For Calendar Year 2011

Site Environmental Report

Pantex Plant

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Site Environmental Report

Pantex Plant 2011

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

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

Pantex Plant Babcock & Wilcox Technical Services Pantex, LLC
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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:

Julie Chavarria, B&W Pantex/09-059
P.O. Box 30020, Amarillo, TX 79120-0020
Phone: (806) 477-6533; Fax: (806) 477-3119

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

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?

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

Other Comments?

Thank you!

Annual Site Environmental Report for Pantex Plant

Julie Chavarria
B&W Pantex/09-059
P.O. Box 30020
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CHEMICALS AND UNITS OF MEASURE

Ag	silver
As	arsenic
Ba	barium
Be	beryllium
Bq	Becquerel
°C	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)
°F	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
TNX	hexahydro-1,3,5-Trinitroso-1,3,5-triazine
TPY	tons per year
yr	year
Zn	zinc
μ	micro (1.0×10^{-6})

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
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
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
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

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 2.7×10^{-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.

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 Agrilife Bush Research Farm at Bushland, Texas, have often been used as a control or background location.

Background radiation – Ionizing radiation 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 3.7×10^{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.

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).

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 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.

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.

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.

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.

Offsite – Outside the Pantex Plant site boundary.

Onsite – 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 second period of the Cenozoic era, following the Tertiary; also, the corresponding system of rocks. It began two to three Ma and extends to the present. It consists of 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 (DOE, 2002).

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.

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.

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.

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.

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Acknowledgements

This report was prepared primarily by the staffs of the Environmental Programs of Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex). The Environmental Stewardship Department is managed by Jeffrey R. Flowers, the Projects Division is managed by Dennis E. Huddleston, Jr., and the Waste Operations Department is managed by Deborah R. Franklin.

Report preparation was managed by Kimberly A. Bush and Julie A. Chavarria. Graphics support was provided by Barry W. Guidry.

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

The *2011 Site Environmental Report for Pantex Plant* was reviewed for classification and security issues; it was determined to be Unclassified.

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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) (formerly the Pantex Site Office). Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex) manages the environmental aspects of its operations systematically, in a manner consistent with Integrated Safety Management.

The Purpose of the Report

The *2011 Site Environmental Report for Pantex Plant* summarizes the efforts, data, and status of B&W Pantex's environmental protection, compliance, and monitoring programs for calendar year 2011. 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. xxxiv-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. B&W Pantex also operates a meteorological monitoring program that supports several of the requirements. Samples for 2011 were routinely collected at diverse locations, and 29,973 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 2011, the calculated annual radiation dose from releases to the atmosphere from Plant operations was 3.23×10^{-6} mrem (3.23×10^{-8} 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 2011 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 93.5 mrem for the calendar year 2011. This is consistent with historical data. No unplanned radionuclide releases occurred at Pantex Plant in 2011. Ambient air monitoring results for 2011 were generally similar to those from previous years. All results were below the applicable DOE Derived Concentration Guide (DCG).

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 nonradiological 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 2011 confirmed that the drinking water system at Pantex Plant met all applicable regulatory requirements.

Permit-required sampling of wastewater and storm water and environmental surveillance sampling of surface water was conducted for both radiological and nonradiological constituents. Sampling at the Wastewater Treatment Facility (WWTF) was conducted at outfalls in accordance with Texas Water Quality Permit No. WQ0002296000 and Texas Land Application Permit No. WQ0004397000, each issued by the Texas Commission on Environmental Quality (TCEQ). Results of permit-required sampling were reported monthly, quarterly, and annually to the TCEQ.

Surface water monitoring is generally dependent on precipitation or discharge events, since samples can only be collected when flow occurs. Storm water runoff involving industrial activities at Pantex Plant is sampled in accordance with the TCEQ issued Texas Pollutant Discharge Elimination System Multi-Sector General Permit No. TXR0P506 (MSGP) for storm water. Results of sampling at the surface water outfalls and playas (when samples could be collected) were normal and consistent with past monitoring results. However, the explosive 2-nitrotoluene was detected in one playa sample in 2010, a first since sampling for this explosive began in 2004. Follow-up sampling could not be conducted in 2010 due to declining water levels in the playa or in 2011 due to the severe drought. Subsequent sampling, as water becomes available, will monitor for this analyte in the future.

