditions, an additional monitoring well may need to be installed to the east to continue to delineate the dry area north of the treatment zone, as well as quantify mass flux entering the ISB system. The downgradient performance monitoring well information is included in Table 6.3.

TABLE 6.3 – *Summary of Southeast ISB Performance Monitoring Well Data*

Well ID	Hexavalent Chromium					RDX				
	Max	1Q2013	2Q2013	3Q2013	4Q2013	Max	1Q2013	2Q2013	3Q2013	4Q2013
PTX06-1037	108.5	<15	<15	<10	<10	2800	0.53	0.37	<1	0.27
PTX06-1123	10	<15	<15	<10	<10	4300	1.1	0.33	<0.99	0.73
PTX06-1153	146	11	118	150	133	320	290	240	210	250
PTX06-1154	13	<15	23	8.5	<10	630	<0.39	<0.4	<1	<1

Concentrations provided in µg/L.
Highlighted cells indicate concentrations less than the GWPS.

Two other performance monitoring wells (one upgradient, one farther downgradient) were dry and could not be sampled. This indicates that water levels may be declining in the southeast area. As the pump and treat systems continue to remove water and water levels decline, the future need for injections at the Southeast ISB could be reduced or eliminated.

Pantex also monitors for degradation products of RDX to evaluate whether complete breakdown is occurring. Monitoring results for the system indicate that RDX and breakdown products (hexahydro-1-Nitroso-3,5-Dinitro-1,3,5-triazine [MNX], hexahydro-1,3-Dinitroso-5-Nitro-1,3,5-triazine [DNX], and hexahydro-1,3,5-Trinitroso-1,3,5-triazine [TNX]) are present in downgradient performance monitoring wells. TNX, the final degradation product, is the best indicator of degradation because the other intermediate products (MNX, DNX) degrade rapidly and do not accumulate in the environment. As shown in Figure 6.7, the ratio of TNX to RDX is quite variable in the downgradient wells.

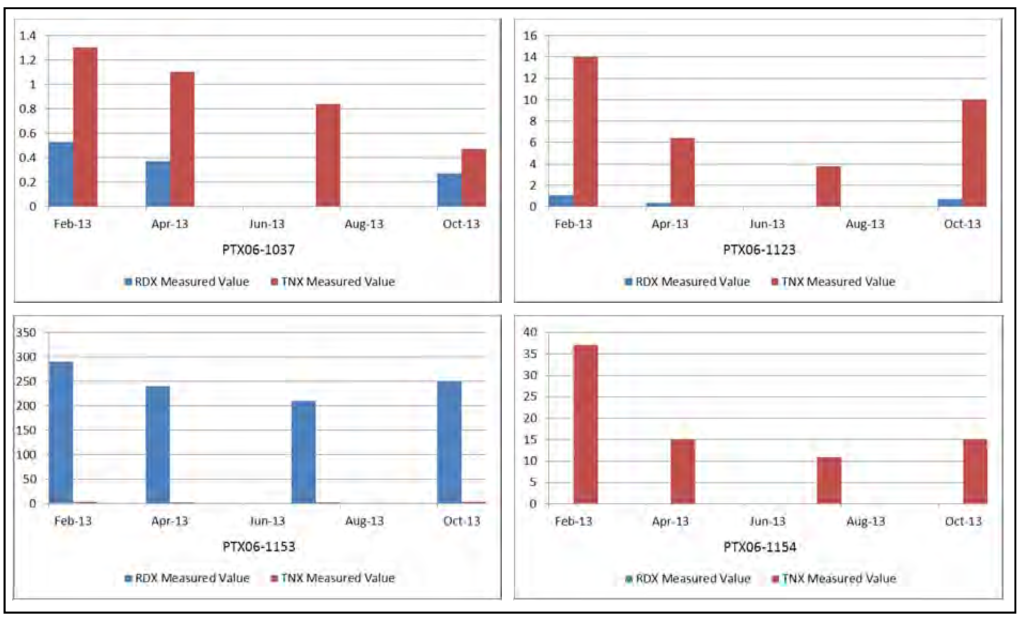


FIGURE 6.7 – *RDX and TNX Concentrations in Parts per Billion (ppb) from Southeast ISB Downgradient Performance Monitoring Wells*

Both RDX and TNX have been reduced to concentrations below the GWPS and TNX is exhibiting a decreasing trend at well PTX06-1037. High RDX concentrations and low TNX concentrations at well PTX06-1153 indicate little to no treatment at this location. Both wells PTX06-1123 and PTX06-1154 have high TNX concentrations compared to RDX, indicating possible incomplete treatment of RDX. However, the TNX concentrations are low compared to baseline concentrations and had decreasing trends in 2013. RDX concentrations have been reduced from historic high values exceeding 500 µg/L to concentrations below the GWPS of 2 µg/L in three downgradient ISPM wells. These trends are expected to continue as biodegradation continues.

The Zone 11 ISB system was installed in early 2009 with injection completed in the original 23 wells by June 2009. An additional nine wells were installed during 2009 to better treat the perchlorate plume on the eastern side and the TCE plume on the western side of the ISB system. A total of five injection events have been conducted at the Zone 11 ISB system, with the fifth injection event completed in July 2013. Due to the higher saturated thickness and velocity of the perched groundwater in the Zone 11 area, injection events are scheduled for every 12 months. Eleven treatment zone wells and three downgradient ISPM wells are used to evaluate the Zone 11 ISB system (Figure 6.8).

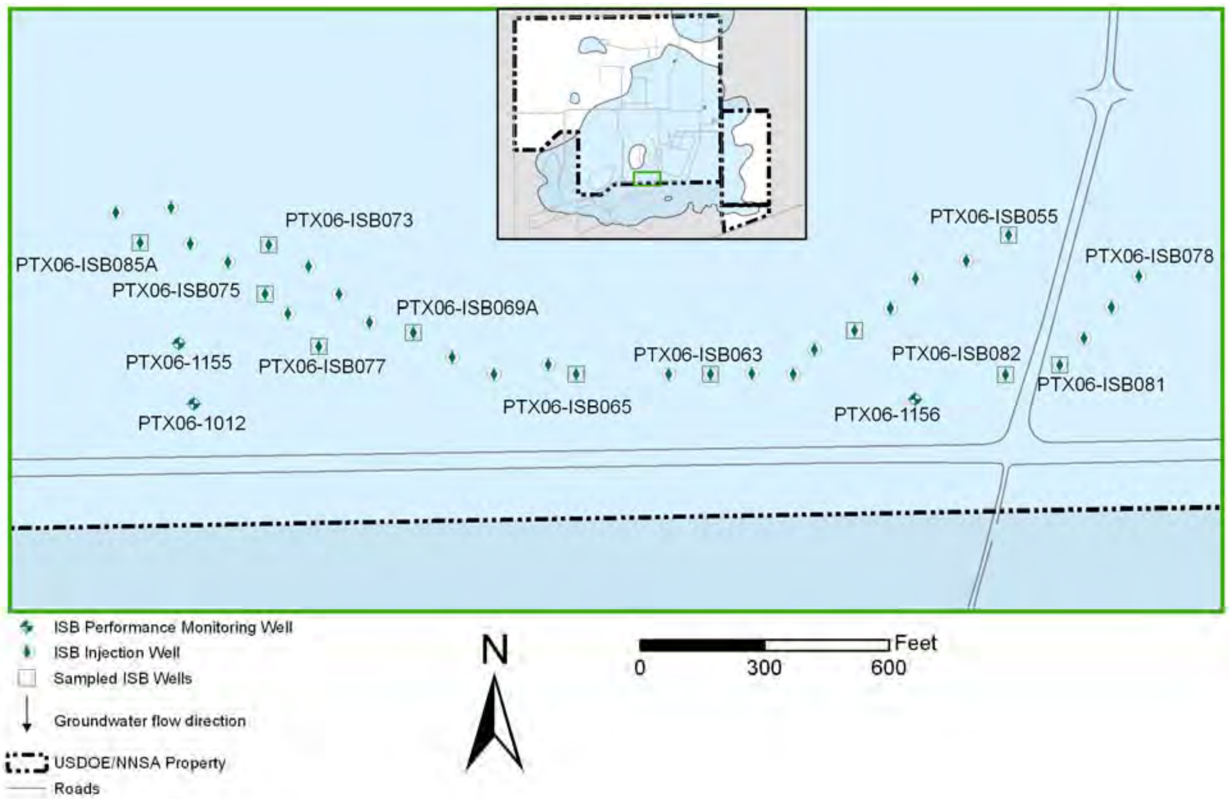


FIGURE 6.8 – ***Wells Sampled at Zone 11 ISB***

Data collected in 2013 indicate that a mild to strong reducing zone has been established and maintained over time. Conditions favorable for reductive dechlorination are present as nitrate and sulfate concentrations have declined. Evaluation of COC data collected downgradient of the treatment zone (Table 6.4) indicate that, by the end of 2013, COC concentrations are below the GWPS and most are non-detect with the exception of TCE in one well. As shown in Table 6.4, all perchlorate data collected in 2013 are non-detect. TCE concentrations are significantly decreasing in PTX06-1155. If this trend continues, TCE concentrations will be below GWPS in all downgradient wells in one to two years.

TABLE 6.4 – *Summary of Zone 11 ISB Monitoring Well Data*

Well ID	Perchlorate					TCE				
	Max	1Q2013	2Q2013	3Q2013	4Q2013	Max	1Q2013	2Q2013	3Q2013	4Q2013
PTX06-1012	341	<12	<12	<12	<12	580	250	210	200	170
PTX06-1155	487	<12	<12	<12	<12	660	170	27	18	4.8
PTX06-1156	2140	<12	<12	<12	<12	7.4	<3	<3	<3	<3

Highlighted cells indicate concentrations less than or equal to the GWPS.
When COC was not detected, a “less than” with the detection limit is provided.

Cis-1,2-dicloroethene, a break down product of TCE, is exhibiting increasing trends in ISPM wells PTX06-1155 and PTX06-1012 and is now exceeding the GWPS in PTX06-1155. These trends may indicate incomplete treatment of TCE in the treatment zone caused by the lack of proper bacterial population (*Dehalococcoides sp*.) required for complete dechlorination. Pantex is currently investigating these issues. If the proper bacteria are not present in sufficient quantities in the treatment zone, bio-augmentation, which is the introduction of a laboratory-cultured bacterial population into the treatment zone, may be necessary for complete TCE treatment.

6.5 Uncertainty Management and Early Detection

Because the evaluation of uncertainty management and early detection well types is similar, they are evaluated together for unexpected conditions. The purpose of uncertainty management wells in perched groundwater is to confirm expected conditions identified in the RCRA Facility Investigations and ensure there are not any deviations, fill potential data gaps, and fulfill long-term monitoring requirements for soil units evaluated in the baseline risk assessment. The purpose of early detection wells is to identify breakthrough of constituents to the drinking water aquifer from overlying perched groundwater, if present, or potential source areas in the unsaturated zone, before potential points of exposure have been impacted.

Perched groundwater uncertainty management wells that are within identified contaminant plumes are not evaluated until the five-year review when a more comprehensive list of constituents will be sampled to specifically evaluate those wells. Figure 6.9 depicts the perched and Ogallala aquifer wells used in this evaluation for 2013. A total of 47 wells were evaluated for unexpected conditions. Because of the differing frequency of sampling, all available data for these wells were used in this evaluation.

Pantex monitors for the most widespread and leachable contaminants at the uncertainty management and early detection wells. The monitoring lists for these wells are included in the *SAP* (PANTEXm) and consist of all HEs found in perched groundwater, degradation products of RDX, PCE, TCE and its degradation products, chloroform, and boron. Perchlorate, hexavalent chromium, and total chromium are analyzed in select drinking water aquifer monitoring wells that are downgradient from their respective plumes in perched groundwater. The data for each well in each aquifer were evaluated for unexpected conditions. Those uncertainty management or early detection wells with unexpected conditions are discussed in the following sections.

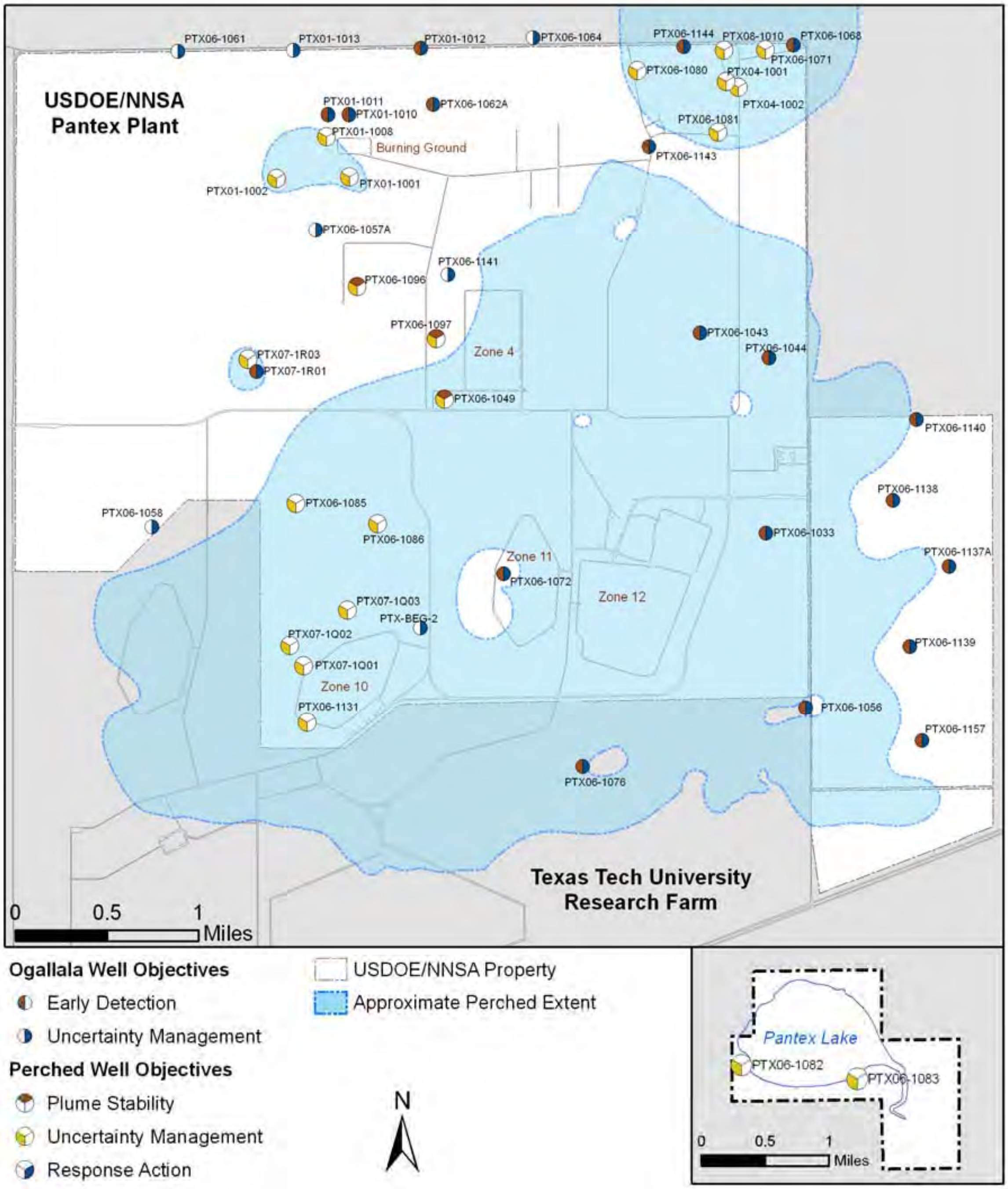


FIGURE 6.9 – ***Uncertainty Management and Early Detection Wells***

6.5.1 Perched Groundwater Uncertainty Management

The summary of detections and expected conditions for perched groundwater is included in Table 6.5. This table includes all detections of COCs, with the exception of boron and total chromium. Only those naturally occurring metals above established background concentrations are included in the table. Five perched monitoring wells had detections of COCs in 2013. All but one of these conditions was expected, as those wells or wells in the area had previous similar detections of the COCs. All wells will continue to be monitored over time to trend the concentrations.

TABLE 6.5 – *Summary of Detections and Expected Conditions in Perched Groundwater Wells*

Well ID	Sample Date	Analyte	Measured Value (ug/L)	Above PQL?	Above GWPS?	Expected Condition ?
PTX01-1001	5/2/2013	4-Amino-2,6-Dinitrotoluene	0.236J	N	N	Y[1]
PTX01-1001	5/2/2013	Perchlorate	9.48J	N	N	Y[1]
PTX01-1001	5/2/2013	TCE	0.58J	N	N	Y[1]
PTX01-1001	10/30/2013	TCE	0.6J	N	N	Y[1]
PTX04-1002	7/23/2013	HMX	0.684	Y	N	Y[2]
PTX04-1002	7/23/2013	RDX	0.151J	N	N	Y[2]
PTX04-1002	7/23/2013	TCE	0.46J	N	N	Y[2]
PTX06-1049	5/15/2013	4-Amino-2,6-Dinitrotoluene	3.34	Y	Y	Y[1]
PTX06-1049	5/15/2013	RDX	2.53	Y	Y	Y[1]
PTX06-1049	5/15/2013	RDX	2.49	Y	Y	Y[1]
PTX06-1049	5/15/2013	TCE	1.04	Y	N	Y[1]
PTX06-1049	5/15/2013	TCE	1.25	Y	N	Y[1]
PTX06-1049	11/21/2013	4-Amino-2,6-Dinitrotoluene	3.47	Y	Y	Y[1]
PTX06-1049	11/21/2013	RDX	3.02	Y	Y	Y[1]
PTX06-1049	11/21/2013	TCE	1.12	Y	N	Y[1]
PTX06-1081	7/23/2013	TCE	0.3J	N	N	Y[2]

PQL = Practical quantitation limit from the *SAP* (PANTEXm).
GWPS = Groundwater protection standard published in the *Record of Decision* (Pantex Plant and Sapere, 2008).
Wells with unexpected conditions are in **bold**.
[1] COC has been detected in this well previously.
[2]All of these wells are located in the northeast corner of Pantex Plant where the OSTP formerly operated. All of these wells have previous detections of these analytes.

PTX06-1049 has had sporadic detections of TCE since 2006 and is now exhibiting consistent concentrations below the practical quantitation limit (PQL) and the GWPS. In 2009, 4-amino-2,6-dinitrotoluene was detected at low concentrations below the PQL and GWPS, but concentrations increased to values above the GWPS in 2011 and continue to slowly increase. RDX was detected for the first time in 2011 and concentrations continued to increase and are now exceeding GWPS. This well is near the southwest corner of Zone 4, west of Playa 1. The recent impacts observed in this well appear to be a result of contaminants that have expanded radially from Playa 1, and contamination is slowly moving into this well. This well will continue to be monitored over time to trend the concentrations.

PTX01-1001, installed in a separate zone of perched groundwater under the Burning Ground area, had several detections of COCs, including perchlorate, TCE, and 4-amino-2,6-dinitrotoluene, in 2013. All of these COCs had been detected in this well before 2013, so these are not considered to be unexpected conditions.

Pantex will continue to monitor these wells according to the SAP and *Ogallala Aquifer and Perched Groundwater Contingency Plan* (PANTEXi).

6.5.2 Ogallala Aquifer Uncertainty Management and Early Detection

The summary of detections and unexpected conditions is included in Table 6.6. This table includes all detections of COCs, with the exception of boron and total chromium. Those naturally occurring metals are compared to established background concentrations. Only concentrations that exceed background are provided in the table. In addition, confirmation sampling or other results used to evaluate unexpected conditions are included in the table. Seven Ogallala Aquifer (Ogallala/Dockum) wells had detections in 2013. Two of those wells had unexpected conditions and are discussed below. Wells with expected conditions are footnoted with explanations in Table 6.6.

TABLE 6.6 – *Summary of Detections and Expected Conditions in Ogallala Aquifer Wells*

Well ID	Sample Date	Analyte	Measured Value (µg/L)	Ratio MV/ Background	Above Background ?	Above PQL?	Above GWPS ?	Expected Condition?
PTX06-1033	10/29/2013	Cr(VI)	4.64		NA	N	N	Y[1]
PTX06-1033	10/29/2013	Nickel	17.8	1.2	Y	NA	N	Y[1]
PTX06-1043	1/22/2013	Boron	195	1.0	Y	NA	N	Y[2]
PTX06-1043	8/5/2013	Boron	197	1.0	Y	NA	N	Y[2]
PTX06-1043	**8/5/2013**	**Cr(VI)**	**4.07**		**NA**	**N**	**N**	**N**
PTX06-1056	4/17/2013	Boron	225	1.2	Y	NA	N	Y[3]
PTX06-1056	**6/18/2013**	**Cr(VI)**	**4.46**		**NA**	**N**	**N**	**N**
PTX06-1056	10/28/2013	Boron	223	1.2	Y	NA	N	Y[3]
PTX06-1056	**10/28/2013**	**Cr(VI)**	**4.64**		**NA**	**N**	**N**	**N**
PTX06-1137A	4/24/2013	Boron	232	1.2	Y	NA	N	Y[2]
PTX06-1137A	10/24/2013	Boron	196	1.0	Y	NA	N	Y[2]
PTX06-1138	**10/24/2013**	**Cr(VI)**	**5.56**		**NA**	**N**	**N**	**N**
PTX06-1139	1/22/2013	Boron	200	1.0	Y	NA	N	Y[2]
PTX06-1139	8/5/2013	Boron	200	1.0	Y	NA	N	Y[2]
PTX06-1140	4/24/2013	Boron	206	1.1	Y	NA	N	Y[2]
PTX06-1140	**6/18/2013**	**Cr(VI)**	**3.62**		**NA**	**N**	**N**	**N**
PTX06-1140	10/28/2013	Boron	198	1.0	Y	NA	N	Y[2]
PTX06-1140	**10/28/2013**	**Cr(VI)**	**4.64**		**NA**	**N**	**N**	**N**
PTX06-1144	4/25/2013	Boron	201	1.0	Y	NA	N	Y[2]
PTX07-1R01	4/25/2013	Boron	198	1.0	Y	NA	N	Y[2]

Background values for naturally occurring constituents from the *Risk Reduction Rule Guidance to the Pantex RFI* (PANTEXl).
Cr(VI) – hexavalent chromium
PQL = Practical quantitation limit reported from the laboratory.
GWPS = Groundwater protection standard published in the *Record of Decision* (Pantex Plant and Sapere, 2008).
Wells with unexpected conditions are in **bold.**
[1]Chromium and nickel are components of stainless steel. This well has documented corrosion of the stainless steel screen and subsequent release of metals. Oxidizing conditions in the aquifer can then favor the hexavalent oxidation state of chromium.
[2] Background for boron is 194 ppb. This concentration only slightly exceeds background – see ratio of background to measured value column. This is considered as background variability that is likely to occur in the Ogallala Aquifer and has been observed previously in this well. Boron will continue to be monitored according to the *SAP* and evaluated for trends.
[3] PTX06-1056 is installed in deeper segments of the Ogallala formation, PTX06-1056 consistently demonstrates boron concentrations above background established for the aquifer, and is believed to be influenced by the lower Dockum formation. Because of this, boron concentrations slightly above background are expected in deeper segments of the Ogallala formation.

Several wells, including PTX06-1043, PTX06-1056, PTX06-1137A, PTX06-1139, PTX06-1140, PTX06-1144, and PTX07-1R01 had boron detections slightly above the background value of 194 ppb. Because the boron concentrations at these wells are very close to background and observed boron concentrations tend to be considerably variable, it appears that these concentrations represent background for these wells. Evaluation of historic boron data in these wells does not indicate increasing trends. The measured concentrations are well below the GWPS of 7,300 ppb. Pantex will continue to monitor these wells according to the *SAP*. Boron detections were higher in PTX06-1056, but this well is installed in a deeper region of the Ogallala formation, and may be influenced by the lower Dockum formation. While PTX06-1137A was not installed in a deeper portion of the Ogallala aquifer, the boron results from the second sampling event had returned to near background levels, illustrating the potential variation in boron results around background.

Nickel was detected above background and hexavalent chromium was detected below the laboratory PQL in PTX06-1033. This well has had documented microbial growth, corrosion, and subsequent detections of components of stainless steel. Therefore, these detections are not considered to be representative of the surrounding formation. This well has been assigned a maintenance frequency of two years in the recently completed Well Maintenance Plan, which will reduce the potential for these types of detections in the future.

Hexavalent chromium was detected in five wells (PTX06-1033, PTX06-1043, PTX06-1056, PTX06-1138, and PTX06-1140) in 2013 below the laboratory PQL of 10 ug/L and well below the GWPS of 100 ug/L. These detections are likely a result of one or more of the following:

- Low concentration background level of hexavalent chromium in the Ogallala aquifer as suggested in a recent Texas Tech study where hexavalent chromium was present in all samples collected across the Texas Panhandle.
- Lower detection limits for Method SW-7196 based on improvements to the method. Method Detection Limits (MDLs) dropped from 5 ug/L to 3.3 ug/L and the PQL dropped from 15 ug/L to 10 ug/L in June 2013. The new detection limits allow low background concentration levels to be estimated above the new MDL and below the PQL.
- Corrosion of stainless steel screen/casing. Specific wells at Pantex have documented evidence of corrosion and conversion of total chromium to hexavalent chromium is possible due to oxidizing conditions in the Ogallala Aquifer.
- False positive detections near the MDL due to the colorimetric analytical method. Typically, these detections are not confirmed by total chromium results.

It is likely that most of these sporadic detections are related to the lower detection limits and the ability to quantify low concentration background detections as all hexavalent chromium detections in 2013 occurred after lower detection limits were achieved in June. PTX06-1033 has documented evidence of corrosion. No evidence of screen corrosion was discernable from data collected from the other wells.

In accordance with the Ogallala Aquifer and Perched Groundwater Contingency Plan (B&W Pantex, 2009b), these wells will continue to be monitored according to the SAP because the detections are below the PQL. It is expected that these low concentration detections will persist as they likely represent background concentrations. These wells are monitored semi-annually and data will be reviewed to determine if concentrations persist or increase. Pantex is planning development of a site-specific hexavalent chromium background. Additional discussion on hexavalent chromium can be found in the 2013 Annual Progress Report (B&W Pantex 2014).

Long-term monitoring data collected in the Ogallala continue to demonstrate concentrations protective of human health.

6.6 Natural Attenuation

Natural attenuation is the result of processes that naturally lower concentrations of contaminants over time. This process is monitored at Pantex to help determine where natural attenuation is occurring, under what conditions it is occurring, and to eventually determine a rate of attenuation. This is an important process for RDX, the primary risk driver in perched groundwater, because it is widespread and extends beyond the reach of the groundwater remediation systems in some areas. Because the right microbes for biodegradation are present in the perched groundwater sediments, Pantex is interested in monitoring for breakdown products of RDX. Pantex started monitoring for degradation products of RDX in all monitoring wells by July 2009 after testing analytical methods to ensure they could reliably detect and quantify those products. Because analytical methods are readily available, Pantex has monitored for degradation products of TNT and TCE in the past and continues to monitor for those in key areas.

Other groundwater conditions that may impact attenuation, such as dissolved oxygen and redox potential, are also monitored in each well. RDX can degrade under aerobic and anaerobic conditions, but achieves best reduction under anaerobic conditions. As more data are collected, trending and statistical analysis can be used to evaluate the degradation of RDX. Trending of concentrations is also performed at each well to determine if concentrations are declining as expected.

Based on monitoring results for TNT and its breakdown products (2-amino-4,6-DNT and 4-amino-2,6-DNT), TNT has naturally attenuated over time (Figure 6.10). TNT has been manufactured at Pantex since the 1950s yet is only present in the central portion of the overall southeastern plume - within the SEPTS well field and near Playa 1. Its first breakdown product, 2-amino-4,6-DNT, occurs near the TNT plume and extends slightly beyond. The plume for the final breakdown product, 4-amino-2,6-DNT, extends to the eastern edge of the perched saturation at low concentrations, indicating that in the older portions of the plume TNT is completely breaking down. Only TNT breakdown products are present in perched groundwater beneath Zone 11 and north of Playa 1. Concentrations of the breakdown products are still above GWPS, but most wells with detections are recently showing a decreasing or stable trend. A table of concentration ranges for wells outside the influence of the ISB systems is included in Figure 6.10.

Perched groundwater sampling results for RDX and breakdown products (MNX, DNX, and TNX) indicate that the breakdown products are present throughout most of the RDX plume, with TNX being the most widespread. TNX, the final degradation product, is a better indicator of degradation because the other intermediate products (MNX, DNX) degrade rapidly and do not accumulate in the environment (SERDP, 2004). If complete biodegradation of RDX is occurring, RDX and all breakdown products would be expected to decrease over time. As depicted in Figure 6.11, the TNX plume is similar in size and extent to the RDX plume, but at much lower concentrations. A table of concentration ranges for wells outside the influence of the ISB systems is included in the figure. More data will be required over time to determine trends and rates of attenuation.

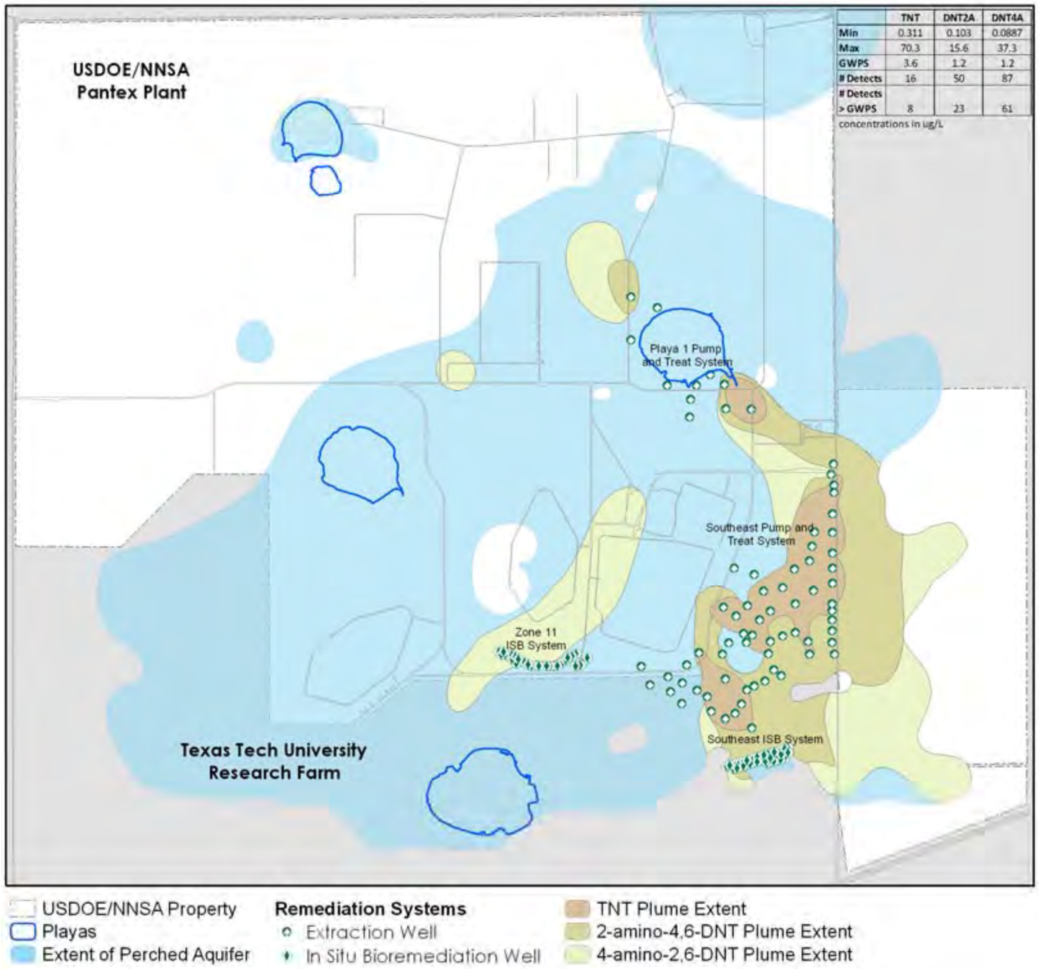


FIGURE 6.10 – ***TNT and Degradation Product Plumes***

Pantex has monitored for breakdown products of TCE for many years; however, a strong indication of natural attenuation of TCE has not been observed in perched groundwater. TCE has started degrading in the Zone 11 ISB treatment zone. The TCE plumes at Pantex are being actively treated by the SEPTS and the ISB treatment zones.

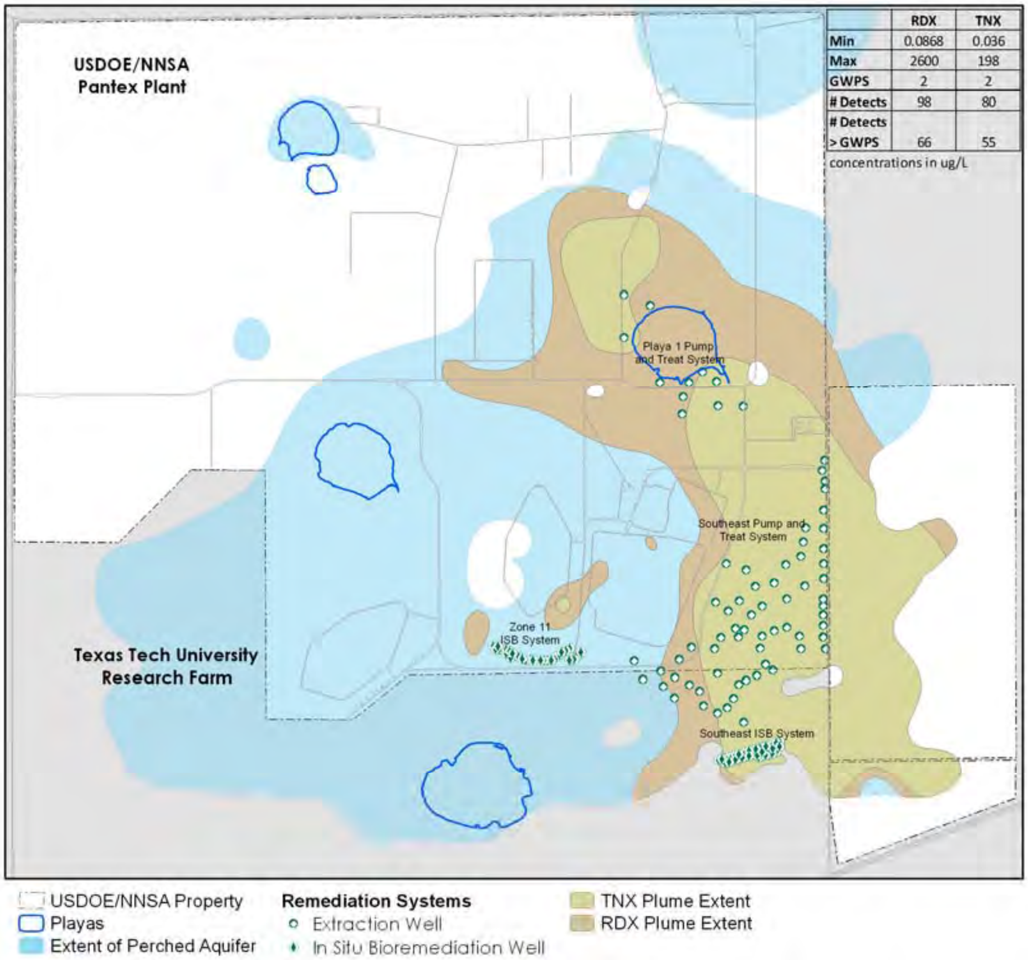


FIGURE 6.11 – ***RDX and Degradation Product Plumes***

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Results from routine drinking water compliance monitoring in 2013 confirmed that the drinking water system at Pantex Plant met all applicable regulatory requirements. All analytical results for radionuclides, volatile/semi-volatile organic compounds, and miscellaneous compounds were below regulatory limits, and adequate levels of disinfectant were maintained in the distribution system. The Pantex Public Water System continues to be recognized by the Texas Commission on Environmental Quality as a "Superior" supply system.

7.1 The Scope of the Program

The Pantex Plant's drinking water system (State of Texas Public Water System I.D. No. 0330007) is considered a non-transient, non-community public water system (NTNC-PWS) system under Safe Drinking Water Act regulations. This category was created by the U.S. Environmental Protection Agency (EPA) to identify private systems that continuously supply water to small groups of people (for example, in schools and factories). Water supplied by such systems is consumed daily by the same group of people over long periods of time.

The Plant's drinking water is obtained from the Ogallala Aquifer. The drinking water production wells supply all of the Plant's water needs. Before being transferred to the distribution system, all water is treated to provide disinfection protection throughout the system. In addition, the system provides water to adjacent Texas Tech University owned property for domestic and agricultural use.

Samples from the drinking water system were collected and analyzed monthly for biological contaminants, and quarterly and/or annually for chemical and radiological contaminants as required by the Safe Drinking Water Act and its implementing regulations (Title 40 of the Code of Federal Regulations [40 CFR] Parts 141 and 143, and Title 30 of the Texas Administrative Code [30 TAC] Chapter 290).

Analytical results were evaluated, and compared to regulatory guidelines for drinking water. The constituents for which analyses were conducted in 2013 are listed in Appendix A. Sampling locations were chosen to meet regulatory requirements and to provide system operators with data that would assist their evaluation of the system's integrity.

7.2 New Requirements and Program Changes

In October 2013, the Texas Commission on Environmental Quality (TCEQ) rules for Stage 2 Disinfectant Byproduct monitoring rules went into effect. The revised rules required Pantex to begin monitoring its distribution system for disinfectant byproducts at the location(s) with the highest annual average value(s) for disinfection byproducts.

7.3 Water Production and Use

During 2013, Pantex Plant produced/pumped approximately 375 million liters (99 million gallons) of water from the Ogallala Aquifer. This is a decrease of 76 million liters (20 million gallons) compared to water produced in 2012. Most of the water used at Pantex is for domestic purposes. The water used as industrial process water provides comfort cooling, heat exchange, and boiler operations. Pantex remains committed to reducing the amount of produced water by implementing a water reuse and recycling program. Examples of the water conservation and reuse initiatives include the procurement of more efficient industrial cooling equipment (such as water re-circulating systems) and beneficial reuse of treated wastewater.

7.4 Sampling

Pantex collected routine drinking water samples at 32 locations. Ten locations were sampled for biological indicators and residual disinfectant levels, 20 locations for lead and copper, and two locations were monitored for chemical and radiological constituents. The sampling locations are representative of drinking water at Pantex Plant. Their locations are listed in Table 7.1. Sampling locations are periodically changed to assure adequate Plant coverage.

TABLE 7.1 — *Drinking Water Sampling Locations, 2013*

Description	Location
Chemical and Radiological Sampling	
DR-115[a]	Building 15-27
16-12-JC	Building 16-12
Biological and Disinfectant Level Sampling	
DR-116	Building 12-103
DR-117	Building 18-1
DR-118	Building 12-6
DR-119	Building 16-12
	Building 12-70
	Building 11-2
	Building 15-27
	Building 16-1
	Building 10-9
	Texas Tech Facility
Lead/Copper Sampling	
	12-100 Women's Restroom
	12-102 Men's Restroom
	12-104 Men's Restroom
	12-106 Men's Restroom
	12-107 Men's Restroom
	T9-060 Men's Restroom
	12-121 Mechanical Room #1
	18-1 Killgore Lab Sink
	Texas Tech House
	11-2
	11-21
	12-21
	12-15
	12-121
	12-70
	12-86
	16-1
	16-12
	16-18
	16-24

[a] Some drinking water sampling locations are designated by use of "DR" numbers.

7.5 Results

In general, results for drinking water monitoring in 2013 were similar to those reported for 2012. Trace amounts (below regulatory limits) of radionuclides and miscellaneous compounds were detected. Based on historical data, these concentrations are thought to be due to naturally occurring materials found in the Ogallala Aquifer.

7.5.1 Radiological Monitoring

Radiological monitoring is not required for a NTNC-PWS; however, as a best management practice, Pantex Plant routinely monitors for these contaminants. Table 7.2 shows that the detected radiological constituents for 2013 were below the MCL. Radiological monitoring results for 2013 documented compliance with Safe Drinking Water Act requirements (40 CFR Part 141), state water quality requirements (30 TAC Chapter 290), and U.S. Department of Energy Order 458.1, “Radiation Protection of the Public and the Environment.”

In the unlikely event that either gross alpha or gross beta readings are significantly higher than the historical average or the maximum contaminant levels (MCLs), additional testing (i.e., isotopic analysis) would be conducted to determine the specific radionuclide involved.

7.5.2 Chemical Monitoring

Chemical monitoring and analysis includes herbicides, pesticides, volatile and semi-volatile organic compounds. For a complete list of chemicals, please refer to Appendix A. Concentrations of chemical constituents in routine samples were below any regulatory limits established in federal or state regulations. Constituent concentrations in routine samples in 2013 were within ranges observed in previous years. Table 7.2 shows a tabular representation of drinking water results from Pantex compared to the City of Amarillo, the TCEQ, and regulatory limits under the Safe Drinking Water Act.

7.5.3 Lead and Copper Monitoring

The Lead and Copper Rule of the Safe Drinking Water Act requires that concentrations of lead and copper remain below action levels (0.015 and 1.3 mg/L, respectively) for the 90th percentile of the sampling locations. By regulation, the required monitoring frequency for lead and copper is on a three year cycle. The next compliance monitoring will be during the summer of 2014. However, as a best management practice, Pantex conducts annual monitoring for lead and copper in the drinking water system. Table 7.2 shows that the detected copper and iron concentrations were well below the established action levels.

7.5.4 Biological Monitoring

Water distribution systems contain naturally occurring microorganisms and other organic matter that may enter a system through leaks, cross-connections, back-flow events or disinfection system failures. Bacterial growth may occur within the water itself, at or near the pipe surfaces (bio-film), or from suspended particulates. Factors that influence bacterial growth include water temperature, flow rate, and chlorination. All drinking water at Pantex is chlorinated, prior to entry into the distribution system. The results are provided in Table 7.2.

TABLE 7.2 — *Water Quality Comparison*

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo 2012 (latest results - average)	City of Canyon 2012 (latest results - average)	Pantex Water System 2013	Typical Source or Effect
Inorganics						
Antimony	ppm	0.006	NR	NR	< 0.003	Discharge from petroleum refineries, fire retardants, ceramics, electronics and solder
Arsenic	ppm	0.05	NR	NR	< 0.003	Erosion of natural deposits, discharge from semiconductor manufacturing, petroleum refineries, herbicides and wood preserving
Asbestos	million fibers/ liter	7 million fibers/liter (longer than 10 µm	NR	NR	< 0.18	Cement/ asbestos piping
Barium	ppm	2	0.176	0.141	0.112	Erosion of natural deposits, discharge from oil and gas drilling waste and metal refineries
Beryllium	ppm	0.004	NR	NR	< 0.0005	Discharge from metal refineries, coal-burning factories and aerospace and defense industries
Boron	ppm	NA	NR	NR	0.155	Erosion of natural deposits and discharge from detergent factories

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo 2012 (latest results - average)	City of Canyon 2012 (latest results - average)	Pantex Water System 2013	Typical Source or Effect
Cadmium	ppm	0.005	NR	NR	< 0.001	Metal plating, coating, baking enamels, photography, ni/cad batteries
Copper[a]	ppm	Action Level = 1.3	0.086 (90th percentile)	0.197 (90th percentile)	0.251 (90th percentile)	Erosion of natural deposits, corrosion of plumbing and leaching from treated wood preservatives
Chromium	ppm	0.1	< 0.10	NR	0.0022	Erosion of natural deposits, discharge from steel and/or pulp mills and plating operations
Fluoride	ppm	4	0.88	2.79	1.59	Erosion of natural deposits, discharge from aluminum and/or fertilizer factories and water treatment
Lead[a]	ppm	Action level = 0.015	1 (90th percentile)	0.0012 (90th percentile)	0.004 (90th percentile)	Erosion of natural deposits and corrosion of plumbing materials
Mercury	ppm	0.002	NR	NR	< 0.0002	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo 2012 (latest results - average)	City of Canyon 2012 (latest results - average)	Pantex Water System 2013	Typical Source or Effect
Nitrate	ppm	10	1.32	1.41	1.38	Runoff from feedlots and the use of fertilizer, leaching from septic systems and erosion of natural deposits
Nitrite	ppm	1	NR	ND	< 0.04	Runoff from feedlots and the use of fertilizer, leaching from septic systems and erosion of natural deposits
Selenium	ppm	0.05	NR	NR	0.004	Discharge from petroleum refineries, erosion of natural deposits and discharge from mining operations
Thallium	ppm	0.002	NR	NR	< 0.002	Leaching from ore-processing, discharge from electronics production and discharge from glass production industries
Biological						
Total Coliform	positive/ negative	Action Level = greater than 5 positive samples	1.6 (highest monthly percent positive)	0	0	Indicator organism for potential pathogens
Radionuclides (averaged)						
Gross Alpha Emitters	pCi/L	15	6.3	7.3	5.10	Erosion of natural deposits
Gross Beta Photon Emitters[b]	pCi/L	50	5.25	9.4	11.35	Decay of natural and man-made deposits

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo 2012 (latest results - average)	City of Canyon 2012 (latest results - average)	Pantex Water System 2013	Typical Source or Effect
Total Radium	pCi/L	5	0	ND	NS	Erosion of natural deposits
Tritium	pCi/L	20,000	NR	NR	-14.87	Naturally occurring elements found in the soil and man-made materials
Secondary Contaminants						
Aluminum	ppm	0.05 – 0.2	NR	NR	< 0.05	Naturally occurring elements found in the soil and man-made materials
Chloride	ppm	300	NR	13	17.66	Naturally occurring elements found in the soil
Color	color units	15	NR	NR	0	Amount of organic material in the water
Corrosivity	mm/year	noncorrosive	NR	NR	0.34	A secondary parameter (non-health related) indicating the aggressiveness of water to corrode piping
Iron	ppm	0.3	NR	< 0.01	0.078	Naturally occurring elements found in the soil
Manganese	ppm	0.05	NR	NR	< 0.005	Naturally occurring elements found in the soil
Silver	ppm	0.1	NR	NR	< 0.001	Naturally occurring elements found in the soil and man-made materials
Sulfate	ppm	300	NR	NR	22.06	Salty taste
Total Dissolved Solids	ppm	1,000	NR	395	281.6	Hardness, salty taste
Zinc	ppm	5	NR	NR	0.007	Metallic taste

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo 2012 (latest results - average)	City of Canyon 2012 (latest results - average)	Pantex Water System 2013	Typical Source or Effect
Trihalomethanes						
Chloroform	ppm	--	0.00011	ND to 0.0012	0.0141	Byproduct of water disinfection
Bromodichloromethane	ppm	--	0.00149	ND to 0.0033	0.012	Byproduct of water disinfection
Chlorodibromomethane	ppm	--	0.0019	ND to 0.006	0.0011	Byproduct of water disinfection
Bromoform	ppm	--	0.00095	ND to 0.0038	0.0056	Byproduct of water disinfection
Sum of Trihalomethanes	ppm	0.08	0.00448	ND to .0143	0.043	Byproduct of water disinfection
Halocetic Acids						
Monochloroacetic Acid	ppm	--	NR	NR	< 0.003	Byproduct of water disinfection
Monobromoacetic Acid	ppm	--	NR	NR	0.0016	Byproduct of water disinfection
Trichloroacetic Acid	ppm	--	NR	NR	0.0024	Byproduct of water disinfection
Dibromoacetic Acid	ppm	--	NR	NR	0.0023	Byproduct of water disinfection
Dichloroacetic Acid	ppm	--	NR	NR	0.0075	Byproduct of water disinfection
Sum of Haloacetic Acids	ppm	0.06	0.00135	ND to .0088	0.014	Byproduct of water disinfection
Water Quality Constituents						
Alkalinity	ppm	--	NR	282	237	Erosion of natural deposits
Calcium (hardness)	ppm	--	NR	220	210	Erosion of natural deposits
Chlorine	ppm	0.2 minimum 4.0 maximum	1.27 min. 1.69 max.	0.4 min. 2.2 max.	1.02 min. 2.43 max.	Disinfectant used to control microbes

Notes
[a] 90th percentile value as defined by the Texas Commission on Environmental Quality
[b] Primary maximum contaminant level (MCL) for the annual dose equivalent to the total body or to an organ. Compliance with this MCL is assumed if gross beta particle activity is less than 50 pCi/L, and if the average annual

concentration of tritium is less than 20,000 pCi/L and strontium-90 is less than 8 pCi/L.
Action Level is the concentration of a contaminant that triggers a treatment technique requirement. Treatment techniques are implemented to reduce contaminant level(s).
CCL is EPA's Contaminant Candidate List. CCLs are evaluated to determine if regulatory limits are necessary.
NR means none reported.
NS means no sample taken.
ppm means parts per million (milligarms/liter).
ppb means parts per billion (micrograms/liter)
S.U. means standard units.
ND means not detected.