Soil samples were collected and analyzed for metals, explosives, semi-volatile, and volatile organic compounds (VOCs). Onsite soil monitoring results for 2011 were, with one exception, 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. The one exception was a sample collected at the Pantex Burning Ground. The initial sampling result for mercury was 0.36 mg/kg at sampling location BG-SS-C1. The established background concentration is 0.29 mg/kg for mercury at this location. The results from confirmation sampling, as provided for in Provision VI.F.1.a of Permit HW-50284, was 0.29 mg/kg for mercury, which did not exceed the established background value at the location. Because the confirmation sample result did not exceed the established background value, no additional action was required.

Flora and fauna monitoring results indicated that there were no detrimental impacts from Plant operations in 2011.

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 onsite 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 2011 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 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 2011. The soil vapor extraction (SVE) system located at the Burning Ground continued to operate during 2011 and effectively removed 630 lbs. of VOCs.

Regulatory Compliance and Permitting

During 2011, the Plant had no exceedances of permit limits of either Texas Water Quality Permit No. WQ0002296000, which regulates wastewater discharges to an onsite playa lake, or Texas Land Application Permit No. WQ0004397000, which regulates disposal of treated wastewater through a subsurface irrigation system. The TCEQ acted upon Pantex's request for a renewal and major modification of its wastewater discharge Permit No. WQ0003497000 by declaring the related application technically complete. During 2011, the TCEQ received a request for a contested case hearing on renewal of Pantex's Water Quality Permit No. WQ0002296000 and the agency is scheduled to rule upon the request in early 2012.

On February 22-28, 2011, the TCEQ conducted a Resource Conservation and Recovery Act (RCRA) inspection at Pantex, to determine compliance with the Plant's Hazardous Waste Permit No. HW-50284. Approximately 90 waste management units were inspected; no violations or areas of concern were identified by the TCEQ. The results of the inspection represent 17 consecutive years with no violations or areas of concern noted for the management of waste.

On March 29, 2011, the TCEQ conducted a Petroleum Storage Tank (PST) Focused Energy Act Investigation for Release Detection, Corrosion Protection, Financial Assurance, Spill Containment, and Overfill Prevention. No areas of concern or violations were alleged as a result of the investigation of Pantex's PST program.

On September 21, 2011, the TCEQ issued Pantex an amended Air Quality Permit (Permit No. 84802) based on an application submitted by Pantex to the TCEQ on December 22, 2010. The application requested that the current Flexible Air Permit issued pursuant to Title 30 of the Texas Administrative Code (30 TAC) Chapter 116, Subpart G be converted to a New Source Review Permit issued pursuant to 30 TAC Chapter 116, Subchapter B. The application was submitted as a result of the TCEQ's Flexible Air Permit Program being the subject of a dispute between EPA and the TCEQ.

Pantex Plant continues to qualify for a reduction in oversight inspections from the State of Texas. The TCEQ did not conduct a Comprehensive Compliance Evaluation Investigation of either of Pantex's wastewater permits or the Pantex Public Water Supply System during 2011 due to a decreased inspection schedule. The decreased inspection schedule is a result of Pantex's Gold level membership in the TCEQ's Clean Texas Program.

A required three-year validation audit of the Pantex EMS was conducted in August of 2011. The audit was consistent with instructions for implementing Executive Order 13423, *Strengthening Federal Environmental and Transportation Management*. A "qualified" party outside the control or scope of Pantex's EMS Program performed the audit. The outcome of the audit indicated that Pantex fully implemented an EMS program that conforms to standards of the International Organization for Standardization 14001, as required by DOE Order 436.1, *Departmental Sustainability*.

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 2011 relating to the Pantex EMS include:

- In association with National Raptor Month, Xcel Energy prepared a news release recognizing Pantex's efforts to protect birds of prey. Quotes were included from Texas Parks and Wildlife Department, U. S. Fish and Wildlife Service, NPO, and officials from Xcel. The release was picked up by the *Playa Lakes Joint Venture*'s Facebook page, the *Hutchison County Highlights* website, the Canyon News, and is also on Xcel Energy's website.
- NNSA issued Pantex a pollution prevention (P2) award in the Safety and Environment category for a proactive hazard reduction initiative involving elimination of the use of gaseous chlorine (MIOX System). In addition, Pantex was issued a prestigious ESTAR award for successful implementation of the initiative.
- A presentation titled *"Wildlife Research and Management on the USDOE/NNSA Pantex Facility"* and "*Home Range and Habitat Components of a Population of High Plains Bobcats: Preliminary Results"* was given at the annual meeting of the Texas Chapter of The Wildlife Society.
- A presentation titled "*Purple Martin Distribution, Outreach, and Research in Northwest Texas and Western Oklahoma,*" was given at the 2011 Purple Martin Conference in Erie, Pennsylvania.
- Support was provided to a DOE Headquarters working group to guide programmatic discussions with the Fish and Wildlife Service to develop a new Memorandum of Understanding concerning E.O. 13186, "*Responsibilities of Federal Agencies to Protect Migratory Bird Populations."*
- Earth Day occurred in April and B&W Pantex coordinated and was present for the cooperative event with other entities such as Wildcat Bluff and Excel Energy. This event helped raise awareness about energy conservation, recycling and other ways to help protect the environment.
- A timeline exhibit was fabricated, signs for audio units (phones) and touch screens for the Building 16-12 Visitor Center were installed, and the reception area in Building 16-12 was remodeled and now provides an updated impression of Pantex's current mission and historical context.

- A Beryllium Emission Compliance Test Report for the Microwave Oven was prepared and submitted to the TCEQ. The report provided applicable information to demonstrate successful operation of the oven and compliance with the standard contained in 40 CFR 61, Subpart C.

Pollution Prevention

Efforts to reduce and eliminate waste from routine operations at Pantex Plant have resulted in significant waste reductions over the last 24 years. From 1987 to 2011, the Plant population and workload increased as the focus of the Plant's mission changed from weapons assembly during the Cold War to dismantlement. Even with these increases, the P2 Program's efforts were successful in reducing the generation of hazardous waste by more than 99%.

In 2009, Executive Order 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 P2 into environmental management systems. 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 prevention of pollution and minimization of waste.

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

****

The DOE, through NPO, is supportive of the Plant's Environmental Policy. Below is the B&W Pantex Environmental Policy.

Bulletin No: BLTN-924 Issue 002
Post: May 12, 2010
Remove: May 12, 2012

ENVIRONMENTAL MANAGEMENT SYSTEM

Date: September 16, 2010

From: John Woolery *John Woolery* Location: 12-69

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

The following is the NPO Environmental Policy Statement.

PXSO P 11-01 **1**
6-27-11

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

Introduction

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 an approximately 7,001 hectare (17,503 acres) site. The Pantex Plant 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 2011, just over 4000 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 (BWXT Pantex), on February 1, 2001. BWXT Pantex combined elements of BWX 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

[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 µCi/mL (Y Bq/m^3)."

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.