7.5.5 Disinfection By-Products

Disinfection By-products (DBPs) are produced by the reaction between the disinfectant (chlorine) and organic matter in the water. Reducing the amount of organic matter in the source water before disinfection can help control the quantity of DBPs produced. In addition, limiting the amount of disinfectant introduced in the system reduces the formation of these byproducts. All public water systems where chlorine is used are required to maintain residual levels between 0.2 and 4.0 mg/L (milligrams per liter) throughout the distribution system. These levels provide assurance that the water is safe from most water-borne pathogens while minimizing any adverse health risks to the population from DBPs or the higher concentrations of chlorine.

DBPs are broken into two groups: total trihalomethanes (TTHMs) and haloacetic acids (HAA5). TTHMs are reported as the sum of the chloroform, dibromochloromethane, bromo-dichloromethane, and bromoform concentrations in milligrams per liter. Haloacetic acids are reported as the sum of the monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid concentrations in milligrams per liter. All tests for DBPs were at or below Safe Drinking Water Act MCLs.

7.6 Inspections

In August 2013, a TCEQ contractor sampled for DBP's and nitrate in the Pantex Plant public water supply system. Sample results were below any regulatory limits under EPA's Safe Drinking Water Act. As a result, Pantex continued to meet or exceed all applicable requirements for a public water supply system and maintain the status of a "Superior" water supply system.

7.7 Conclusions

Pantex continues to providing safe drinking water to all of its customers while maintaining the status of a "Superior" water supply system. During a time of historic drought, Pantex continues to explore new methods of water conservation and water use reduction.

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Pantex operates an on-site wastewater treatment facility. The wastewater treatment system consists of a facultative lagoon and two wastewater storage lagoons. This facility is permitted by the Texas Commission on Environmental Quality (TCEQ) to treat and dispose of domestic and industrial wastewater. During 2013, Pantex beneficially reused more than 250 million gallons of treated wastewater and treated groundwater for agricultural purposes.

8.1 The Scope of the Program

Domestic and industrial wastewaters generated at Pantex Plant are treated at an on-site Wastewater Treatment Facility (WWTF). Industrial effluents from Plant operations are generally pre-treated and are directed into the WWTF for further treatment. All such effluents are collected in the sanitary sewer, managed in the WWTF, and are either disposed through a permitted outfall[34] to an underground irrigation system or discharged through a permitted outfall to an on-site playa lake. The playa is an ephemeral lake and is not connected to any other lakes, rivers, or streams (Figure 8.1).

FIGURE 8.1 — *Playa 1 (in previous years)*

The WWTF (Figure 8.2) is a clay-lined, facultative lagoon that covers approximately 1.58 hectares (3.94 acres) and has a capacity of 42 million liters (11 million gallons). Pantex also has two storage lagoons used for storage and retention of treated wastewater. The east lagoon is a storage lagoon with a polyethylene liner with similar dimensions and capacity as the facultative lagoon and can serve as the facultative lagoon should the need arise (Figure 8.3). In addition to the treated domestic and industrial wastewater, this lagoon receives treated groundwater from environmental remediation projects.

[34] An outfall is a predetermined point of compliance for wastewater monitoring where effluent is discharged to the environment. All permit-required sampling is conducted at this point.

FIGURE 8.2 — *Wastewater Treatment Facility, Facultative Lagoon*

FIGURE 8.3 — *East Wastewater Storage Lagoon*

The northern storage lagoon is a clay-lined lagoon, which covers approximately 1.05 hectares (2.6 acres) and has a capacity of 25.54 million liters (6.7 million gallons). This lagoon is used only for the storage of treated wastewater (Figure 8.4).

The treatment process in the facultative lagoon involves a combination of aerobic, anaerobic, and facultative bacteria. At the surface, aerobic bacteria and algae exist in a symbiotic relationship. Oxygen is provided by natural aeration processes, algal photosynthesis, and by solar-powered mechanical aerators. Bacteria use the oxygen for the aerobic degradation of organic matter. Nutrients and carbon dioxide released in the degradation process are used by the algae. Below the surface and above the bottom of the lagoon, treatment and degradation of organic matter is accomplished with facultative bacteria. At the bottom of the facultative lagoon, organic matter is deposited in a sludge layer and is decomposed by anaerobic bacteria. The wastewater treatment process in a facultative lagoon is complex and nearly all treatment is provided by biological activity.

FIGURE 8.4 — *Wastewater Storage Lagoon*

8.2 Operational Description and Metrics

The TCEQ is the permitting authority for wastewater discharges. During 2013, Pantex had three authorizations for wastewater disposal. These authorizations require analytical monitoring and periodic reporting to the TCEQ.

Pantex is permitted to dispose of treated wastewater by means of a subsurface irrigation system into agricultural fields for beneficial reuse. This permit is referred to as a Texas Land Application Permit (TLAP, WQ0004397000). This permit was modified and reissued on April 5, 2012, and will expire on December 1, 2020. Modifications included a reduction in the number of required parameters based on lack of detection of the parameters during previous monitoring.

During periods when the agricultural fields are fallow, Pantex is authorized to apply limited quantities of wastewater to the irrigation area under an Underground Injection Control (UIC) authorization (5W2000017). There is no expiration date on this authorization.

Finally, Pantex maintains a Texas Water Quality Permit that allows it to discharge treated wastewater to an on-site playa (WQ0002296000). This permit was renewed by the TCEQ on February 10, 2012 and will expire on December 1, 2015. Through compliance with these three authorizations, the Department of Energy and Pantex manage and discharge treated effluent in a manner that is beneficial to the environment.

When discharging to the subsurface irrigation system and prior to application in the fields, the treated wastewater passes through a series of filters designed to remove dirt, debris, and particulate matter. After filtration, the water is pumped to a field filter building where it is filtered again. From this point, water is distributed through manifold pipes to individual zones located within four tracts of land that are each approximately 100 acres in size. Fertilizers and maintenance chemicals are injected into the system through chemical tanks at the field filter building (Figure 8.5). This irrigation system consists of hundreds of miles of piping, tubing, and pressure-compensating drip emitters. The irrigation area consists of agricultural land farmed by Texas Tech University (TTU). Crops grown in this area may include winter wheat, sorghum, soybeans, cotton, corn, oats, and opportunity wheat. Crops will vary from field to field, depending on the cropping needs of TTU.

FIGURE 8.5 — Chemical Injection Tanks

During 2013, Pantex beneficially applied approximately 253 million gallons of treated wastewater to crops managed by TTU (Figure 8.6). This is an increase of 63 million gallons compared to operations during 2012. The increase is due to upgrades to the distribution system and the addition of another 100-acre irrigation tract.

FIGURE 8.6 — Irrigation Tract 101

Since 2004, Pantex has beneficially reused more than one billion gallons of treated wastewater (i.e., domestic, industrial and treated water from Environmental Restoration activities) for crop production. During 2013, opportunity wheat, winter wheat and soybean were grown. Table 8.1 shows the volume of water applied for each irrigation tract.

TABLE 8.1— *Annual Irrigation Summary, 2013*

Irrigation Tract	**Irrigation Area** (acres)	**Volume Applied** (gallons)	**Volume Applied** (acre ft./ac)
101	100.86	87,482,114	2.7
201	100.5	45,914,382	1.4
301	98.75	86,309,279	2.7
401	97.9	44,588,222	1.4

8.3 Sampling Locations

Sampling was conducted at the incoming weir of the lagoon system (before treatment) and at the permitted discharge point(s): (a) for the subsurface irrigation system, Outfall 031, or (b) for the surface water discharge, Outfall 001. Monitoring the water quality at the incoming weir was done to determine the effectiveness of the wastewater treatment system. Results of these efforts showed that the treatment system adequately treats the wastewater to comply with all effluent limitations. During 2013, there was no discharge through, and thus no sampling at, Outfall 001.

8.4 Analytical Results

Sampling was routinely conducted at permitted Outfall 031. Permit-required analyses were reported to the TCEQ in September 2013. There were no exceedances under either permit. A summary of the results from 2013 is shown in Table 8.2.

TABLE 8.2 - ***Water Quality Results from Outfall 031, 2013***

Analyte	TLAP Limits (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Average Concentration (mg/L)	Permit Exceedance/ Violation	Percent Compliance
Copper	2.0	0.006	0.044	0.018	0/0	100
Manganese	3.0	0.006	0.016	0.010	0/0	100
Zinc	6.0	0.003	0.009	0.006	0/0	100
HMX	Report	< 0.001	< 0.001	< 0.001	0/0	100
RDX	Report	< 0.001	< 0.001	< 0.001	0/0	100
PETN	Report	< 0.001	0.001	< 0.001	0/0	100
TNT	Report	< 0.001	< 0.001	< 0.001	0/0	100
Ammonia	Report	0.15	1.31	0.47	0/0	100
BOD	Report	11.0	26.6	14.9	0/0	100
COD	Report	15.2	67.9	37.9	0/0	100
NO2/NO3	Report	0.06	0.79	0.37	0/0	100
Oil/Grease	Report	1.5	4.5	2.6	0/0	100
pH[a]	6.0 Min. 10.0 Max.	8.6	9.5	9.1	0/0	100
Total Kjeldahl Nitrogen	Report	1.52	4.82	2.69	0/0	100

[a] pH is measured in standard units and not in mg/L.
An exceedance is defined as a measured value above or below a permit limit.
A violation is defined as a missing permit parameter such as failure to obtain a sample required by the permit.

All permit-required samples were taken from Outfall 031, with no reported violations. All sample results were within any effluent limitations established in the Land Application Permit Results from the required soil monitoring in the irrigation application area are provided in Chapter 10 of this report.

8.5 Historical Comparisons

Results for ammonia, biochemical oxygen demand (BOD), chemical oxygen demand (COD), explosives, metals, and oil and grease were within expected ranges and did not exceed permit limits.

8.6 Conclusion

Pantex Plant is the only facility in the DOE-complex that beneficially reuses all of its treated wastewater for agricultural purposes. During a period of extreme drought in the region, Pantex not only treats the wastewater, but provides essential water for the irrigation of crops while remaining protective of the environment. Since the subsurface irrigation system was installed in 2004, Pantex has not exceeded any effluent limitations.

Data from the surface water program during 2013, while limited due to a persistent drought, were consistent with historical data from past monitoring activities, indicating that operations at Pantex Plant did not adversely impact the surface water environment at Pantex. No significant changes were made to the surface water sampling program in 2013.

9.1 The Scope of the Program

Pantex Plant is located in a region of relatively flat topography and with a semi-arid climate. Surface water represented by rivers or streams does not exist around the facility site and all surface water drains to isolated playa lakes. Playa lakes are a unique topographic feature in the Texas Panhandle. They are shallow, ephemeral lakes that have clay-lined basins that fill periodically with surface water runoff. There are approximately 20,000 of these playas on the southern High Plains. Playa lakes are extremely important hydrologic features that provide prime habitat for wildlife, especially waterfowl that winter in the southern High Plains. Playas are also believed by most authorities to be an important source of recharge for the Ogallala Aquifer, the area's primary source of groundwater.

At Pantex, six playas are located on U.S Department of Energy (DOE)-owned and -leased property. Two of these are on property owned by Texas Tech University (TTU). Most of the surface drainage on the DOE-owned and -leased lands flows via man-made ditches, natural drainage channels, or by sheet-flow to these on-site playa basins. Playa basins consist of the ephemeral lakes themselves and their surrounding watersheds (Figure 9.1). Figure 9.2 shows the locations of the six playas at the facility site with their respective drainage basins (watersheds). Some storm water flows to off-site playas. These areas are at the outer periphery of the site and, for the most part, a considerable distance from most Plant operations.

FIGURE 9.1 — *Playa Basin at Pantex Plant*

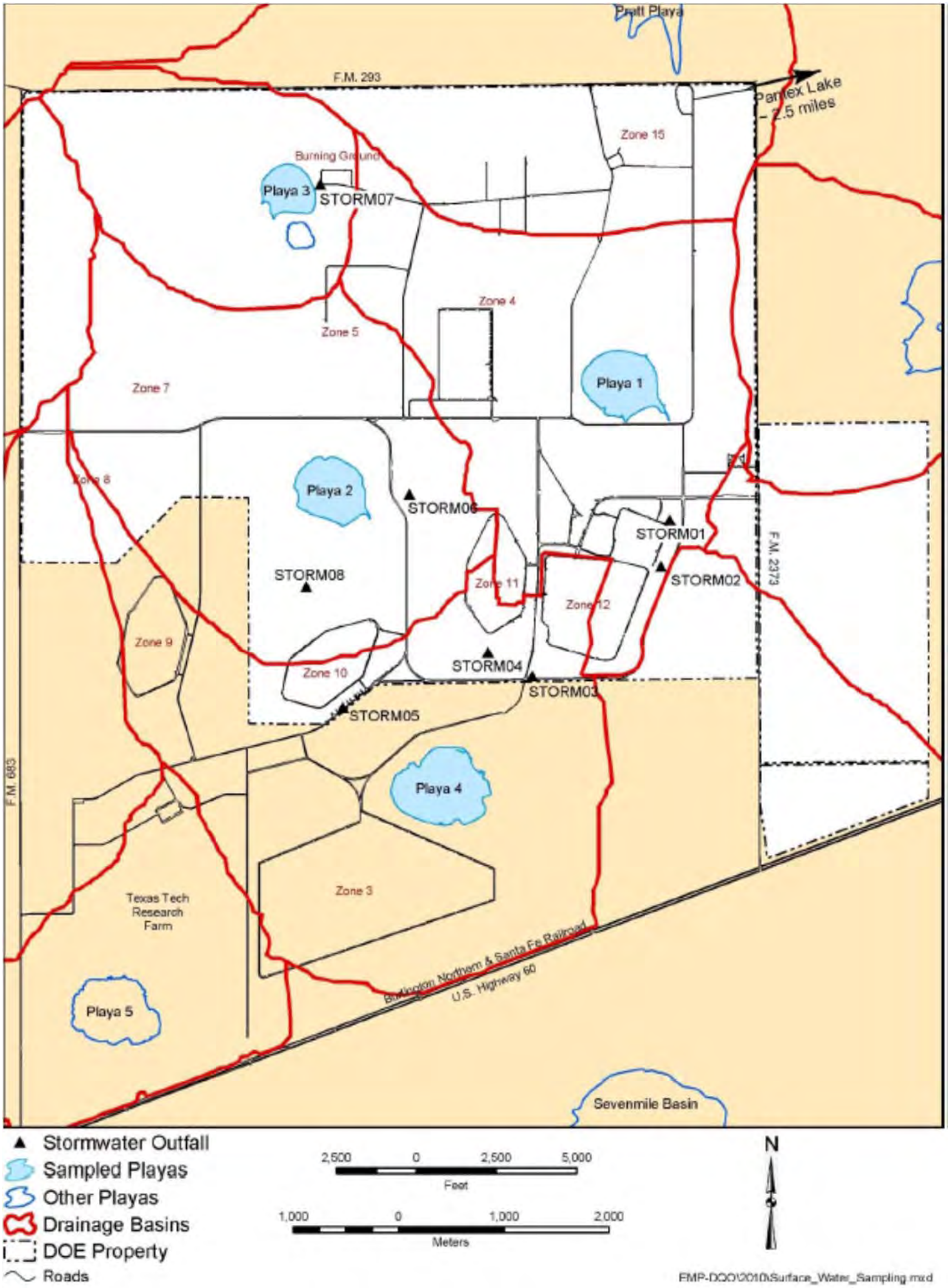

FIGURE 9.2 — ***Drainage Basins, Playas, and Storm Water Outfalls at Pantex Plant***

Effluent from the Wastewater Treatment Facility (WWTF) and storm water runoff from Zones 4, 12, and the northeastern portion of Zone 11 are permitted to discharge through ditches to Playa 1. Storm water runoff from southwestern portions of Zone 11 is channeled to Playa 2 via the ditch system. Storm water runoff from the Burning Ground flows, primarily as sheet flow, into Playa 3. Storm water runoff from southern portions of Zones 10, 11, and 12, discharges into Playa 4 on TTU property. There are no Plant discharges to Pantex Lake, which is located on DOE property to the northeast of the main Plant property, or to Playa 5, which is on TTU property to the southwest. Both of these playas receive storm water runoff from surrounding pastures and agricultural operations.

9.2 Sampling Locations and Monitoring Results

Surface water sampling occurs as a result of precipitation or discharge events. During 2013, sampling was conducted in accordance with permits issued by the Texas Commission on Environmental Quality (TCEQ) and Data Quality Objectives developed by Pantex media scientists. The TCEQ has been delegated as the permitting authority by the U.S. Environmental Protection Agency (EPA) for storm water discharges in Texas.

Storm water runoff at Pantex Plant is sampled in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit (MSGP) TXR050000 for storm water. The MSGP was issued in July of 2011 by the TCEQ. Pantex filed for coverage under the MSGP in November of 2011. The permit expires in August of 2016. Storm water sampling locations, known as “outfalls,” are conveyances in which storm water accumulates and discharges. Locations have been selected based on their proximity to operational areas of the Plant.

The TCEQ developed a five year general permit (TPDES General Permit No TXR150000), relating to storm water discharges associated with construction activities. The general permit expires in March of 2018. Under this permit, four TPDES construction project specific permits were in effect at Pantex at the end of 2013. These permits do not require analytical monitoring, but rely on best management practices, such as storm water pollution prevention plans, erosion controls, soil stabilization controls, and routine field inspections.

Pantex conducted storm water monitoring during 2013 at designated sampling locations in accordance with permit requirements. Environmental surveillance monitoring was also conducted at the playas as a best management practice. Appendix A lists the 2013 surface water analytes. In addition to routine sampling at four on-site playas, Pantex Plant has eight storm water outfalls (shown on Figure 9.2). The flow diagram in Figure 9.3 depicts how storm water and treated industrial effluents discharge through the outfalls, and ultimately to the playas or a subsurface drip irrigation system on the Pantex site.

During 2013, sampling was conducted at all eight storm water outfalls. Playa sampling was only conducted at Playa 1 during 2013. Based on data from the Amarillo National Weather Service (NWS) located northeast of Amarillo and southwest of Pantex Plant, rainfall during 2013 was again below normal for the third consecutive year with approximately 38.61 cm for the year (15.20 inches). While rainfall for Amarillo in 2013 was improved from previous years it was still below average. The annual average rainfall each year is typically 50.1 cm (19.71 inches). The continued drought during 2013 was not a localized event but included parts of New Mexico, Colorado, Kansas, Oklahoma, and significant portions of the State of Texas.

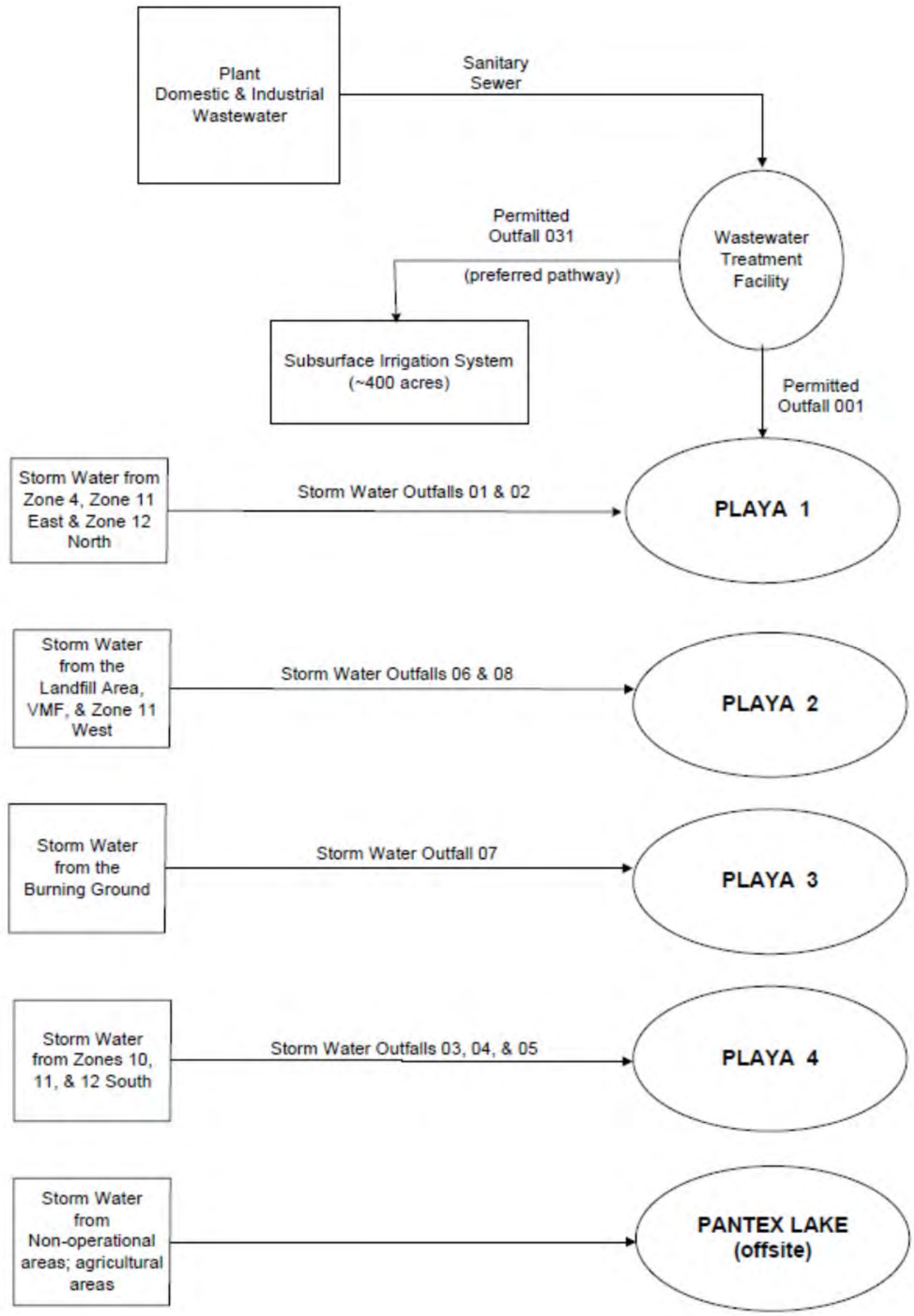

FIGURE 9.3 — *Pantex Surface Water Schematic, 2013*

Storm water monitoring required by the TPDES MSGP in 2013 consisted of both visual monitoring and analytical monitoring. Both are required each year for the duration of the MSGP. Visual monitoring involves the examination of the physical properties of storm water including color, clarity, odor, oil sheen, solids, and foam. Visual samples taken and examined in 2013 appeared to be of good quality, and none showed any abnormalities based on the criteria specified in the MSGP. Analytical monitoring consisted of metals (Inland Water Quality Parameters [IWQPs]) listed in Title 30 of the Texas Administrative Code (30 TAC), Chapter 319 and sector-specific analytes required by the MSGP. Metals were compared with IWQPs. Sector-specific analytes are compared to benchmarks listed in the MSGP. Table 9.1 lists the results for metals from the storm water outfalls in 2013 and compares them with the IWQPs.