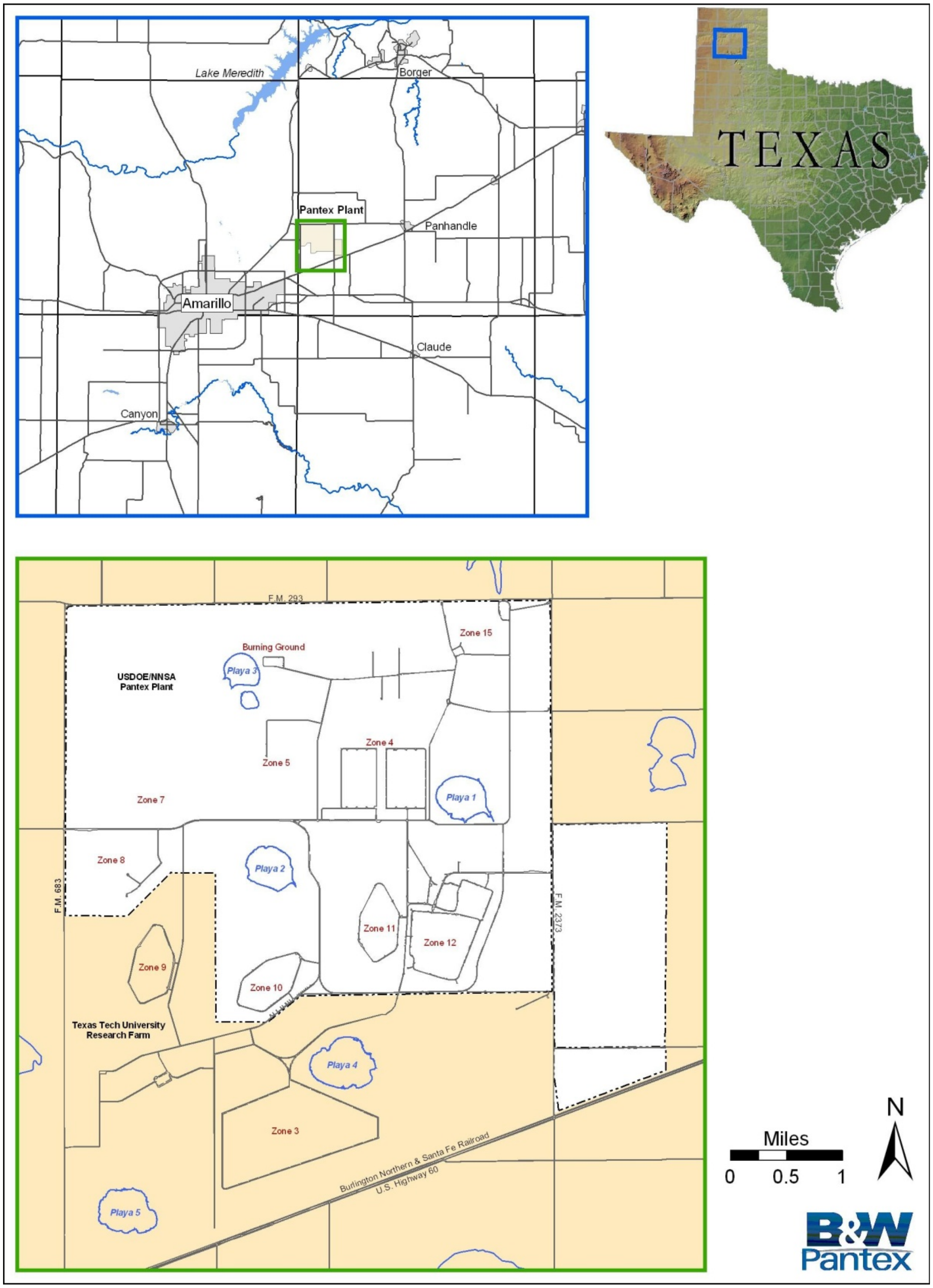


FIGURE 1.1 — ***Pantex Plant Site Location***

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 400 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, and vehicle maintenance 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 non-potable water to the high-pressure fire protection system.