TABLE 9.1 — *Annual Storm Water Results (metals), 2013 (mg/L)*

	Outfall STORM01	Outfall STORM02	Outfall STORM03	*Outfall STORM04*	Outfall STORM05	Outfall STORM06	Outfall STORM07	Outfall STORM08	IWQP
Arsenic	<0.005	<0.005	<0.005	0.002 <0.005	<0.005	<0.005	0.002	<0.005	0.3
Barium	0.168	0.034	0.063	0.054 0.053	0.039	0.295	0.393	0.088	4.0
Cadmium	<0.001	<0.001	<0.001	<0.001 <0.001	0.0002	0.001	0.0004	<0.001	0.2
Chromium	0.003	<0.01	<0.01	<0.01 <0.01	<0.01	0.003	0.009	<0.01	5.0
Copper	0.012	0.002	0.002	0.006 0.006	0.004	0.019	0.01	0.005	2.0
Lead	0.005	0.0008	0.001	0.001 0.001	0.001	0.008	0.008	0.002	1.5
Manganese	0.085	0.018	0.019	0.027 0.023	0.018	0.204	0.134	0.037	3.0
Mercury	<0.0002	<0.0002	<0.0002	<0.0002 <0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.01
Nickel	0.006	0.002	0.002	0.003 0.003	0.002	0.008	0.009	0.004	3.0
Selenium	<0.005	<0.005	<0.005	<0.005 <0.005	<0.005	<0.005	<0.005	<0.005	0.2
Silver	<0.001	0.0003	<0.001	<0.001 <0.001	<0.001	<0.001	<0.001	<0.001	0.2
Zinc	0.071	0.015	0.018	0.023 0.020	0.017	0.127	0.047	0.015	6.0
IWQP= Inland Water Quality Parameter limits, 30 TAC §319.22									

9.2.1 Playa 1 Basin

Playa 1 is approximately 32 hectares (79.3 acres) in size and may receive treated wastewater effluent and storm water runoff from several small drainages. One of the drainages to the playa is associated with Plant operations (permitted Industrial Wastewater Outfall 001). The other drainages receive only storm water runoff from agricultural and operational areas only. There are three drainages along the southern perimeter of Playa 1. All three include storm water from both agricultural and operational areas. Storm Water Outfalls 01 and 02 are located upstream in one of these drainages, which originates from some of the operational areas of Zone 12 North. The western edge of Playa 1 receives storm water runoff from the

Zone 4 area. Two additional drainages transport storm water runoff from agricultural areas that are north of the playa. In 2013, storm water monitoring was conducted at Playa 1 and both Storm Water Outfalls 01 and 02.

Playa 1 was sampled twice in the third quarter during 2013. The first monitoring event was a co-sample with Texas Department of State Health Services (TDSHS) for radionuclides during the month of July. The second sampling in September was for metals, VOCs, SVOCs, explosives, and radionuclides. Metals analyses were all consistent with historic levels found at the playa and all were below the IWQPs. VOCs, and SVOCs were below their respective PQLs. Tritium was below the MCL for drinking water. Isotopic radiological analyses for uranium and plutonium were below the DCGs for ingested water. Explosives were below their respective PQLs except for HMX and RDX detected at 0.00078 and 0.00063 mg/l respectively. Both of these explosives have been detected at these levels historically at Playa 1 in the past. HMX and RDX are legacy contaminants from operations conducted decades ago.

Storm Water Outfall 01—Zone 12 North at BN5A. BN5A is the Pantex Plant designation for the parking lot located north of operational areas, south of Playa 1, and west of agricultural areas. Flow through this outfall consists entirely of storm water and originates in the operational areas of Zone 12 North. Storm water flows northward from the outfall through the BN5A ditch and on northward, finally discharging into Playa 1.

Permit-required monitoring at Storm Water Outfall 01 was conducted during the first, second, and third quarters of 2013. Monitoring included visual monitoring, pH evaluation and metals analysis. Visual examinations showed no abnormalities based on the visual criteria described in the MSGP. All metals were below IWQPs in 2013.

Storm Water Outfall 02—Zone 12 East at S. 15th Street. Flow through this outfall includes storm water discharges from the eastern portions of Zone 12 South which includes some of the operational areas of the Plant.

Permit-required monitoring at Storm Water Outfall 02 was conducted during the first, second, and third quarters of 2013. Monitoring included visual monitoring, pH evaluation and metals analysis. Visual examinations showed no abnormalities based on the visual criteria described in the MSGP. All metals were below IWQPs in 2013.

9.2.2 Playa 2 Basin

Playa 2 is approximately 30 hectares (74 acres) and receives only storm water runoff. Playa 2 receives runoff from the northwest side of Zone 11, the north side of Zone 10, the Weapons Training & Tactics Facility, and an area of agricultural fields that includes both pasture and cultivated fields. Two storm water outfalls, Outfalls 06 and 08, are both within the Playa 2 basin. In 2013, storm water monitoring within the Playa 2 basin was conducted at Outfall 06 and Outfall 08; however, due to drought conditions, no storm water monitoring occurred at Playa 2.

Storm Water Outfall 06 —Vehicle Maintenance Facility (VMF). This outfall receives storm water runoff from an area that includes the VMF and portions of the parking lot around the VMF where vehicles awaiting maintenance are staged (Figure 9.4). The refueling stations for the Plant fleet are also located in this drainage area. The drainage area is primarily a paved lot used for parking and staging vehicles on the south side of the VMF.

Permit-required monitoring at Storm Water Outfall 06 was conducted during the first, second, and third quarters of 2013. Activities included visual monitoring, pH testing, total petroleum hydrocarbons (TPHs) analysis and metals analysis. Visual examinations showed no abnormalities based on the visual criteria contained in the MSGP. TPH results were low in each quarter indicating that runoff from the VMF staging area and refueling operations is not contributing significant pollutants to the environment. All metals were below IWQPs in 2013.

FIGURE 9.4 —*Storm Water Outfall 06*

Storm Water Outfall 08—Landfill. This outfall receives storm water runoff from an area that includes the Plant's active landfill (Figure 9.5). Runoff from active open landfill cells is retained within the cells. Storm water runoff at the outfall consists of runoff over the landfill area, including runoff over closed cells. Storm water from this area eventually makes its way northward to Playa 2.

Permit-required monitoring at Storm Water Outfall 08 was conducted during the first and second quarters of 2013. Monitoring included visual monitoring, pH evaluation and metals analysis. Visual examinations showed no abnormalities based on the visual criteria described in the MSGP. All metals were below IWQPs in 2013. Sector-specific monitoring is required at this location and includes total suspended solids (TSS) and iron. TSS was below the benchmark level of 100 mg/L at 42.8 mg/L. Iron was detected at 2.14 mg/L (benchmark level, 1.0 mg/L). Both of these analytes have been above benchmark levels historically and are characteristic of past results. These results are not indicative of a contaminant problem but reflect the nature of storm water at the site.

9.2.3 Playa 3 Basin

Playa 3, the smallest playa at the Pantex site, is approximately 22 hectares (54 acres) and receives only storm water runoff from pastureland, cultivated fields, and portions of the Burning Ground. No well-defined ditches feed into the playa and runoff occurs primarily as sheet flow. Storm Water Outfall 07 is located within the basin and is northeast of Playa 3 between the playa and the Pantex Burning Ground. In 2013, storm water monitoring within the Playa 3 basin was conducted at Storm Water Outfall 07. Playa 3 was never sampled during the year because of drought conditions.

FIGURE 9.5 — *Storm Water Outfall 08*

Storm Water Outfall 07—Burning Ground. This outfall receives only storm water runoff, primarily as sheet flow, from the Burning Ground operational area. For this reason, sampling at the outfall can be a challenge. The drainage area is primarily grassland, and the outfall is located between the Burning Ground to the northeast and Playa 3 to the southwest.

Permit-required monitoring at Storm Water Outfall 07 was conducted during the second quarter of 2013. Monitoring included visual monitoring, pH evaluation and metals analysis. Visual examinations showed no abnormalities based on the visual criteria described in the MSGP. All metals were below IWQPs in 2013.

9.2.4 Playa 4 Basin

Playa 4 is approximately 46 hectares (112.5 acres) and is located on property owned by Texas Tech University. The playa receives runoff primarily from pasture areas but does receive storm water runoff from portions of Zone 10 (through Storm Water Outfall 05), Zone 11 (through Storm Water Outfall 04), and Zone 12 South (through Storm Water Outfall 03). Discharges from Zone 12 are predominately storm water runoff; however, occasionally, Fire Department personnel discharge water when flushing storage tanks or testing fire hydrants. In 2013, storm water monitoring within the Playa 4 basin was conducted at Storm Water Outfalls 03, 04, and 05. Playa 4 was never sampled during the year due to drought conditions.

Storm Water Outfall 03—Zone 12 South. Surface water monitored at this outfall is primarily storm water runoff from the west half of Zone 12 South. Periodically, water from the Plant's fire protection system is discharged through this outfall. There are no industrial effluents discharged through this outfall.

Permit-required monitoring at Storm Water Outfall 03 was conducted during the first, second, and third quarters of 2013. Activities included visual monitoring, pH testing, and metals analyses. Visual examinations showed no abnormalities based on the visual criteria contained in the MSGP and the pH was normal. All metals were below IWQPs in 2013.

Storm Water Outfall 04—Zone 11 South. Surface water monitored at this outfall is entirely storm water runoff from the southern half of Zone 11. Storm water from this area discharges southward through the outfall to Playa 4 (Figure 9.6). There are no industrial effluents discharged through this outfall.

Permit-required monitoring at Storm Water Outfall 04 was conducted during the first, second, and third quarters of 2013. Monitoring included visual monitoring, pH evaluation and metals analysis. Visual examinations showed no abnormalities based on the visual criteria described in the MSGP and pH was normal. All metals were below IWQPs in 2013.

FIGURE 9.6 — *Technician Checking Storm Water Outfall 04*

Storm Water Outfall 05—Zone 10 South. Surface water monitored at this outfall is entirely storm water runoff from the southern half of Zone 10 in an area where several contractor laydown yards are located. Some of the laydown yards contain overhead storage tanks for re-fueling vehicles and heavy equipment. Waste staging, primarily scrap metal, is conducted in the area as well as container staging. Drainage in this vicinity is very flat. There are no industrial effluents discharged through this outfall.

Permit-required monitoring at Storm Water Outfall 05 was conducted during the first, second, and third quarters of 2013. Monitoring included visual monitoring, pH testing and metals analyses. Visual examinations showed no abnormalities based on the visual criteria contained in the MSGP. All metals were below IWQPs in 2013.

9.2.5 Pantex Lake

Pantex Lake is the largest playa controlled by the DOE and is approximately 136 hectares (337 acres) in size. The playa is located off the Plant proper in a remote area northeast of the main Plant site, approximately 2.5 miles to the northeast. It receives only storm water runoff from surrounding pastures and cultivated fields. Although Plant discharges to Pantex Lake were discontinued in 1970, routine monitoring at the playa continued through 2003 because of those wastewater discharges. There are no monitored storm water outfalls in the Pantex Lake basin.

9.3 Historical Comparisons

Limited storm water sampling data was available in 2013 because of continuing dry conditions during the year. Sampling results from storm water outfalls that were available during 2013 showed no significant changes during the year. Results were consistent with historical data from past years. All monitoring results for metals are within the IWQP established by the State of Texas. TPH results are consistent with samples taken in the past. Sampling continues to indicate that storm water discharges at Pantex are of good quality and that current operations at the Plant are not degrading storm water quality.

Very little playa sampling results were obtained during 2013 due to continued dry conditions that persisted for the entire year. Therefore, historical comparisons were limited to only Playa 1. Results that were obtained during 2013 were very similar with past monitoring results. The limited data continues to support the position that operations at Pantex Plant are not negatively impacting the water quality of the playa.

9.4 Conclusions

Monitoring storm water runoff at Pantex Plant is performed as required by the TCEQ's general permits. The playa lakes at Pantex are monitored as a best management practice. Data are often limited due to the semi-arid climate and drought conditions that often occur in the Texas Panhandle. Based on the data collected in 2013, surface water monitoring at Pantex Plant continues to reinforce the premise that continuing Plant operations are having no detrimental impact to the quality of the surface waters at the Plant.

Results of permit required soil monitoring are reported in this chapter. Results of soil monitoring conducted at the Pantex Burning Ground in 2013 were within established background comparison values. A renewed and amended Texas Land Application Permit was issued on April 5, 2012 that included changes to the parameters for soil monitoring conducted at the subsurface irrigation site during 2013.

10.1 The Scope of the Program

This chapter presents the results of permit required soil sampling at Pantex Plant during 2013. Surface soil samples were collected at the Pantex Burning Ground and analyzed for metals and explosives in accordance with Provision VI.H of the Pantex Plant Hazardous Waste Permit HW-50284 (Permit HW-50284). Subsurface soil samples were also collected from four subsurface irrigation tracts and analyzed for various parameters in accordance with Provision V.O of the Pantex Plant Texas Land Application Permit ([TLAP] No. WQ0004397000). All samples were analyzed by off-site contract laboratories that meet U.S. Environmental Protection Agency requirements as discussed in Chapter 13, Quality Assurance. Specific analytes are listed in Appendix A.

10.2 Burning Ground Surface Soil Sampling and Analysis

In 2013, surface soil samples were collected from two general landscape positions: playa bottoms and interplaya uplands. The characteristic soil types for these landscape positions are Randall clay in playas, and Pullman clay loam in the uplands. During 2013, soil was sampled at five on-site locations, representing three upland and two playa sampling areas associated with the Burning Ground. Samples were collected from a depth of zero to two inches from each associated grid area, and combined to form individual composite samples (Figure 10.1).

10.2.1 Surface Soil Data Comparisons

Background comparison levels were determined by obtaining samples during three consecutive calendar quarters in 2006 for each monitoring parameter required by Permit HW-50284. If all analytical results of the background samples for a particular constituent at any location were less than the Method Detection Limit (MDL) identified in Permit HW-50284, the background value was set at the MDL or the Practical Quantitation Limit (PQL), whichever was greater. If less than 50 percent of the analytical results of the background samples for a particular constituent at any location were greater than the MDL, the background value was set at the highest detected value, the MDL, or the PQL, whichever was greater. If the analytical results of more than 50 percent of the background samples for a particular constituent at any location were greater than the MDL, the background value was calculated using a 95 percent upper tolerance limit with 99.9 percent coverage.

10.2.2 Surface Soil Metals Analysis

Soil samples collected from the Burning Ground and Playa 3 were analyzed for 10 metals (See the “BG Soil” column in Appendix A). All of the metal concentrations observed in 2013 were below the established permit background concentrations.

10.2.3 Surface Soil Explosives Analysis

Soil samples collected from the Burning Ground and Playa 3 were analyzed for eight explosive compounds (Appendix A). All sampling results for explosives in 2013 were below the established permit background concentrations as shown in Tables 10.1 through 10.5.

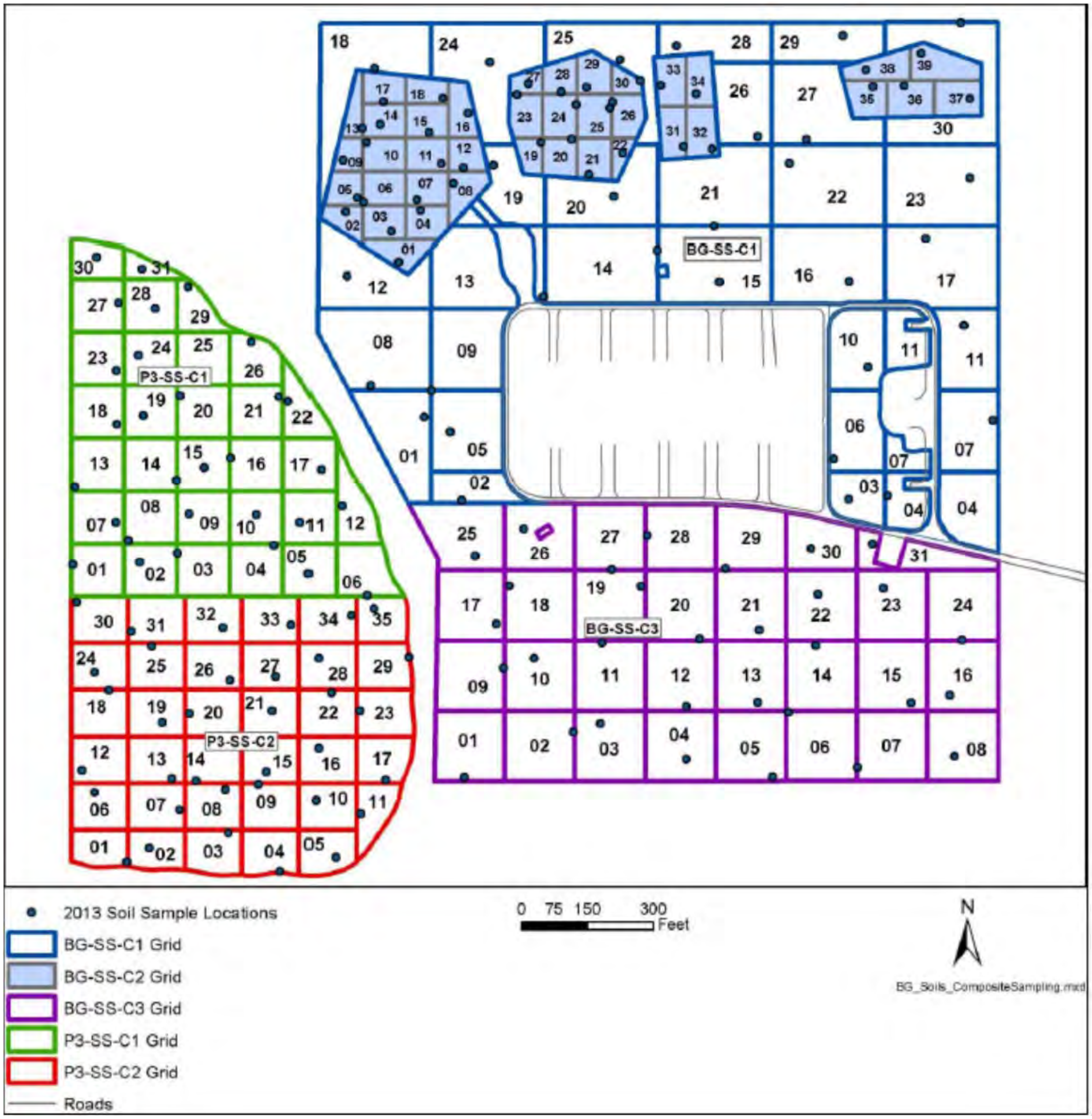

FIGURE 10.1 — ***Burning Ground Multi-Incremental Soil Sampling Locations for 2013***

TABLE 10.1 — ***Calendar Year 2013 Monitoring Results at Location BG-SS-C1 (in mg/kg)***

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Silver (Ag)	1.4	8.42	No
Boron (B)	3.6 J	50.0	No
Cadmium (Cd)	0.69	1.0	No
Cobalt (Co)	8.0	17.55	No

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Chromium (Cr)	13.0	19.93	No
Copper (Cu)	21.0	67.34	No
2,4-dinitrotoluene (DNT24)	< 0.2	0.5	No
2,6-dinitrotoluene (DNT26)	< 0.2	0.5	No
Mercury (Hg)	0.21	0.29	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	89.0	858.24	No
Nickel (Ni)	16.0	29.76	No
Lead (Pb)	19.0	54.76	No
Pentaerythritol tetranitrate (PETN)	< 2.0	5.0	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	0.8	2.6	No
Triaminonitrobenzene (TATB)	3.2	23.25	No
1,3,5-trinitrobenzene (TNB135)	< 0.2	10.0	No
Trinitrotoluene (TNT)	< 0.2	10.0	No
Zinc (Zn)	66.0	160.58	No

TABLE 10.2 — *Calendar Year 2013 Monitoring Results at Location BG-SS-C2 (in mg/kg)*

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Silver (Ag)	0.13	1.0	No
Boron (B)	< 20.0	50.0	No
Cadmium (Cd)	0.28	1.0	No
Cobalt (Co)	8.3	8.77	No
Chromium (Cr)	14.0	16.23	No
Copper (Cu)	23.0	75.38	No
2,4-dinitrotoluene (DNT24)	< 0.2	0.5	No
2,6-dinitrotoluene (DNT26)	< 0.2	0.5	No
Mercury (Hg)	0.02	0.2	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	< 0.2	1.0	No
Nickel (Ni)	16.0	24.53	No
Lead (Pb)	14.0	77.82	No
Pentaerythritol tetranitrate (PETN)	< 2.0	5.0	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	< 0.2	1.0	No
Triaminonitrobenzene (TATB)	< 0.2	3.0	No
1,3,5-trinitrobenzene (TNB135)	< 0.2	10.0	No
Trinitrotoluene (TNT)	< 0.2	10.0	No
Zinc (Zn)	88.0	317.32	No

TABLE 10.3 — *Calendar Year 2013 Monitoring Results at Location BG-SS-C3 (in mg/kg)*

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Silver (Ag)	0.45	1.0	No
Boron (B)	< 20.0	50.0	No
Cadmium (Cd)	0.67	1.0	No
Cobalt (Co)	7.8	18.68	No
Chromium (Cr)	13.0	28.96	No
Copper (Cu)	27.0	53.84	No
2,4-dinitrotoluene (DNT24)	< 0.19	0.5	No
2,6-dinitrotoluene (DNT26)	< 0.19	0.5	No
Mercury (Hg)	0.06	0.2	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	31.0	367.1	No
Nickel (Ni)	15.0	30.88	No
Lead (Pb)	32.0	54.88	No
Pentaerythritol tetranitrate (PETN)	< 1.9	5.0	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	0.36	1.8	No
Triaminonitrobenzene (TATB)	1.6	26.86	No
1,3,5-trinitrobenzene (TNB135)	< 1.9	10.0	No
Trinitrotoluene (TNT)	< 1.9	10.0	No
Zinc (Zn)	69.0	168.0	No

TABLE 10.4 — *Calendar Year 2013 Monitoring Results at Location P3-SS-C1 (in mg/kg)*

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Silver (Ag)	0.18	1.0	No
Boron (B)	< 19.0	50.0	No
Cadmium (Cd)	0.6	1.0	No
Cobalt (Co)	9.2	35.78	No
Chromium (Cr)	16.0	36.35	No
Copper (Cu)	23.0	44.21	No
2,4-dinitrotoluene (DNT24)	< 0.2	0.5	No
2,6-dinitrotoluene (DNT26)	< 0.2	0.5	No
Mercury (Hg)	0.04	0.2	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	< 0.2	1.0	No
Nickel (Ni)	18.0	43.38	No
Lead (Pb)	19.0	54.13	No
Pentaerythritol tetranitrate (PETN)	<2.0	5.0	No

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	< 0.2	1.0	No
Triaminonitrobenzene (TATB)	< 0.2	3.0	No
1,3,5-trinitrobenzene (TNB135)	< 0.2	10.0	No
Trinitrotoluene (TNT)	< 0.2	10.0	No
Zinc (Zn)	76.0	129.75	No

TABLE 10.5 — *Calendar Year 2013 Monitoring Results at Location P3-SS-C2 (in mg/kg)*

Constituent (IRPIMS Code)	2013 Monitoring Result	Background Comparison Level	2013 Monitoring Result Exceeds Background?
Silver (Ag)	0.12	1.0	No
Boron (B)	< 20.0	50.0	No
Cadmium (Cd)	0.44	1.0	No
Cobalt (Co)	8.2	37.21	No
Chromium (Cr)	14.0	49.34	No
Copper (Cu)	18.0	43.93	No
2,4-dinitrotoluene (DNT24)	< 0.2	0.5	No
2,6-dinitrotoluene (DNT26)	< 0.2	0.5	No
Mercury (Hg)	0.04	0.2	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	< 0.2	1.0	No
Nickel (Ni)	15.0	53.18	No
Lead (Pb)	22.0	24.41	No
Pentaerythritol tetranitrate (PETN)	< 2.0	5.0	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	< 0.2	1.0	No
Triaminonitrobenzene (TATB)	< 0.2	3.0	No
1,3,5-trinitrobenzene (TNB135)	< 0.2	10.0	No
Trinitrotoluene (TNT)	< 0.2	10.0	No
Zinc (Zn)	60.0	139.91	No

10.3 Subsurface Drip Irrigation System Soil Sampling and Analysis

In 2013, the annual TLAP subsurface drip irrigation system soil samples were collected from four locations, Tract 101, Tract 201, Tract 301, and Tract 401, with each tract representing 100 acres. Representative soil samples were collected from the root zones of the irrigation areas using random sampling and composite techniques. Each composite sample represented no more than 40 acres with no less than two soil cores representing each composite sample. Subsamples were composited by like sampling depth and soil type, and individually at depths of 0-12 and 12-24 inches for analysis and reporting (Figure 10.2). These composite samples were analyzed for agricultural parameters, reactivity, two high explosives, and one semi-volatile organic compound (SVOC). See the TLAP Soil column in Appendix A for specific analytes.

10.3.1 Subsurface Drip Irrigation System Soil Sampling Results

The 2013 subsurface soil sampling results for high explosives, reactivity, and the one SVOC were all non-detects. The results of the agricultural parameters (nutrient parameters analyzed on a plant available or extractable basis) are presented in Tables 10-6 through 10-9. The TLAP subsurface soil sampling results are reported annually to the Texas Commission on Environmental Quality as report only information, with no comparison values. The agricultural parameters are also used for decision making regarding the addition of nutrient amendments to the agricultural soils.

10.4 Conclusions

On-site Burning Ground surface soil monitoring results for 2013 were within the concentration ranges of the established background levels. Results of soil monitoring conducted at the subsurface irrigation were consistent with previous year’s results and indicate operations are having no negative impact to the environment.

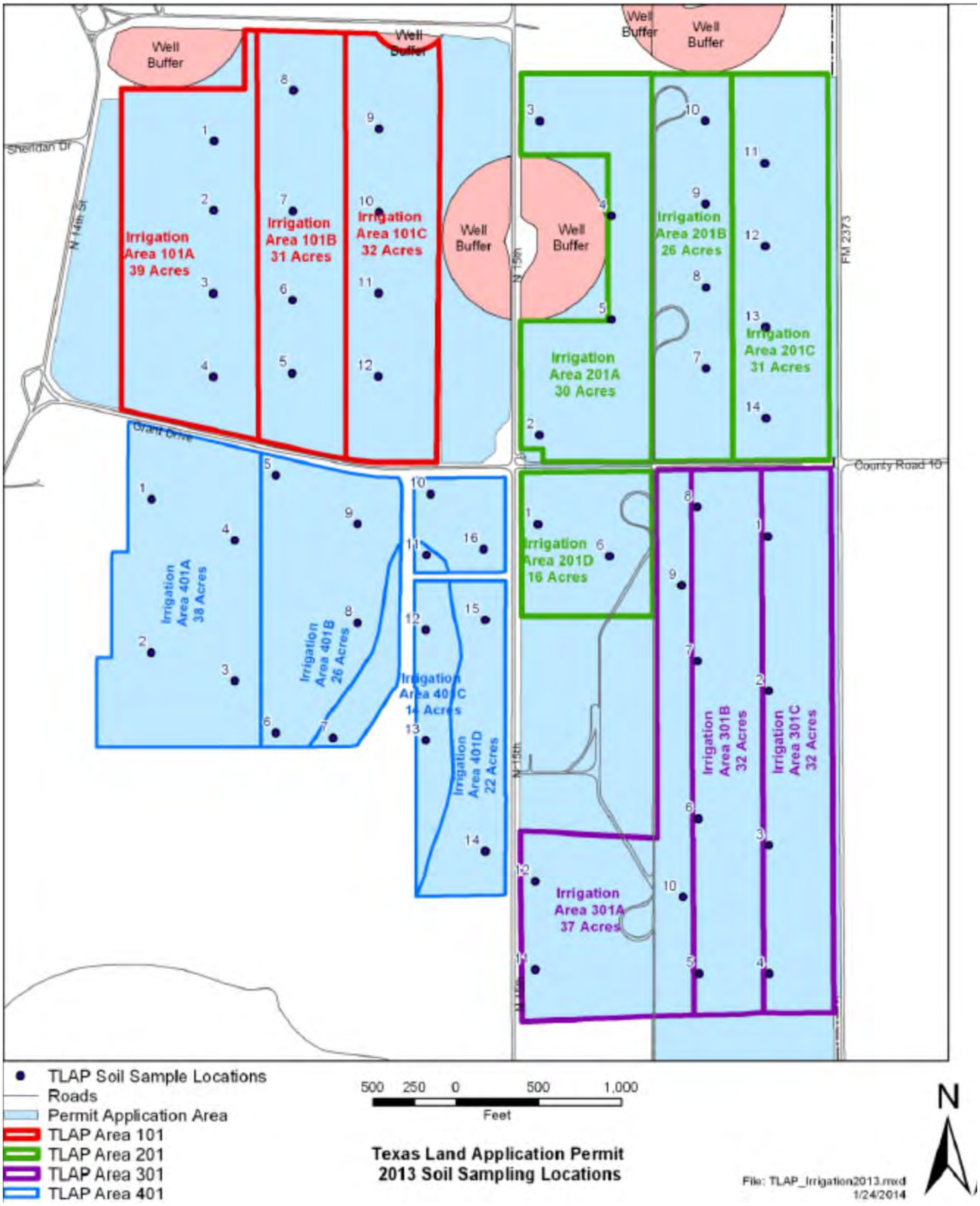

FIGURE 10.2 — *TLAP Soil Sampling Locations for 2013*

TABLE 10.6 — *TLAP Soil Results from Tract 101*

Analyte (Agricultural Parameters)	Tract 101A Measured Value		Tract 101B Measured Value		Tract 101C Measured Value		Unit of Measurement
	Depth (Inches)		Depth (Inches)		Depth (Inches)		
	12	24	12	24	12	24	
pH (2:1 ratio soil pH)	7.5	8	7.4	8	7.3	8.1	pH Units
Total Nitrogen	1,042	787	1,017	624	1,031	588	MG/KG
Nitrate (as Nitrogen)	3.1	1.6	3.1	0.3	3.3	0.3	MG/KG
Total Kjeldahl Nitrogen	1,039	785.4	1013.9	623.7	1027.7	587.7	MG/KG
Ortho Phosphate (Plant-available)	17	8	14	4	17	4	MG/KG
Calcium (Plant-available)	3,818.5	9,170	3,653	8,140	3,488	7,190	MG/KG
Magnesium (Plant-available)	767.5	909	819	1,008	761	1,034	MG/KG
Sodium (Plant-available)	180.5	199	153	207	128	188	MG/KG
Sodium Absorption Ratio (SAR)	1.75	1.9	1.4	1.7	1.2	1.9	
Potassium (Plant-available)	562	431	528	406	570	357	MG/KG
Conductivity (S Salts 1:1)	1.2	0.85	1.19	0.75	1.4	1.01	MMHOS/CM
Calcium (Water-soluble)	107.5	81	113	76	142	91	MG/L
Magnesium (Water-soluble)	23	19	26	17	37	26	MG/L
Sodium (Water-soluble)	75	74	64	63	60	80	MG/L
Sulfur (Plant-available)	17.0	16	17	24	17	24	MG/KG

TABLE 10.7 — *TLAP Soil Results from Tract 201*

Analyte (Agricultural Parameters)	Tract 201A Measured Value		Tract 201B Measured Value		Tract 201C Measured Value		Tract 201D Measured Value		Unit of Measurement
	Depth (Inches)		Depth (Inches)		Depth (Inches)		Depth (Inches)		
	12	24	12	24	12	24	12	24	
pH (2:1 ratio soil pH)	7.8	8.2	7.6	8.2	7.5	8.1	7.9	8.1	pH Units
Total Nitrogen	871	531	897	500	920	590	969	599	MG/KG
Nitrate (as Nitrogen)	18.7	6.8	9.6	2.7	9.5	4	14	5	MG/KG
Total Kjeldahl Nitrogen	852.3	524.2	887.4	497.3	910.5	586	955	594	MG/KG
Ortho Phosphate (Plant-available)	25	10	17	6	13	5	24	7	MG/KG
Calcium (Plant-available)	4,972	9,054	3,483	8,368	3,477	8,321	5,904	7,604	MG/KG
Magnesium (Plant-available)	894	974	805	1,005	757	917	834	959	MG/KG

Analyte (Agricultural Parameters)	Tract 201A Measured Value		Tract 201B Measured Value		Tract 201C Measured Value		Tract 201D Measured Value		Unit of Measurement
	Depth (Inches)		Depth (Inches)		Depth (Inches)		Depth (Inches)		
	12	24	12	24	12	24	12	24	
Sodium (Plant-available)	285	246	200	202	214	171	211	188	MG/KG
Sodium Absorption Ratio (SAR)	2.5	2.4	2.2	2.1	2.2	1.6	2	1.7	
Potassium (Plant-available)	646	475	601	435	550	408	583	436	MG/KG
Conductivity (S Salts 1:1)	1.35	0.94	1.51	0.78	1.4	0.93	1.04	0.82	MMHOS/CM
Calcium (Water-soluble)	110	77	138	66	130	90	94	72	MG/L
Magnesium (Water-soluble)	27	21	35	19	32	23	23	20	MG/L
Sodium (Water-soluble)	114	93	113	76	110	66	82	65	MG/L
Sulfur (Plant-available)	22	23	16	22	16	24	16	18	MG/KG

TABLE 10.8 — *TLAP Soil Results from Tract 301*

Analyte (Agricultural Parameters)	Tract 301A Measured Value		Tract 301B Measured Value		Tract 301C Measured Value		Unit of Measurement
	Depth (Inches)		Depth (Inches)		Depth (Inches)		
	12	24	12	24	12	24	
pH (2:1 ratio soil pH)	7.6	8.2	7.8	8.2	7.9	8.3	pH Units
Total Nitrogen	871	623	908	607	862	545	MG/KG
Nitrate (as Nitrogen)	0.1	0.1	1	0.1	0.9	0.1	MG/KG
Total Kjeldahl Nitrogen	870.9	622.9	907	606.9	866.1	544.9	MG/KG
Ortho Phosphate (Plant-available)	17	4	18	5	18	6	MG/KG
Calcium (Plant-available)	3,229	7,024	4,357	7,595	5,136	7,824	MG/KG
Magnesium (Plant-available)	740	866	706	839	835	925	MG/KG
Sodium (Plant-available)	184	173	170	165	144	173	MG/KG
Sodium Absorption Ratio (SAR)	2.1	1.8	1.8	1.7	1.7	1.8	
Potassium (Plant-available)	439	343	502	403	477	411	MG/KG
Conductivity (S Salts 1:1)	0.67	0.57	0.69	0.59	0.75	0.66	MMHOS/CM
Calcium (Water-soluble)	58	52	67	60	82	60	MG/L
Magnesium (Water-soluble)	17	14	16	15	24	17	MG/L
Sodium (Water-soluble)	70	58	64	57	67	62	MG/L
Sulfur (Plant-available)	14	16	19	13	22	15	MG/KG

Table 10.9 - ***TLAP Soil Results from Tract 401***

Analyte (Agricultural Parameters)	Tract 401A Measured Value		Tract 401B Measured Value		Tract 401C Measured Value		Tract 401D Measured Value		Unit of Measurement
	Depth (Inches)		Depth (Inches)		Depth (Inches)		Depth (Inches)		
	12	24	12	24	12	24	12	24	
pH (2:1 ratio soil pH)	7.1	8.3	7.8	8.3	7.9	7.8	7.9	8.3	pH Units
Total Nitrogen	985	536	884	596	1,063	667	864	546	MG/KG
Nitrate (as Nitrogen)	3.2	0.4	3.3	1.4	21.4	9.3	6.2	0.9	MG/KG
Total Kjeldahl Nitrogen	981.8	535.6	880.7	594.6	1041.6	657.7	857.8	545.1	MG/KG
Ortho Phosphate (Plant-available)	19	5	10	5	25	10	14	7	MG/KG
Calcium (Plant-available)	2,793	7,702	6,752	11,470	4,817	6,695	6,268	9,050	MG/KG
Magnesium (Plant-available)	633	1,004	715	796	509	774	774	934	MG/KG
Sodium (Plant-available)	48	208	74	126	54	117	74	187	MG/KG
Sodium Absorption Ratio (SAR)	0.7	2	0.6	1.2	0.5	1.1	0.6	1.7	
Potassium (Plant-available)	562	399	490	297	551	365	535	410	MG/KG
Conductivity (S Salts 1:1)	0.94	0.53	0.6	0.6	1.17	0.54	0.58	0.5	MMHOS/CM
Calcium (Water-soluble)	114	46	80	56	170	65	70	46	MG/L
Magnesium (Water-soluble)	28	13	15	13	25	13	15	11	MG/L
Sodium (Water-soluble)	33	61	23	39	28	36	23	51	MG/L
Sulfur (Plant-available)	12	13	9	11	20	13	10	14	MG/KG

No changes in the faunal monitoring program were made for 2013, although prairie dog sampling was dropped from a few locations due to a lack of species to sample. Radionuclide concentrations in faunal samples (black-tailed prairie dogs and cottontail rabbits) were compared to historical values and values observed in samples from control locations. Comparisons indicated no detrimental impacts from Plant operations in 2013.

11.1 The Scope of the Program

Faunal surveillance is complementary to air, flora, and water monitoring in assessing potential short- and long-term effects of Pantex Plant operations on the environment. Animals at Pantex Plant were sampled to determine whether Plant activities had an impact on them. Prairie dogs and cottontail rabbits were the species selected for sampling because they interact with both primary (air, water) and secondary (vegetation) environmental media also being analyzed. Prairie dog samples were analyzed for radionuclides and for various diseases that could potentially impact Plant personnel working in areas where prairie dog colonies have been established. Cottontail rabbits were sampled for radionuclides because the rabbits are present across the Plant, including around work areas in Zones 4 and 12.

11.2 Radiological Surveillance in Fauna

Radionuclide surveillance of fauna at Pantex was scheduled semi-annually at nine on-site locations and one control location. They were the Burning Ground, Firing Site 4 (FS-4), Zone 4, Zone 12 South, northwest of Building 12-36, west of Zone 4, Playa 2, Playa 3, Zone 8, and a control site, Buffalo Lake National Wildlife Refuge (BLNWR) near Umbarger, Texas (Randall County). BLNWR was chosen as the control site because populations there are far enough from the Pantex Plant (66 km/41 mi) to be unaffected by Plant operations, and more so than on private lands, affords a dependable availability of prairie dogs and property access. In 2013, prairie dogs were only available in the area west of Zone 4, in Zone 8, near Playa 2, and at BLNWR.

Sample animals are live-trapped, euthanized, and shipped to the analytical lab. Whole-body composites are prepared for determination of tritium, $^{233/234}$Uranium ($^{233/234}$U), and ^{238}Uranium (^{238}U) levels. These analytes are associated with Pantex activities, but are also naturally occurring in Pantex soils.

Analytical results of the 2013 faunal sampling are presented in Table 11.1 (prairie dogs) and 11.2 (cottontails), as are the historical means (1997-2000 for prairie dogs and 2007-2010 for cottontails). Fourteen prairie dogs and eight cottontails were sampled. With the exception of one prairie dog (U^{238}) and two cottontail samples (one each, $U^{233/234}$ and U^{238}) taken at the control site, all 2013 results for cottontail and prairie dog samples were below minimum detection activity (MDA) and all results were similar to or less than historic data.

11.3 General Health and Disease Surveillance in Prairie Dogs

Prairie dog analysis for disease at Pantex Plant began in July 1996. A veterinary medical diagnostic laboratory was subcontracted to assess the health of the prairie dogs through histopathological analysis, necropsy, and complete blood counts using standard diagnostic laboratory procedures. The results provide information about the presence of diseases and the general health of the prairie dog populations at Pantex Plant, and the control site (BLNWR). Cottontails are not tested for disease, but would be subject to sampling for cause-of-death analysis should an outbreak be suspected or indicated.

TABLE 11.1 - *Tritium, ²³³/²³⁴U, and ²³⁸U in Prairie Dogs in 2013, in pCi/g Dry Weight*

Location	No. of Samples (# ≤ MDA)	Maximum[a]	Minimum[a]	Mean ± Std.[b]	No. of Samples in 1997-2000	1997-2000 Mean ± Std
Tritium						
Zone 4 (W)	2 (2)	0.107 ± 0.675	-0.160[c] ± 0.285	-0.027 ± 0.189	--[d]	--
Zone 8	4 (4)	0.091 ± 0.731	-0.376 ± 0.301	-0.183 ± 0.210	14	0.017 ± 0.065
Playa 2	4 (4)	0.322 ± 0.687	-0.392 ± 0.349	-0.091 ± 0.327	14	0.055 ± 0.136
Burning Ground	--	--	--	--	11	0.152 ± 0.300
Playa 3	--	--	--	--	14	0.019 ± 0.070
FS-4	--	--	--	--	--	--
12-36	--	--	--	--	--	--
Buffalo Lake[e]	4 (4)	0.336 ± 0.803	-0.367 ± 0.330	-0.098 ± 0.337	14	0.015 ± 0.055
$^{233/234}$Uranium						
Zone 4 (W)	2 (2)	0.010 ± 0.120	-0.013 ± 0.022	-0.002 ± 0.016	--	--
Zone 8	4 (4)	0.018 ± 0.090	0.011 ± 0.021	0.014 ± 0.003	11	0.012 ± 0.019
Playa 2	4 (4)	0.043 ± 0.043	0.007 ± 0.021	0.027 ±0.017	11	0.013 ± 0.022
Burning Ground	--	--	--	--	9	0.018 ±0.040
Playa 3	--	--	--	--	11	0.020 ±0.022
FS-4	--	--	--	--	--	--
12-36	--	--	--	--	--	--
Buffalo Lake	4 (4)	0.049 ± 0.092	0.017 ± 0.017	0.034 ± 0.014	11	0.017 ± 0.025
^{238}Uranium						
Zone 4 (W)	2 (2)	0.004 ± 0.053	0.000 ± 0.023	0.002 ± 0.003	--	--
Zone 8	4 (4)	0.007 ± 0.046	-0.002 ± 0.008	0.002 ± 0.004	11	0.010 ± 0.021
Playa 2	4 (4)	0.016 ± 0.033	0.000 ± 0.024	0.009 ± 0.008	11	0.009 ± 0.009
Burning Ground	--	--	--	--	9	0.013 ± 0.026
Playa 3	--	--	--	--	11	0.011 ± 0.015
FS-4	--	--	--	--	--	--
12-36	--	--	--	--	--	--
Buffalo Lake	4 (3)	0.036 ± 0.028	0.015 ± 0.026	0.024 ± 0.009	11	0.015 ± 0.029

[a] Counting error at 95percent confidence level. The second of each paired set of values in the "Maximum" and "Minimum" columns is the "error."
[b] Standard deviation. (see definition in glossary.)
[c] Negative values indicate results below the (statistically determined) background level for the counting system used at the analytical laboratory.
[d] Prairie dogs not available.
[e] Control location.

TABLE 11.2 - ***Tritium, $^{233/234}U$, and ^{238}U in Cottontail Rabbits in 2013, in pCi/g Dry Weight***

Location	No. of Samples (# ≤ MDA)	Maximum[a]	Minimum[a]	Mean ± Std.[b]	No. of Samples 2007-2010[c]	2007-2010 Mean ± Std.
Tritium						
Zone 4	2 (2)	-0.326[d] ± 0.578	-0.331 ± 0.325	-0.329 ± 0.004	12	0.087 ± 0.274
Zone 12 South	2 (2)	-0.258 ± 0.563	-0.323 ± 0.290	-0.291 ± 0.046	13	0.346 ± 0.397
Buffalo Lake[e]	4 (4)	0.215 ± 0.695	-0.347 ± 0.313	0.000 ± 0.243	10	0.175 ± 0.260
$^{233/234}$Uranium						
Zone 4	2 (2)	0.015 ± 0.047	0.005 ± 0.014	0.010 ± 0.007	12	0.014 ± 0.013
Zone 12 South	2 (2)	0.011 ± 0.044	0.008 ± 0.011	0.009 ± 0.002	13	0.012 ± 0.008
Buffalo Lake	4 (3)	0.073 ± 0.048	0.011 ± 0.030	0.029 ± 0.029	10	0.042 ± 0.031
^{238}Uranium						
Zone 4	2 (2)	0.009 ± 0.027	0.007 ± 0.010	0.008 ± 0.001	12	0.009 ± 0.011
Zone 12 South	2 (2)	0.005 ± 0.023	0.002 ± 0.009	0.003 ± 0.002	13	0.005 ± 0.005
Buffalo Lake	4 (3)	0.036 ± 0.028	0.018 ± 0.014	0.025 ± 0.009	10	0.029 ± 0.022

a Counting error at 95percent confidence level. The second of each paired set of values in the "Maximum" and "Minimum" columns is the "error."
b Standard deviation. (See definition in Glossary.)
c Sampling of rabbits began in 2007; thus historical data is based on these years.
d Negative values indicate results below the (statistically determined) background level for the counting system used at the analytical laboratory.
e Control location.

Eight prairie dogs (from Pantex and Buffalo Lake) were collected in 2013 and tested for diseases that might impact human or animal populations, including eastern and western equine encephalitis, tularemia, plague, and pseudorabies. With the assumption that Pantex sites are close enough that disease would likely impact multiple areas, sampling for disease is only conducted at sites established prior to 2005, with the exception of Pantex Lake, which was added as a sixth on-site sampling location for health and disease monitoring in 2008. This site is located several miles from other sampled locations, is in close association to many private landowners, and thus is the subject of concern that includes disease issues.

Herpes virus testing has been continued despite it not being a factor in human health (Mock, 2004). It is; however, of interest to researchers involved in wildlife diseases, with possible implications to research on human viruses. Many mammalian species have some form of associated herpes virus, and some forms may become endemic to certain host populations. Prairie dogs at Pantex Plant, as well as the control site, have demonstrated the presence of a herpes virus since sampling began in 1996. All eight (100 percent) individuals analyzed in 2013 tested positive for herpes virus or titers of herpes virus, up from 11 of 17 (64.7 percent) in 2012. Evidence of the virus was detected at both Pantex and the control site. No other diseases or antibodies were detected in the specimens examined in 2013.

11.4 Conclusions

Radionuclide concentrations in fauna samples (black-tailed prairie dogs and cottontail rabbits) were comparable to values observed in samples from control locations and historical data and indicated no detrimental impacts from Plant operations in 2013. Sampling results indicated that prairie dogs are not harboring any diseases of concern to Plant workers or neighboring landowners.

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Radionuclide concentrations in vegetation samples, which included both native vegetation and crops from on-site and off-site locations, were compared to historical values and values observed in samples from control locations. These comparisons indicated no adverse impacts from Plant operations in 2013.

12.1 The Scope of the Program

Flora surveillance is complementary to air, fauna, and surface water monitoring in assessing potential short- and long-term effects of Pantex Plant operations on the environment. Radionuclide analyses were performed on both native vegetation and crops. Native vegetation species on the southern High Plains consist primarily of prairie grasses and forbs. Crops are defined as any agricultural product harvested or gathered for animal or human food, including garden produce, forage, or fiber. Because various vegetation species accumulate contaminants differently under varied growing conditions, data interpretation is complex, and results must be evaluated in concert with other environmental media.

12.2 Radiological Surveillance of Vegetation

Surveillance of vegetation and crops at on-site and off-site locations monitors potential impacts from current Plant operations at the Burning Ground, the Firing Sites, Zone 12 (Figure 12.1), off-site at the immediate perimeter of the Plant site and out to approximately 8 kilometers (5 miles) from the center of the Plant (Figure 12.2). Rotational crops are also sampled (Figure 12.3). Background samples of crop and native vegetation species were collected from control locations at Bushland, Texas. The control locations were selected because of their distance and direction from Pantex Plant, ease of access, lack of industrial activity, and the presence of typical Southern High Plains vegetation.