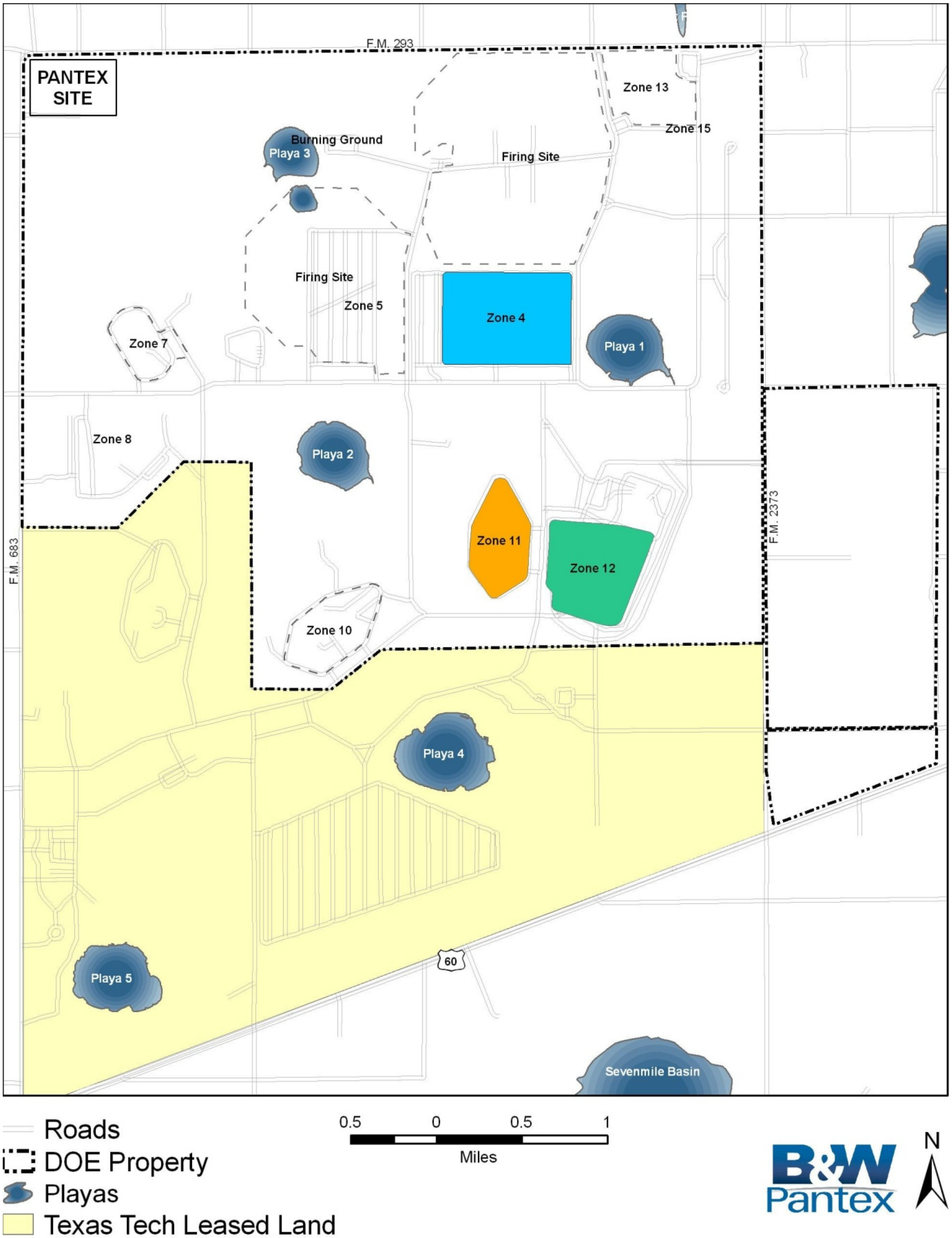


FIGURE 1.2 — *Principal Features of the Pantex Plant Site*

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 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 onsite 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 onsite sanitary landfill for disposal. Since then, this waste has been processed to remove recyclable materials and the nonrecyclable material is sent to an offsite landfill. Practices preclude disposal of hazardous materials in onsite landfills; therefore, hazardous materials are transported offsite 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 temperature extremes, low relative humidity, and irregularly spaced rainfall of moderate amounts. Three-fourths of the average precipitation falls from April through September, generally occurring with thunderstorm activity. The average annual snowfall is 17.8 inches (Department of Commerce [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 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 degrees (F) within a 12-hour period are not uncommon. Temperature drops of 40 degrees (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 2010 (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 26 tornadoes reported in the Texas and Oklahoma Panhandles during 2011 (DOCc), close to the average, but less than half the number observed during the very active year of 2007.

The normal annual mean temperature in Amarillo is 14.1˚C (57.3˚F), while the normal annual rainfall for Amarillo is 51.7 cm (20.36 in) (DOCa). The mean temperature at the official Amarillo Airport National Weather Service (NWS) location during 2011 (15.3˚C [59.6˚F]) was only slightly above normal. The area of the Pantex Plant experienced the driest year on record as the official NWS rain gauge recorded 17.8 cm (7.0 in) of precipitation.[3] A large portion of this precipitation occurred during snow events which occurred in early February, late October, and on Christmas Day in December. In addition to the drought conditions during much of the year, the other major weather events were the numerous instances during June, July, and August when daily temperature records were tied and/or broken. Some of the notable records that were broken included the all-time record high (43.9 ˚C (111˚F) set on June 26), the most number of 100-degree days (50 days), and the hottest average monthly temperature on record (July at 29.6 ˚C (85.2˚F)) (DOCc). 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 Pantex Plant maintains a meteorological monitoring station located 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 taken every two-eight seconds. The tower's data logger calculates and stores 15 minute averages of the data. Every 15 minutes, the system uploads 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 on a bi-weekly basis 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 2011 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 (nearly 50 percent) of the winds blew from the southeast through southwest during the year. Figure 1.3(b) shows that wind direction and speed frequencies vary by season: Northern winds are most

[2] High speed "straight-line" winds produced in the downdraft region of a thunderstorm.
[3] Precipitation includes the liquid water equivalent from snowfall.

frequent during the period from January 1 through March 31 (roughly corresponding to "winter"). Wind direction frequency is more bi-modal during the periods from April 1 through June 30 and from October 1 through December 31 ("spring" and "fall" respectively). The vast majority of winds are from the southern sector in "summer" (i.e., July 1 through September 30), including over 40 percent from the south and south-southwest directions.