Sampling locations are approximately 10-meter diameter circles from which vegetation is collected, when it is available. Drought, cultivation, excessive grazing, and/or mowing may limit vegetation availability during certain parts of the growing season. Vegetation samples were analyzed for tritium, $^{233/234}$Uranium ($^{233/234}$U) and ^{238}Uranium (^{238}U). Analytical data were corrected for moisture content and reported in pCi/g dry weight. The on-site and off-site data were compared to those from the control locations and six-year mean values, where possible, to identify and interpret differences. Although the U.S. Department of Energy limits the dose to terrestrial plants to one rad/day (see Chapter 4), there are currently no limiting concentrations for tritium or uranium in vegetation.

12.2.1 Native Vegetation

Native vegetation samples, primarily consisting of stems and leaves from grasses and forbs were collected from one control, 10 on-site, and 10 off-site locations. Samples were collected during the growing season, no more frequently than once per month in 2013. The presence of adequate vegetation for sampling varied in 2013 due to prolonged dry conditions during the growing season.

Tritium results from 100 percent of on-site and off-site sample locations were at or below minimum detectable activity (MDA) levels. The mean results of tritium analyses at on-site and off-site locations were similar to the results at the control location OV-VS-20 (Figure 12.2) and the historical mean (calendar years 1997-2002).

Results from sampling events during the year starting in late April yielded no higher measured value for tritium than any of the results from the control location during the year and were also less than the historical mean results from the control location.

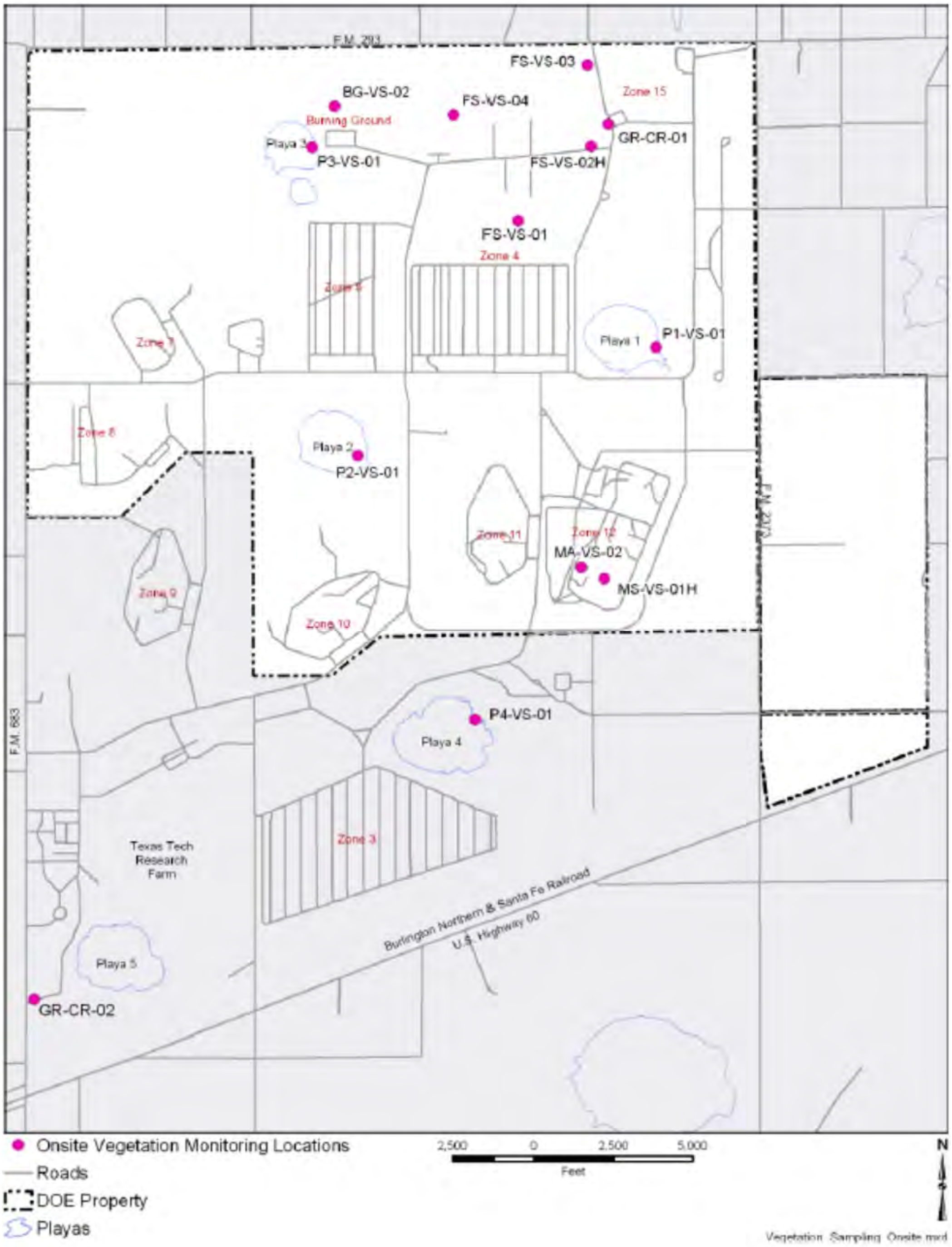

FIGURE 12.1 — *On-site Vegetation Monitoring Locations*

NOTE: On Figures 12.1, 12.2, and 12.3, note the following designations: B- Bushland, BG- Burning Ground, CR- crops, FS- Firing Sites, GR- garden produce, MA- Material Access Area, O- off-site, P- playa, S- sample, SO- grain sorghum, TL-Texas Land Application Permit, V-vegetation, and WW- winter wheat. Any sample location with H behind it is historical and is not currently being sampled.

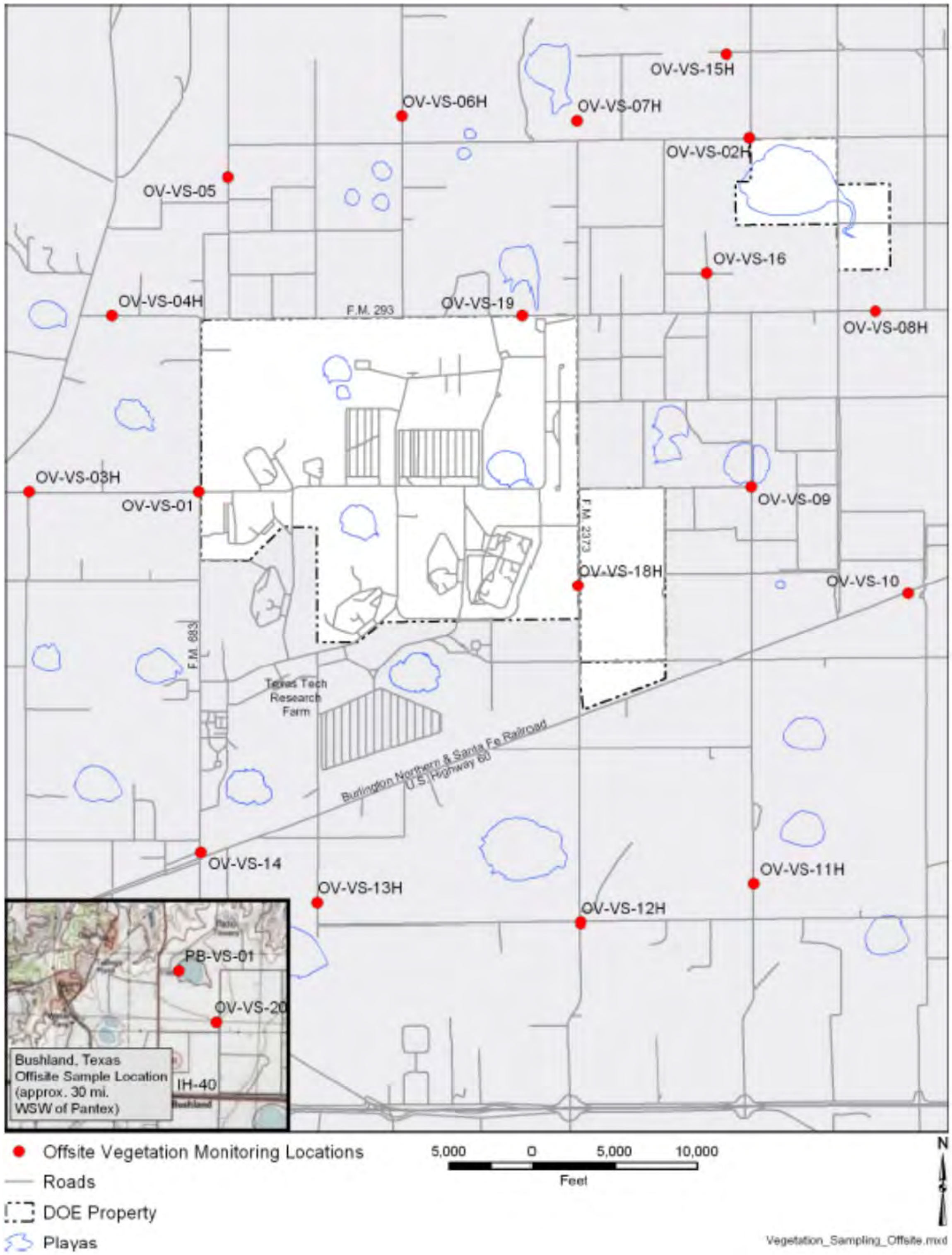

FIGURE 12.2 — *Off-site Vegetation Monitoring Locations*

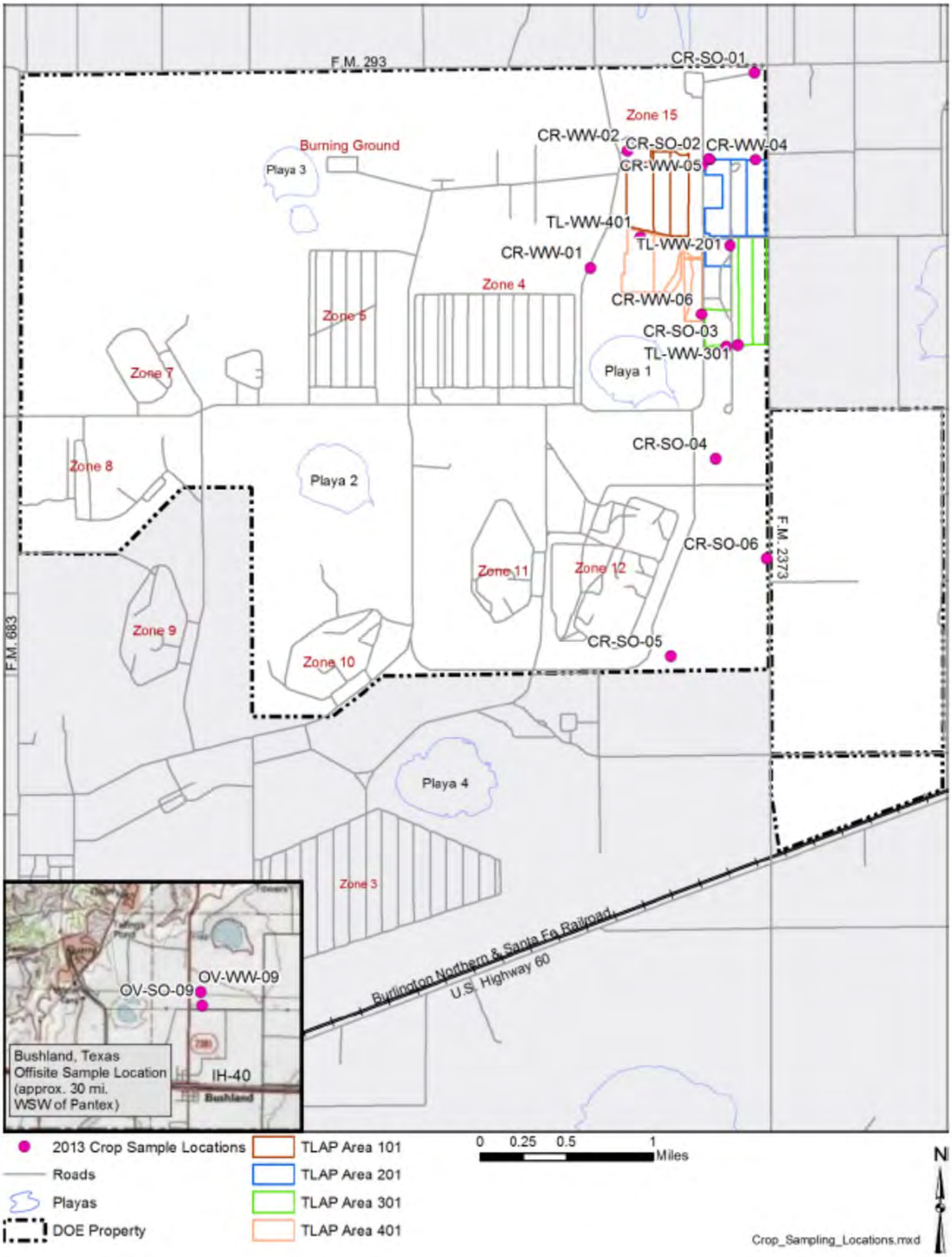

FIGURE 12.3 — ***Crop Monitoring Locations for 2013***

The percentage of vegetation samples at or below the MDA level for $^{233/234}U$ and ^{238}U in all vegetation were 100 and 99 percent, respectively. These percentages are higher than most years. Usually the percentage of vegetation samples at or below the MDA level is near 50 percent. One location P3-VS-01 had a measured value for ^{238}U in 2013 at 0.05±0.03 pCi/g and a MDA of 0.05 pCi/g. The control location OV-VS-20 for the same sampling event was 0.02±0.02 pCi/g and a MDA of 0.04 pCi/g. The Mean and Standard Deviation for this location was not significantly different than the control location (Table 12.1). The measured values for this location earlier in the year were not elevated and were comparable to the control location. Results for all other on-site and off-site locations were consistent with those found in previous years. Concentration of ^{238}U in native vegetation indicates that no uptake of ^{238}U into vascular plants has occurred.

Table 12.1 - ***Native Vegetation Comparison of ^{238}U – September 2013 Sampling Results and the Control Location***

Sampling Location	^{238}U pCi/g	^{238}U Mean + 1 St. Dev.
P3-VS-01	0.05 ± 0.03	0.034 ± 0.021
OV-VS-20 (control)	0.02 ± 0.02	0.030 ± 0.015

12.2.2 Crops

Crop surveillance enables evaluation of potential impacts from Plant operations on humans and livestock. Samples consisting of stems and leaves of dryland and irrigated winter wheat and irrigated grain sorghum were collected on-site and at the Bushland, Texas control locations.

Crop sampling locations vary annually according to crop rotation. Garden produce was sampled at two specially-grown garden locations: one on the northeast side of the Pantex property and one on the southwest side of the Texas Tech property (Figure 12.1).

Six dryland and three irrigated winter wheat samples, along with a duplicate from on-site, were collected in April 2013, and one control sample was collected from the control site (Bushland, Texas). The majority of on-site winter wheat and grain sorghum sampling locations were east of the Firing Sites, Burning Ground, and on the Texas Land Application Permit area, with the remainder evenly distributed across the Plant (Figure 12.3). Six dryland grain sorghum samples, a control sample and duplicate from the control site were collected in August 2013. Fruits and leaves from garden plants were sampled in August 2013.

All crop and garden samples were analyzed for tritium, $^{233/234}U$ and ^{238}U. All crop and garden produce analysis in 2013 were at or below the MDA level for tritium, $^{233/234}U$, and ^{238}U and were comparable to the off-site control location.

12.3 Conclusions

Radionuclide concentrations in flora samples were comparable to values observed in samples from control locations or historical data and indicate no detrimental impacts from Plant operations in 2013.

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Pantex, because our unique mission and service to our country, must strive to become a High Reliability Organization (HRO). High reliability includes robust quality assurance that ensures all environmental monitoring data provides definitive evidence of regulatory compliance and protection of human health and the environment. The complexity of analytical chemistry and radiochemistry performed to support environmental monitoring programs necessitates that Pantex maintain an unparalleled quality assurance (QA) and quality control (QC) program that meets our need for high reliability. Of the 19,469 individual analytical results obtained during 2013, 99.7 percent were useable for making environmental decisions.

13.1 The Scope of the Program

Pantex Plant has an established QA/QC program designed to ensure the reliability of analytical data used to support all site environmental programs. This program also satisfies the quality requirements implemented under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision, Texas Commission on Environmental Quality (TCEQ) Groundwater Compliance Plan, CP-50284, U.S. Department of Energy (DOE) Order 414.1D *Quality Assurance (DOEg)*, and ISO-2004 *Environmental Management Systems – Requirements with Guidance for Use, 2004* (ISO, 2004). During 2013, the QA/QC program enhanced the reliability of data acquired for environmental monitoring, which includes air, soil, groundwater, surface water, flora, and fauna programs.

The ultimate goal of the Pantex environmental monitoring QA/QC program is to consistently generate reliable, high quality environmental monitoring data. One measure of success for this QA/QC program is the amount of useable environmental data based on technical acceptance criteria for chemical and radiochemical measurements. By providing consistently useable data, Pantex fosters a high degree of confidence for regulatory compliance and protection of human health and the environment with stakeholders. This approach also allowed Pantex to provide maximum value for the resources utilized to acquire environmental monitoring data.

13.2 Environmental Data Acquisition, Planning and Execution

Acquisition of environmental monitoring data is planned with its end use in mind. Each media scientist or subject matter expert defined data collection requirements based on program needs and used guidance such as EPA QA/G4 *Guidance for Data Quality Objective Process* (EPAa), in developing data quality objectives (DQOs) for data collection. The media scientists prepared the DQOs based on the overall data collection needs, regulatory requirements, stakeholder concerns, technical factors, quality requirements, and historical data in their respective areas of expertise.

The approved DQO for a specific monitoring program was scheduled and executed by using technical specifications in the DQO. This includes sample location, sampling frequency, analytical method, and data acceptance criteria. During 2013, each DQO was associated with a procedure, defining requirements for sample collection and data management. Procedures were reviewed and updated, as necessary, to reflect new requirements in associated DQOs or enhancements to the sample collection and data management process.

13.3 Environmental Data Quality Assurance and Control

Pantex relies on a robust quality system described in the Pantex Plant Environmental Monitoring Program Management and Quality Plan, QPLAN-0010 (PANTEXd). The intent of this system is to integrate and manage quality elements for field sampling, laboratory analysis, data management and to monitor and control factors that affect overall data quality. Components of this quality system are described below.

Field and Laboratory Assessments

Internal assessments are conducted annually; at a minimum, on representative field and laboratory operations. The assessments on field operations are performed on both liquid and solid media sampling programs. These assessments are used to assure the reliability and defensibility of analytical data acquired to support environmental monitoring programs. They are also a tool for continuous improvement of sampling operations, administrative functions, control procedures, and quality systems. Activities reviewed in the field assessment may include calibration and documentation for field equipment, proper field sampling procedures, provisions for minimization of potential sample contamination, compliance with Chain-of-Custody (COC) procedures, sample documentation, and sample transfer to the laboratory. Activities reviewed for laboratory operations may include quality systems, sample receiving, handling, COC, storage procedures, documentation for laboratory procedures, such as run logs, data reduction, standard operating procedures (SOPs), condition and calibration of analytical instruments, and sample disposal.

Other assessments, including management and independent assessments are also conducted. Most assessments are performed using checklists with specific criteria for each procedure observed. Checklists from the United States Department of Energy Consolidated Audit Program (DOECAP) are used as guidance in developing the checklists for the laboratory assessments. An exit meeting is conducted at the end of an audit to discuss the findings. The findings are summarized in a report, and a Corrective Action Plan (CAP) is submitted by the laboratory for all the findings, including the root cause, corrective action, personnel responsible for the corrective action implementation, and projected date for completion of the corrective action. A nonconformance report (NCR) is generated when a departure from documented requirements such as procedures, sampling plans, and QC criteria occurs. A formal Corrective Action Report (CAR) may be necessary depending on the severity, repetitiveness, and impact to reported data. Corrective actions are required to be implemented in a timely manner by the appropriate personnel who are knowledgeable about the work.

Data Management Systems Audit

An audit of the data management systems, primarily the Integrated Environmental Database (IEDB), is performed at least annually to document oversight activities. Areas audited include IEDB security, verification that software programs accurately perform their intended functions, tracking changes to electronic records, and manual entries.

Annual Review of all Operations

An annual review of the sampling operations, administrative functions, and quality systems is conducted by Pantex to assure their continued effectiveness. The items reviewed include the suitability of policies and procedures, outcome of internal and external assessments, trending of NCRs and CARs, client complaints, changes in volume of work, staffing and resources.

Recordkeeping

All environmental records and documents are issued, revised, controlled, stored, and archived in accordance with Pantex Plant requirements.

13.3.1 Quality Plan Requirements for Subcontract Laboratories

Subcontract laboratories are accredited by The NELAC Institute (TNI) and in accordance with Title 30 of the Texas Administrative Code, Chapter 25 for all parameters within the scope of work provided by Pantex Plant. Exceptions might be made when TNI accreditation is not available.

Each subcontract laboratory must be qualified by Pantex prior to receiving samples for analysis. The prequalification process includes a review of the technical proposal submitted by the prospective laboratory, successful analysis of Performance Evaluation (PE) samples, and a systems audit performed by DOECAP, National Nuclear Security Administration Analytical Management Program, or Pantex Supplier Quality Department.

In addition to the initial systems audit, all subcontract laboratories must submit to annual systems audits in order to maintain status as a qualified subcontract laboratory. These audits are technical and programmatic and performed by DOECAP. Their purpose is to ensure that all existing subcontract laboratories are qualified to provide high quality analytical laboratory services.

A Data Package Assessment is conducted annually at subcontract laboratories. In this type of assessment, random analytical deliverables are selected, and all the supporting documentation such as calibration records, method detection limits, and QA/QC reports are reviewed. The subcontract laboratory is also required to conduct internal audits at least annually to assure they are compliant with the laboratory's quality systems and with the *Pantex Statement of Work (SOW) for Analytical Laboratories* (PANTEXn).

Qualified subcontract laboratories must successfully analyze PE samples semi-annually in order to maintain qualified status, and they may be subject to submission of PE samples from Pantex Plant at any time. PE sample analyses are designed to evaluate normal laboratory operations, and evaluation of the PE sample results must consider factors such as identification of false positives, false negatives, large analytical errors, and indications of calibration or dilution errors. If the subcontract laboratory performs any combination of inorganic, organic, and radiological testing, participation in two semi-annual inter-laboratory comparison PE programs is required. One program must be the Mixed Analyte Performance Evaluation Program (MAPEP), and the other program should be from a vendor accredited by the National Institute of Standards and Technology (NIST) under TNI Proficiency Test Standards. Participation in additional inter-laboratory comparison PE programs is necessary if the laboratory provides other unique services such as asbestos or lead in paint.

Nonconformance reports are submitted by the laboratory if unacceptable PE results are reported. PE sample requirements may be waived for any analysis in which a suitable PE sample is not available. Sample shipments to a subcontract laboratory may be suspended if it is determined that the laboratory is not capable of meeting the analytical, quality assurance, and deliverable requirements of the SOW.

13.4 Laboratory Quality Assurance

During 2013, the Pantex Laboratory Quality Assurance Program (LQAP) continued to provide qualified laboratory auditors to participate in DOECAP. The primary function of DOECAP is to evaluate laboratory quality assurance systems and verify that they are effective. Pantex supports this resource-sharing approach to laboratory quality assurance.

During 2013, all Pantex requirements for the subcontract laboratories were met. All of the subcontract laboratories had the proper certifications for analyzing environmental samples from Pantex. They performed the necessary internal audits, and participated in the appropriate PE programs. Annual DOECAP audits were also conducted. A technical and contractual verification of the laboratory deliverables, performed by staff scientists as analytical results were received from the laboratories, ensured that contractual deliverable specifications, technical content, and QC deliverables complied with SOW requirements consistent with industry standards.

13.4.1 Data Review and Qualification

Historically, the vast majority of analytical results are useable unless there is a catastrophic QA/QC failure (such as no surrogate or radiotracer recovery) during the analytical process that causes the results to be rejected (declared not useable). Based on industry standard conventions, sample results are qualified as useable by means of various data qualifier flags to alert the end user to any limitations in using the result. This approach was taken to make use of as many sample results as possible without sacrificing quality. Sample results that were completely unusable were rejected and not made available for use. Several criteria were used during the verification process so that analytical results could be appropriately qualified. Some of the criteria that caused data to be rejected during the verification process were:

- Missed Holding Times. The analysis was not initiated, or the sample was not extracted/prepared, within the time frame required by the EPA method and the SOW.
- Control Limits. A quality control parameter such as a surrogate, spike recovery, response factor, or tracer recovery associated with a sample failed to meet the limits of acceptability.
- Not Confirmed. Analytical methods for high explosives and perchlorate may employ enhanced confirmation techniques, such as mass spectral or diode array detectors. This information is used to qualify data obtained from traditional techniques, such as use of a second chromatographic column, which may be prone to matrix interference. Second column confirmation is especially susceptible to false positives when the constituent of interest is at or near the method detection limit.
- Sample or Blank Contamination. The sensitivity of modern analytical techniques makes it virtually impossible to have a blank sample that is truly analyte-free. This is especially true for inorganic parameters such as metals. When the laboratory either accidentally contaminated the actual sample or the lab blank contained parameters of interest above a control limit, the associated sample results may be rejected.
- Other. This category includes, but is not limited to, the following:
    - Broken COC. There was a failure to maintain proper custody of samples, as documented on Chain-of-Custody forms and laboratory sample log-in records.
    - Instrument Failure. Either the instrument failed to attain minimum method performance specifications or the instrument or a piece of equipment was not functioning.
    - Preservation Requirements. The requirements, as identified by the EPA or a specific method, were not met and/or properly documented.
    - Incorrect Test Method. The analysis was not performed according to a method contractually required by Pantex.
    - Incorrect or Inadequate Detection or Reporting Limit. The laboratory is required to attain specific levels of sensitivity when reporting target analytes, unless matrix effects prevent adequate detection and quantitation of the compound of interest.

The Pantex media scientist was alerted to any limitations in the use of the data, based on the DQO requirements. Of the 19,469 individual results obtained in 2013 from all laboratory analyses, 99.7 percent were deemed to be of suitable quality for the intended end use of the data. Figure 13.1 graphically summarizes the causes for the 0.3 percent of data rejected.

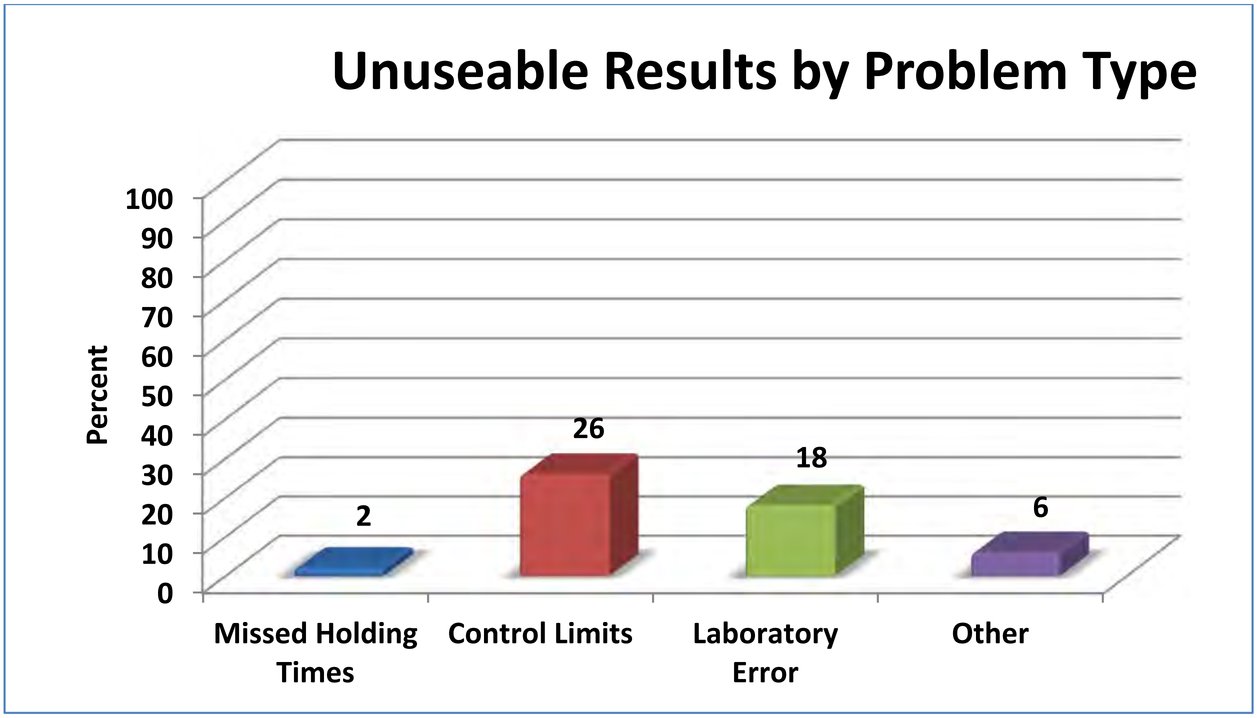

FIGURE 13.1 — *2013 Data Rejection Summary*

13.4.2 Laboratory Technical Performance

All subcontract laboratories were required to participate in inter-laboratory comparison studies administered by DOE and EPA. In 2013, Pantex off-site subcontract laboratories participated in MAPEP PE sample analysis, sponsored by the DOE/Idaho Operations Office.

The MAPEP samples include radiological, inorganic, and organic compounds in matrices including water, soil, air filters, and vegetation. Under MAPEP, the DOE Idaho Operations Office publishes evaluation reports, rating the analyses from each participating laboratory. MAPEP results, particularly the results for MAPEP Series 28 and 29, for all participating subcontract laboratories used by Pantex in 2013 (GEL and TestAmerica) are presented in Figure 13.2. Both subcontract laboratories had acceptable MAPEP results in 2013.

The primary purpose of the PE programs is to measure a laboratory's implementation of methods to obtain accurate results and serve as a comparison between laboratories. The SOW and DOECAP have requirements that all labs shall participate in several PE programs, including the potable and non-potable water programs (EPA Supply and Water Pollution), and MAPEP.

13.5 Field Operations Quality Assurance

Quality assurance samples, such as duplicates, replicates, blanks, and equipment rinsates were collected at intervals specified in the DQOs. This was initiated to allow the media scientists to evaluate the data for potential bias or variability originating from either the sampling or the analytical process.

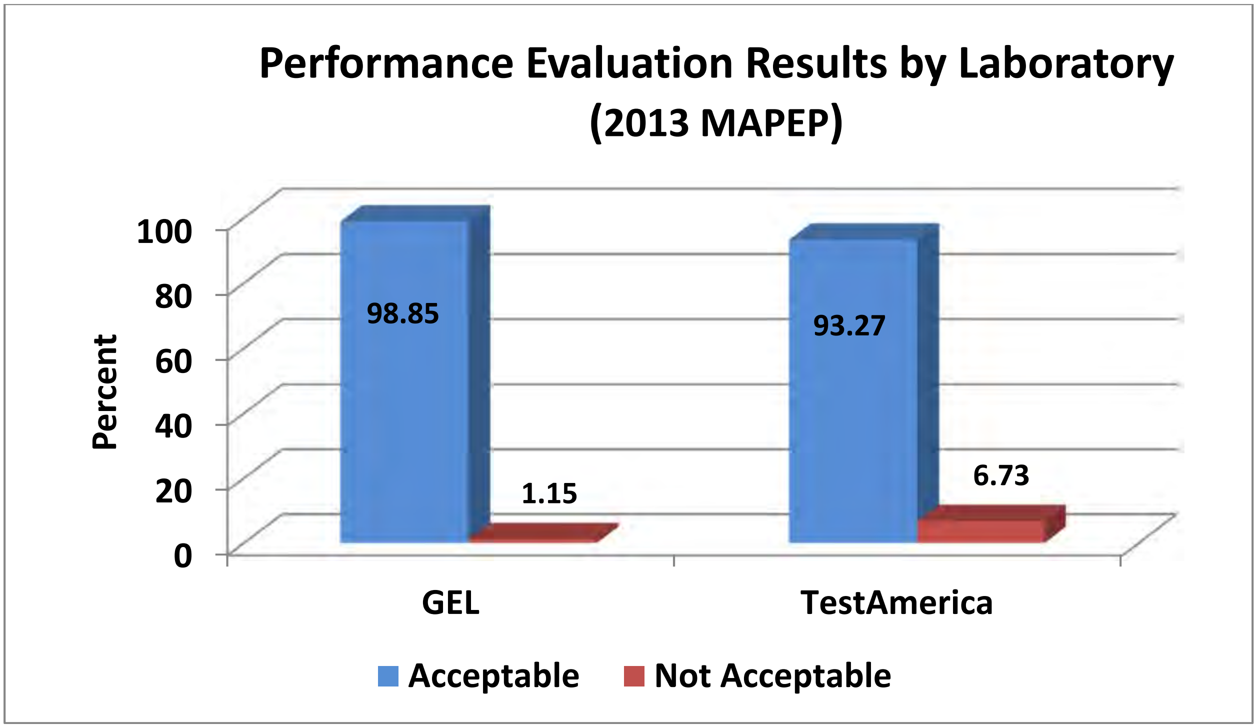

FIGURE 13.2 — *2013 MAPEP Results*

13.5.1 Duplicate and Replicate Analyses

During 2013, Pantex continued to collect and analyze field duplicate and replicate samples. A true field duplicate sample set consists of a thoroughly homogenized sample collected from one desired location. The sample is split into two discrete samples and may even be labeled as representing two separate sampling locations. When the laboratory is not informed that the two samples are sub-samples from a single sampling location, these samples are referred to as "blind duplicate samples." When samples are collected from the same site at the same time, the samples are considered field replicates. For comparison purposes, field duplicates and field replicates are evaluated by the same criteria. Random replicate samples were collected for all media except air and fauna. These exceptions are based upon the uniqueness of the sample type and the inability to replicate the sample.

The vegetation program's isotopic uranium data were analyzed to compare actual sample values to field replicate values. This program was chosen for statistical analysis because of the relatively high number of replicates required during the sample collection process. The replicate error ratio (RER) was used to perform the replicate analysis. The ratio takes into account the sample and replicate uncertainty to determine data variability. The RER is given by:

$$RER = | S - R | / (\sigma_{95S} + \sigma_{95R});$$

Where:
RER = replicate error ratio
S = sample value (original)
R = replicate sample value
σ_{95S} = sample uncertainty (95 percent)
σ_{95R} = replicate uncertainty (95 percent)

A RER of less than or equal to one indicates that the replicates are comparable within the 95 percent confidence interval. For 2013, the average RER value for vegetation data was 0.283 with an associated standard deviation of 0.262. The 2013 vegetation sample RER analysis indicated that field replicate sample precision accurately reflects the actual sample value. Figure 13.3 summarizes the RER data.

13.5.2 Blanks and Rinsates

During 2013, trip blanks, field blanks, and/or rinsate samples were collected for all media except fauna. Blank samples were used to evaluate contamination that may have occurred during sampling, sample shipment, or laboratory operations. Trip blank and field blank values were used to flag detects found in sample values. The detects found were used to flag sample detects as "U" (undetected).

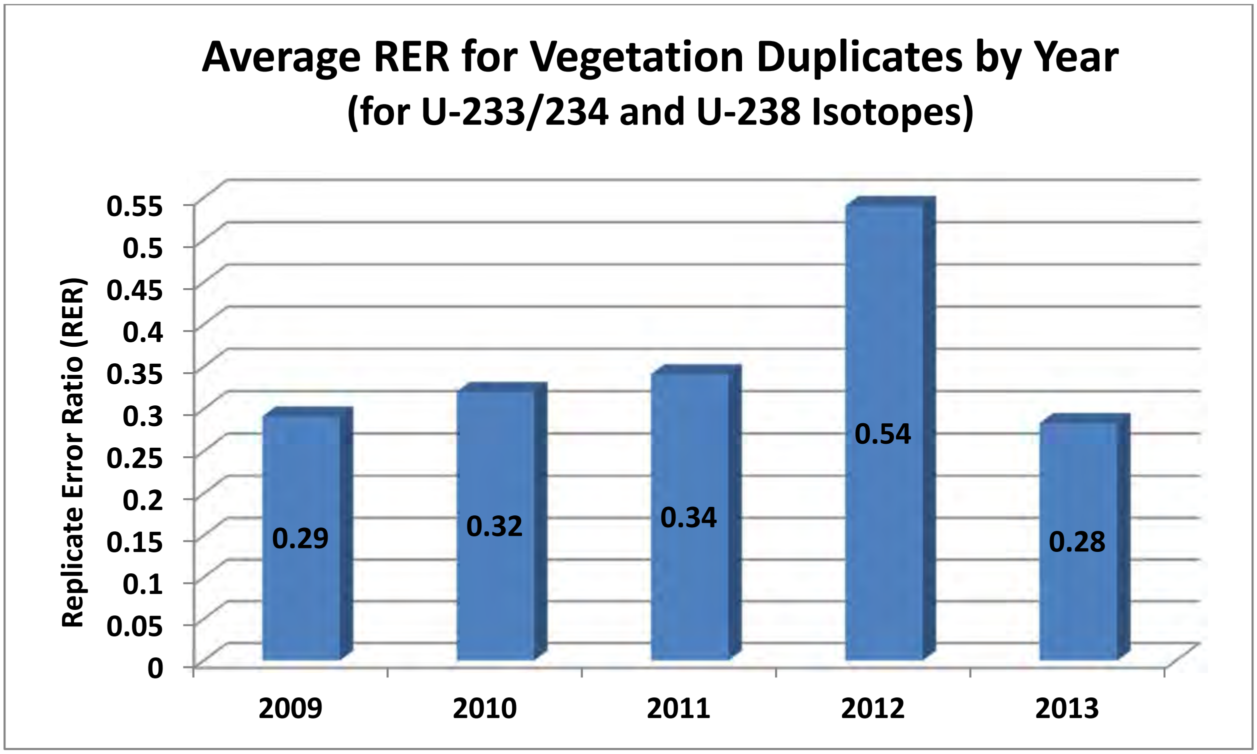

FIGURE 13.3 — *Five Year Average Replicate Error Ratio for Vegetation Duplicates*

A rinsate (equipment) blank is a sample of analyte-free water poured over or through decontaminated sampling equipment. The rinse solution is collected to show that there is no contamination from the sampling tool, or cross contamination between samples.

Field blanks are analyte-free water samples that are taken to the field and opened for the duration of the sampling event and then closed and sent to the lab. Field blanks assess if airborne contamination exists at the sampling site.

Trip blanks are provided for each shipping container (cooler) containing volatile organic compound (VOC) vials to evaluate potential contamination of the sample bottles during shipment from the manufacturer, storage of the bottles, shipment to the laboratories, or analysis at the laboratory. VOCs such as cis-1,2-dichloroethene and tetrachloroethene were detected in trip blanks in 2013. These compounds are indicative of common laboratory solvents. The frequency of detection was 0.59 percent.

13.6 On-site Analytical Laboratories

A limited number of samples were analyzed on-site during 2013, using approved EPA or standard industry methods. On-site analyses included the following:

- Pantex Industrial Hygiene Laboratory performed analysis of samples for boron and asbestos; and
- Pantex Materials and Analytical Services Laboratory performed analysis of samples for alkalinity, color, flashpoint, hardness, nitrates, nitrites, and hexavalent chromium.

These on-site laboratories followed an internal quality control program similar to the program outlined in the SOW. The on-site laboratories were audited by the Plant's internal quality audit program. Sampling technicians performed field measurements of certain samples for residual chlorine, dissolved oxygen, turbidity, conductivity, hydrogen sulfide, temperature, Oxidation Reduction Potential and pH.

13.7 Continuous Improvement

During 2013, Pantex Plant acquired analytical data to support several aspects of the environmental monitoring program as required by permits, regulations, and DOE Orders**.** The QA/QC program described in this chapter was implemented to ensure the programmatic and technical elements required to meet these criteria were executed. In addition, this program functioned to provide cost efficient analytical data of known and defensible quality.

Overall programmatic data quality has continued to improve because of improved analytical methods, quality control/assurance practices, and refinement of data quality objectives, which can be quantified by trending the amount of useable data acquired over the past 18 years (Figure 13.4). Using 1996 as the base year, a 95 percent lower performance target was established to trend data usability. As with any data collection process, improvements are continually being made in defining technical specifications and improving sample collection methodology, laboratory instrumentation, and quality control practices. It is important to remember that any viable quality system undergoes continuous improvement by the very nature of the quality elements employed. This is the QA/QC program perspective used to review data critically for the annual site environmental report.

A well-established quality framework exists at Pantex that supports the environmental monitoring program. The acquisition and review of analytical data is based on procedurally controlled sampling, analysis, data management (validation), and standardized technical specifications governing analytical measurements. The integration of each of these elements ensures environmental data collection and monitoring requirements are achieved meeting all site and stakeholder requirements for quality and reliability.

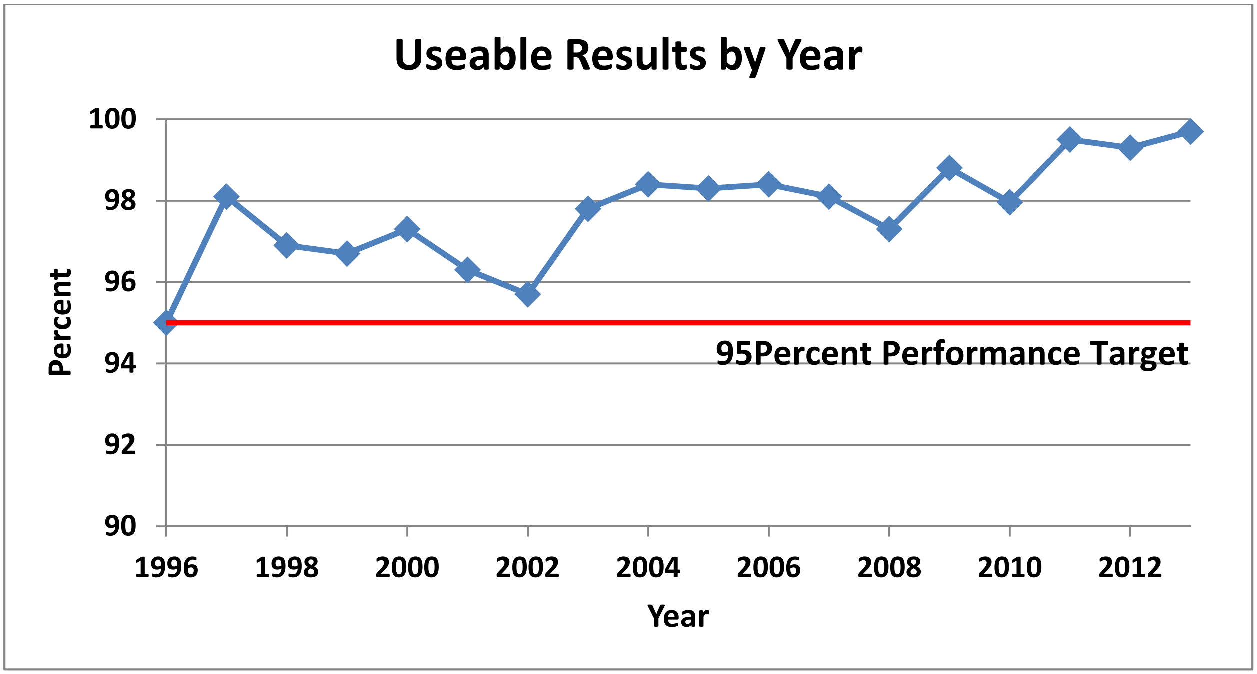

FIGURE 13.4 — *History of Useable Results Data*

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Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Radionuclides										
Gross alpha, total	12587-46-1	-	-		-	-	-	-	-	-
Gross beta, total	12587-47-2	-	-		-	-	-	-	-	-
^{238}Plutonium	12059-95-9	-	-	-		-	-	-	-	-
$^{239/240}$Plutonium	10-12-8		-	-		-	-	-	-	-
Tritium	10028-17-8		-			-	-	-		
$^{233/234}$Uranium	11-08-5			-		-	-	-		
$^{235/236}$Uranium	15117-96-1	-		-		-	-	-	-	-
^{238}Uranium	7440-61-1			-		-	-	-		
Metals										
Aluminum	7429-90-5	-			-	-	-	-	-	-
Antimony	7440-36-0	-			-		-	-	-	-
Arsenic	7440-38-2	-					-	-	-	-
Barium	7440-39-3	-				-	-	-	-	-
Beryllium	7440-41-7	-			-		-	-	-	-
Boron	7440-42-8	-						[9]	-	-
Cadmium	7440-43-9	-						-	-	-
Calcium	7440-70-2	-		-	-	-	-	[9]	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Chromium	7440-47-3	-						-	-	-
Chromium (hexavalent)	18540-29-9	-		-	-	-	-	-	-	-
Cobalt	7440-48-4	-		-				-	-	-
Copper	7440-50-8	-						9	-	-
Iron	7439-89-6	-				-	-	9	-	-
Ferric Iron	N/A									
Ferrous Iron	1345-25-1	-		-	-	-	-	-	-	-
Lead	7439-92-1	-							-	-
Magnesium	7439-95-4	-		-	-	-	-	9	-	-
Manganese	7439-96-5	-					-	9	-	-
Manganese, divalent	16397-91-4									
Mercury	7439-97-6	-							-	-
Molybdenum	7439-98-7	-		-	-		-	-	-	-
Nickel	7440-02-0	-		-			□	-	-	-
Potassium	7440-09-7	-		-	-	-	-	9	-	-
Selenium	7782-49-2	-		□	□		-	-	-	-
Silver	7440-22-4	-		□	□		□	-	-	-
Sodium	7440-23-5	-	□	-	-	-	-	9	-	-
Strontium	7440-24-6	-	-	-	-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Thallium	7440-28-0	-		□	-		-	-	-	-
Tin	7440-31-5	-		-	-		-	-	-	-
Titanium	7440-32-6	-	-	-	-		-	-	-	-
Uranium, Total	11-09-6	-		-	-		-	-	-	-
Vanadium	7440-62-2	-	□	-	-		-	-	-	-
Zinc	7440-66-6	-		□	□		□	[9]	-	-
Explosives										
1,3-dinitrobenzene	99-65-0	-			□	-	-	-	-	-
1,3,5-trinitrobenzene	99-35-4	-		-	□	-		-	-	-
2-amino-4,6-dinitrotoluene	35572-78-2	-		-	□	-	-	-	-	-
2-nitrotoluene	88-72-2	-	-	-	□	-	-	-	-	-
2,4-dinitrotoluene	121-14-2	-		-	□	-			-	-
2,6-dinitrotoluene	606-20-2	-		-	□	-		-	-	-
3-nitrotoluene	99-08-1	-	-	-	□	-	-	-	-	-
4-amino-2,6-dinitrotoluene	1946-51-0	-		-	□	-	-	-	-	-
4-nitrotoluene	99-99-0	-	-	-	□	-	-	-	-	-
HMX	2691-41-0	-	□	□	□		□	-	-	-
Nitrobenzene	98-95-3	-	-	-	□	-			-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
PETN	78-11-5	-	-				□	-	-	-
RDX	121-82-4	-						-	-	-
TATB	3058-38-6	-	-	-	-	-		-	-	-
Tetryl	479-45-8	-	-	-	□	-	-	-	-	-
TNT	118-96-7	-						-	-	-
MNX	5755-27-1	-		-	-	-	-	-	-	-
DNX	80251-29-2	-		-	-	-	-	-	-	-
TNX	13980-04-6	-		-	-	-	-	-	-	-
Polychlorinated Biphenyls (PCBs)										
Aroclor 1016	12674-11-2	-	-		-	-	-	-	-	-
Aroclor 1221	1104-28-2	-	-		-	-	-	-	-	-
Aroclor 1232	11141-16-5	-	-		-	-	-	-	-	-
Aroclor 1242	53469-21-9	-	-		-	-	-	-	-	-
Aroclor 1248	12672-29-6	-	-		-	-	-	-	-	-
Aroclor 1254	11091-69-1	-	-		-	-	-	-	-	-
Aroclor 1260	11096-82-5	-	-		-	-	-	-	-	-
Pesticides										
Alachlor	15972-60-8	-	-		-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Aldrin	309-00-2	-	-		-	-	-	-	-	-
Atrazine	1912-24-9	-	-		-	-	-	-	-	-
Bromacil	314-40-9	-	-		-	-	-	-	-	-
Chlordane	57-74-9	-	-		-	-	-	-	-	-
Dieldrin	60-57-1	-	-		-	-	-	-	-	-
Endrin	72-20-8	-	-		-	-	-	-	-	-
Heptachlor	76-44-8	-	-		-	-	-	-	-	-
Heptachlor epoxide	1024-57-3	-	-		-	-	-	-	-	-
Lindane (gamma-BHC)	58-89-9	-	-		-	-	-	-	-	-
Methoxychlor	72-43-5	-	-		-	-	-	-	-	-
Methyl n,n-dimethyl-n-{(methlycarbamoyl)oxy}-1	23135-22-0	-	-		-	-	-	-	-	-
s-Methyl-n-((Methylcarb amoyl)-oxy)-thioacetimidate	16752-77-5	-	-		-	-	-	-	-	-
Metribuzin	21087-64-9	-	-		-	-	-	-	-	-
Prometon	1610-18-0	-	-		-	-	-	-	-	-
Propachlor	1918-16-7	-	-		-	-	-	-	-	-
Sevin (carbaryl)	63-25-2	-	-		-	-	-	-	-	-
Simazine	122-34-9	-	-		-	-	-	-	-	-
Herbicides										
2,4-D	94-75-7	-	-	-	-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Miscellaneous										
Alkalinity	T-005	-			-	-	-	-	-	-
Ammonia (as N)	7664-41-7	-		-	-		-	-	-	-
Biochemical oxygen demand	10-26-3	-	-	-	-		-	-	-	-
Bromide	24959-67-9	-		-	-	-	-	-	-	-
Chemical oxygen demand	C-004	-	-	-	-		-	-	-	-
Chlorate	14866-68-3	-		-	-	-	-	-	-	-
Chloride	16887-00-6	-			-	-	-	-	-	-
Chlorine residual	7782-50-5	-	-		-	-	-	-	-	-
Color	M-002	-	-		-	-	-	-	-	-
Corrosivity	10-37-7	-	-		-	-	-	-	-	-
Cyanide, free	10-71-9	-	-		-	-	-	-	-	-
Cyanide, total	57-12-5	-	-		-		-	-	-	-
Dissolved Organic Carbon	11-59-6	-		-	-	-	-	-	-	-
Dissolved Oxygen	NA	-		-	-	-	-	-	-	-
Electrical Conductivity (S Salts 1:1)	NA	-	-	-	-	-	-	[9]	-	-
Fluoride	7782-41-4	-			-	-	-	-	-	-
Foaming agents (surfactants)	NA	-	-		-	-	-	-	-	-
Ignitability	NA	-	-	-	-	-	-		-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Nitrte (as N)	14797-55-8	-			-	-	-		-	-
Nitrate/nitrite (as N)	1-005	-		-	-		-	-	-	-
Nitrite (as N)	14797-65-0	-	-		-	-	-	-	-	-
Oil and grease	10-30-0	-	-	-	-		-	-	-	-
Ortho Phosphate	14265-44-2	-	-	-	-	-	-	[9]	-	-
Perchlorate	14797-73-0	-			-	-	-	-	-	-
pH	10-29-7	-					-	-	-	-
pH (1:1 ratio soil pH)	NA	-	-	-	-	-	-	[9]	-	-
pH (2:1 ratio soil pH)	NA	-	-	-	-	-	-	[9]	-	-
Phosphorus, Total (As P)	7723-14-0	-		-	-	-	-	-	-	-
Reactivity	NA	-	-	-	-	-	-		-	-
Sodium Adsorption Ratio	NA	-	-	-	-	-	-	[9]	-	-
Specific conductance	10-34-4	-	-		-	-	-	-	-	-
Sulfate	14808-79-8	-			-	-	-	-	-	-
Sulfide	18496-25-8	-	-	-	-	-	-	-	-	-
Sulfur	NA	-	-	-	-	-	-	[9]	-	-
Temperature	NA	-					-	-	-	-
Total dissolved solids	10-33-3	-			-	-	-	-	-	-
Total hardness (as $CaCO_3$)	11-02-9	-	-		-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Total Kjeldahl Nitrogen	NA	-	-	-	-	-	-	[9]	-	-
Total Nitrogen	NA	-	-	-	-	-	-	[9]	-	-
Total organic carbon	C-012	-			-	-	-	-	-	-
Total petroleum hydrocarbons	10-90-2	-	-	-		-	-	-	-	-
Turbidity	G-019	-			-	-	-	-	-	-
Volatile Organics										
1,1,1,2-tetrachloroethane	630-20-6	-				-	-	-	-	-
1,1,2,2-tetrachloroethane	79-34-5	-				-	-	-	-	-
1,1,1-trichloroethane	71-55-6	-				-	-	-	-	-
1,1,2-trichloroethane	79-00-5	-				-	-	-	-	-
1,2,3-tricholorobenzene	87-61-6	-	-		-	-	-	-	-	-
1,2,3-trichloropropane	96-18-4	-				-	-	-	-	-
1,2,4-trimethylbenzene	95-63-6	-	-		-	-	-	-	-	-
1,3,5-trimethylbenzene	108-67-8	-	-		-	-	-	-	-	-
1,1-dichloroethane	75-34-3	-				-	-	-	-	-
1,1-dichloroethene	75-35-4	-				-	-	-	-	-
1,1-dichloropropene	563-58-6	-	-		-	-	-	-	-	-
1,2-dibromo-3-chloropropane	96-12-8	-	-			-	-	-	-	-
1,2-dibromoethane	106-93-4	-	-			-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
1,2-dichlorobenzene	95-50-1	-				-	-	-	-	-
1,2-dichloroethane	107-06-2	-				-	-	-	-	-
1,2-dichloroethene	156-60-5	-	-	-		-	-	-	-	-
cis-1,2-dichloroethene	156-59-2	-				-	-	-	-	-
trans-1,2-dichloroethene		-				-	-	-	-	-
1,2-dichloropropane	78-87-5	-				-	-	-	-	-
1,3-dichlorobenzene	541-73-1	-				-	-	-	-	-
1,3-dichloropropane	142-28-9	-	-		-	-	-	-	-	-
cis-1,3-dichloropropene	10061-01-5	-	-			-	-	-	-	-
trans-1,3-dichloropropene	10061-02-6	-				-	-	-	-	-
trans-1,4-dichloro-2-butene	110-57-6	-		-		-	-	-	-	-
1,4-dichlorobenzene	106-46-7	-				-	-	-	-	-
2,2-dichloropropane	594-20-7	-	-		-	-	-	-	-	-
2-butanone (methyl ethyl ketone)	78-93-3	-				-	-	-	-	-
2-chloro-1,3-butadiene	126-99-8	-		-		-	-	-	-	-
2-chlorotoluene	95-49-8	-	-		-	-	-	-	-	-
2-hexanone	591-78-6	-				-	-	-	-	-
4-chlorotoluene	106-43-4	-	-		-	-	-	-	-	-
4-isopropyltoluene	99-87-6	-	-		-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Acetone	67-64-1	-				-	-	-	-	-
Acetonitrile	75-05-8	-		-		-	-	-	-	-
Acrolein	107-02-8	-		-		-	-	-	-	-
Acrylonitrile	107-13-1	-				-	-	-	-	-
Allyl Chloride	107-05-1	-		-		-	-	-	-	-
Benzene	71-43-2	-				-	-	-	-	-
Bromobenzene	108-86-1	-	-		-	-	-	-	-	-
Bromochloromethane	74-97-5	-	-		-	-	-	-	-	-
Bromodichloromethane	75-27-4	-	-			-	-	-	-	-
Bromoform	75-25-2	-	-			-	-	-	-	-
Bromomethane	74-83-9	-	-			-	-	-	-	-
sec-Butylbenzene	135-98-8	-	-		-	-	-	-	-	-
tert-Butylbenzene	98-06-6	-	-		-	-	-	-	-	-
Carbon disulfide	75-15-0	-				-	-	-	-	-
Carbon tetrachloride	56-23-5	-				-	-	-	-	-
Chlorobenzene	108-90-7	-				-	-	-	-	-
Chloroethane	75-00-3	-				-	-	-	-	-
Chloroform	67-66-3	-				-	-	-	-	-
Chloromethane	74-87-3	-				-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Dibromochloromethane	124-48-1	-				-	-	-	-	-
Dibromomethane	74-95-3	-				-	-	-	-	-
Dichlorodifluoromethane	75-71-8	-				-	-	-	-	-
Ethylbenzene	100-41-4	-				-	-	-	-	-
Ethyl methacrylate	97-63-2	-				-	-	-	-	-
Freon 113	76-13-1	-	-	-		-	-	-	-	-
Iodomethane	74-88-4	-				-	-	-	-	-
Isobutyl alcohol	78-83-1	-		-		-	-	-	-	-
Isopropylbenzene	98-82-8	-	-		-	-	-	-	-	-
Methylacrylonitrile	126-98-7	-		-		-	-	-	-	-
Methylene chloride	75-09-2	-				-	-	-	-	-
Methyl isobutyl ketone	108-10-1	-				-	-	-	-	-
Methyl methacrylate	80-62-6	-				-	-	-	-	-
n-Butylbenzene	104-51-8	-	-		-	-	-	-	-	-
n-Propylbenzene	103-65-1	-	-		-	-	-	-	-	-
Pentachloroethane	76-01-7	-		-		-	-	-	-	-
Propionitrile	107-12-0	-		-		-	-	-	-	-
Styrene	100-42-5	-				-	-	-	-	-
tert-Butyl methyl ether	1634-04-4	-	-		-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Tetrachloroethylene	127-18-4	-				-	-		-	-
Tetrahydrofuran	109-99-9	-	-		-	-	-	-	-	-
Toluene	108-88-3	-				-	-	-	-	-
Trichloroethene (Trichloroethylene)	79-01-6	-				-	-	-	-	-
Trichlorofluoromethane	75-69-4	-				-	-	-	-	-
Vinyl acetate	108-05-4	-				-	-	-	-	-
Vinyl chloride	75-01-4	-				-	-	-	-	-
Xylene, m	108-38-3	-	-			-	-	-	-	-
Xylene, o	95-47-6	-	-			-	-	-	-	-
Xylene, p	106-42-3	-	-	-		-	-	-	-	-
Xylenes, Total	1330-20-7	-		-		-	-	-	-	-
Semi Volatile Organic Compounds										
1,2,4,5-tetrachlorobenzene	95-94-3	-	-	-		-	-	-	-	-
1,2,4-trichlorobenzene	120-82-1	-	-			-	-	-	-	-
1,2-diphenylhydrazine	122-66-7	-	-	-		-	-	-	-	-
1,4-dioxane	123-91-1	-		-		-	-	-	-	-
1,4-naphthoquinone	130-15-4	-	-	-		-	-	-	-	-
2,3,4,6-tetrachlorophenol	58-90-2	-	-	-		-	-	-	-	-
2,4,5-trichlorophenol	95-95-4	-	-	-		-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
2,4,6-trichlorophenol	88-06-2	-	-	-		-	-	-	-	-
2,4-dichlorophenol	120-83-2	-	-	-		-	-	-	-	-
2,4-dimethylphenol	105-67-9	-	-	-		-	-	-	-	-
2,4-dinitrophenol	51-28-5	-	-	-		-	-	-	-	-
2-chloronaphthalene	91-58-7	-	-	-		-	-	-	-	-
2-chlorophenol	95-57-8	-		-		-	-	-	-	-
2-methylnaphthalene	91-57-6	-	-	-		-	-	-	-	-
2-methylphenol (o-Cresol)	795-48-7	-	-	-		-	-	-	-	-
4,6-dinitro-2-methylphenol	534-52-1	-	-	-		-	-	-	-	-
4-chloroaniline	106-47-8	-		-		-	-	-	-	-
4-chlorophenyl phenyl ether	7005-72-3	-	-	-		-	-	-	-	-
4-methylphenol (p-Cresol)	106-44-5	-	-	-		-	-	-	-	-
Acenaphthene	83-32-9	-	-			-	-	-	-	-
Acenaphthylene	208-96-8	-	-			-	-	-	-	-
Acetophenone	98-86-2	-	-	-		-	-	-	-	-
Anthracene	120-12-7	-	-			-	-	-	-	-
Benzidine	92-87-5	-	-	-		-	-	-	-	-
Benzo[*a*]anthracene	56-55-3	-	-			-	-	-	-	-
Benzo[*a*]pyrene	50-32-8	-	-			-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Benzo[*b*]fluoranthene	205-99-2	-	-			-	-	-	-	-
Benzo[*g,h,i*]perylene	191-24-2	-	-			-	-	-	-	-
Benzo[*k*]fluoranthene	207-08-9	-	-			-	-	-	-	-
Benzoic acid	65-85-0	-	-	-		-	-	-	-	-
Benzyl alcohol	100-51-6	-	-	-		-	-	-	-	-
bis(2-chloroethyl) ether	111-44-4	-	-	-		-	-	-	-	-
bis(2-chloroisopropyl) ether	39638-32-9	-	-	-		-	-	-	-	-
bis(2-ethylhexyl) phthalate	117-81-7	-	-			-	-	-	-	-
Butyl benzyl phthalate	85-68-7	-	-			-	-	-	-	-
Carbazole	86-74-8	-	-	-		-	-	-	-	-
Cresol, m	108-39-4	-	-	-		-	-	-	-	-
Chrysene	218-01-9	-	-			-	-	-	-	-
Dibenz[*a,h*]anthracene	53-70-3	-	-			-	-	-	-	-
Dibenzofuran	132-64-9	-	-	-		-	-	-	-	-
Dibromoacetic acid	631-64-1	-	-		-	-	-	-	-	-
Dichloroacetic acid	79-43-6	-	-		-	-	-	-	-	-
Diethyl phthalate	84-66-2	-	-			-	-	-	-	-
Dimethyl phthalate	131-11-3	-	-		-	-	-	-	-	-
Di-n-butyl phthalate	84-74-2	-	-			-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Di-n-octyl phthalate	117-84-0	-	-	-		-	-	-	-	-
Diphenylamine	122-39-4	-	-	-		-	-	-	-	-
Fluoranthene	206-44-0	-	-	-		-	-	-	-	-
Fluorene	86-73-7	-	-			-	-	-	-	-
Hexachlorobenzene	118-74-1	-	-		-	-	-	-	-	-
Hexachlorobutadiene	87-68-3	-	-			-	-	-	-	-
Hexachlorocyclopentadiene	77-47-4	-	-		-	-	-	-	-	-
Hexachloroethane	67-72-1	-	-	-		-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	193-39-5	-	-			-	-	-	-	-
Isophorone	78-59-1	-	-	-		-	-	-	-	-
Monobromoacetic acid	79-08-3	-	-		-	-	-	-	-	-
Monochloroacetic acid	79-11-8	-	-		-	-	-	-	-	-
Naphthalene	91-20-3	-	-			-	-	-	-	-
N-nitrosodiethylamine	55-18-5	-	-	-		-	-	-	-	-
N-nitrosodimethylamine	62-75-9	-	-	-		-	-	-	-	-
N-nitrosodiphenylamine	86-30-6	-	-	-		-	-	-	-	-
N-nitrosodi-n-propylamine	621-64-7	-	-	-		-	-	-	-	-
N-nitrosopyrrolidine	930-55-2	-	-	-		-	-	-	-	-
Parathion, ethyl	56-38-2	-	-		-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Parathion, methyl	298-00-0	-	-		-	-	-	-	-	-
Pentachlorophenol	87-86-5	-	-	-		-	-		-	-
Phenanthrene	85-01-8	-	-			-	-	-	-	-
Phenol	108-95-2	-	-	-		-	-	-	-	-
Pronamide	23950-58-5	-	-	-		-	-	-	-	-
Pyrene	129-00-0	-	-			-	-	-	-	-
Pyridine	110-86-1	-	-	-	-	-	-	-	-	-
Trichloroacetic acid	76-03-9	-	-		-	-	-	-	-	-
Biological										
Complete blood count	NA	-	-	-	-	-	-	-	-	
Histopathology	NA	-	-	-	-	-	-	-	-	
Necropsy	NA	-	-	-	-	-	-	-	-	
Total coliform bacteria	10-46-8	-	-		-	-	-	-	-	-
Escherichia coli	NA	-	-		-	-	-	-	-	-
Eastern encephalitis	NA	-	-	-	-	-	-	-	-	
Western encephalitis	NA	-	-	-	-	-	-	-	-	
Hanta virus	NA	-	-	-	-	-	-	-	-	
Plague bacteria	NA	-	-	-	-	-	-	-	-	
Pseudorabies	NA	-	-	-	-	-	-	-	-	

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Tuleremia	NA	-	-	-	-	-	-	-	-	
Volatile Fatty Acids[8]										
Acetic Acid	64-19-7	-			-	-	-	-	-	-
Butyric Acid	107-92-6	-			-	-	-	-	-	-
Hexanoic Acid	142-62-1	-			-	-	-	-	-	-
i-Hexanoic Acid	646-07-1	-			-	-	-	-	-	-
i-Pentanoic Acid	503-74-2	-			-	-	-	-	-	-
Lactic Acid and HIBA	50-21-5	-			-	-	-	-	-	-
Pentanoic Acid	109-52-4	-			-	-	-	-	-	-
Propionic Acid	79-09-4	-			-	-	-	-	-	-
Pyruvic Acid	127-17-3	-			-	-	-	-	-	-
Dissolved Gases[8]										
Ethane	74-84-0	-			-	-	-	-	-	-
Ethene	74-85-1	-			-	-	-	-	-	-
Methane	74-82-8	-			-	-	-	-	-	-

Analyte	CAS Number	Air	GW1	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna

1 Groundwater
2 Drinking water & production wells
3 Storm water and playas
4 Irrigation water
5 Burning Ground soils & sediment
6 Texas Land Application Permit (TLAP) soils
7 Vegetation
8 Only applicable to ISB and ISPM wells to monitor performance of the ISB Systems
9 TLAP nutrient parameters analyzed on a plant available or extractable basis
= Sampled for
- = Not sampled
NA = Not available

Common Name	*Scientific Name*
Double-crested cormorant	*Phalacrocorax*
Cattle egret	*Bubulcus ibis*
Black-crowned night-heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Blue-winged teal	*Anas discors*
Redhead	*Aythya americana*
American coot	Fulica america
American avocet	*Recurvirostra americana*
Black-necked stilt	*Himantopus mexicanus*
Killdeer	*Charadrius vociferus*
Upland sandpiper	*Bartramia longicauda*
American kestrel	*Falco sparverius*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
Swainson's hawk	*Buteo swainsoni*
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Turkey vulture	*Cathartes aura*
American Bald eagle	*Haliaeetus leucocephalus*
Northern bobwhite	*Colinus virginianus*
Ring-necked pheasant	*Phasianus colchicus*
Rock dove (feral pigeon)	*Columba livia*
Mourning dove	*Zenaida macroura*

COMMON NAME	SCIENTIFIC NAME
Eurasian collared dove	*Streptopelia decaocto*
Greater roadrunner	*Geococcyx californianus*
Burrowing owl	*Athene cunicularia hypugea*
Common nighthawk	*Chordeiles minor*
Northern flicker	*Colaptes auratus collaris*
Red-headed woodpecker	*Melanerpes erethrocephalus*
Eastern kingbird	*Tyrannus tyrannus*
Western kingbird	*Tyrannus verticalis*
Scissor-tailed flycatcher	*Tyrannus forficatus*
Say’s phoebe	*Syornis saya*
Horned lark	*Eremophila alpestris*
Barn swallow	*Hirundo rustica*
Cliff swallow	*Hirundo pyrrhonota*
Chihuahuan raven	*Corvus cryptoleucus*
Rock wren	*Salpinctes obsoletus*
American robin	*Turdus migratorius*
Loggerhead shrike	*Lanius ludovicianus*
Northern mockingbird	*Mimus polyglottos*
Curve-billed thrasher	*Toxostoma curvirostre*
European starling	*Sturnus vulgaris*
Blue grosbeak	*Guiraca caerulea*
Grasshopper sparrow	*Ammodramus savannarum*
Lark sparrow	*Chondestes grammacus*
Cassin’s sparrow	*Aimophila cassinii*
Lark bunting	*Calamospiza melanocorys*

COMMON NAME	SCIENTIFIC NAME
Western meadowlark	*Sturnella neglecta*
Red-winged blackbird	*Agelaius phoeniceus*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Great-tailed grackle	*Quiscalus mexicanus*
Northern oriole	*Icterus galbula bullocki*
Western tanager	*Piranga ludoviciana*
House sparrow	*Passer domesticus*
House finch	*Carpodacus mexicanus*

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Units of Radiation Measurement

Current System	*Systéme International*	Conversion
curie (Ci)	becquerel (Bq)	1 Ci = 3.7 10^{10} Bq
rad	gray (Gy)	1 rad = 0.01 Gy
rem	sievert (Sv)	1 rem = 0.01 Sv

Scientific Notation Used for Units

Multiple	Decimal Equivalent	Notation	Prefix	Symbol
1 10^{3}	1,000	E+03	kilo-	k
1 10^{-2}	0.01	E-02	centi-	c
1 10^{-3}	0.001	E-03	milli-	m
1 10^{-6}	0.000001	E-06	micro-	µ
1 10^{-9}	0.000000001	E-09	nano-	n
1 10^{-12}	0.000000000001	E-12	pico-	p
1 10^{-18}	0.000000000000000001	E-18	atto-	a

Metric Conversions

When you know	Multiply by	To Get	When you know	Multiply by	To Get
cm	0.39	in.	in.	2.54	cm
m	3.28	ft	ft	0.305	m
km	0.62	mi	mi	1.61	km
kg	2.21	lb	lb	0.45	kg
L	0.26	gal	gal	3.79	L
L	1.04	quart	quart	0.95	L
hectare	2.47	acre	acre	0.40	hectare
km^2	0.39	mi^2	mi^2	2.59	km^2
m^3	35.32	ft^3	ft^3	0.03	m^3

To convert the temperature in degrees Celsius (C) to degrees Fahrenheit (F), use F = 1.8(C) + 32 .

Prefixes Used in the Metric System

Prefix	Abbreviation	Meaning	Example
Giga	G	10^{9}	1 gigameter (Gm) = 1 x 10^{9}m
Mega	M	10^{6}	1 megameter (Mm) = 1 x 10^{6}m
Kilo	k	10^{3}	1 kilometer (km) = 1 x 10^{3}m
Deci	d	10^{-1}	1 decimeter (dm) = 0.1m
Centi	c	10^{-2}	1 centimeter (cm) = 0.01m
Milli	m	10^{-3}	1 millimeter (mm) = 0.001m
Micro	µ[a]	10^{-6}	1 micrometer (µm) = 1 x 10^{-6}m
Nano	n	10^{-9}	1 nanometer (nm) = 1 x 10^{-9}m
Pico	p	10^{-12}	1 picometer (pm) = 1 x 10^{-12}m
Femto	f	10^{-15}	1 femtometer (fm) = 1 x 10^{-15}m

[a] This is the Greek letter mu (pronounced “mew”).

Pantex Plant, Amarillo, Texas