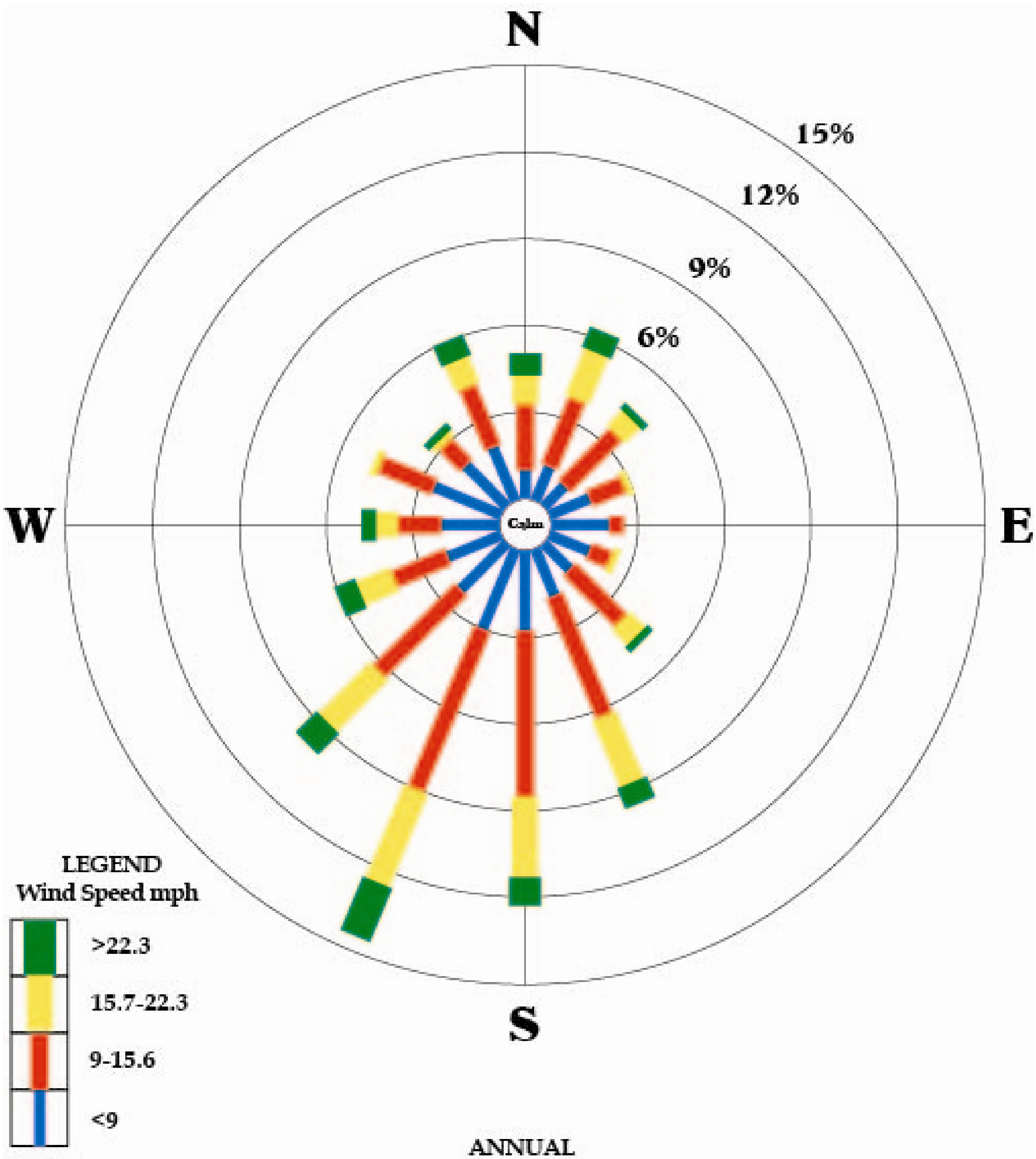


FIGURE 1.3(a) — *Pantex Plant Annual Wind Rose for 2011*

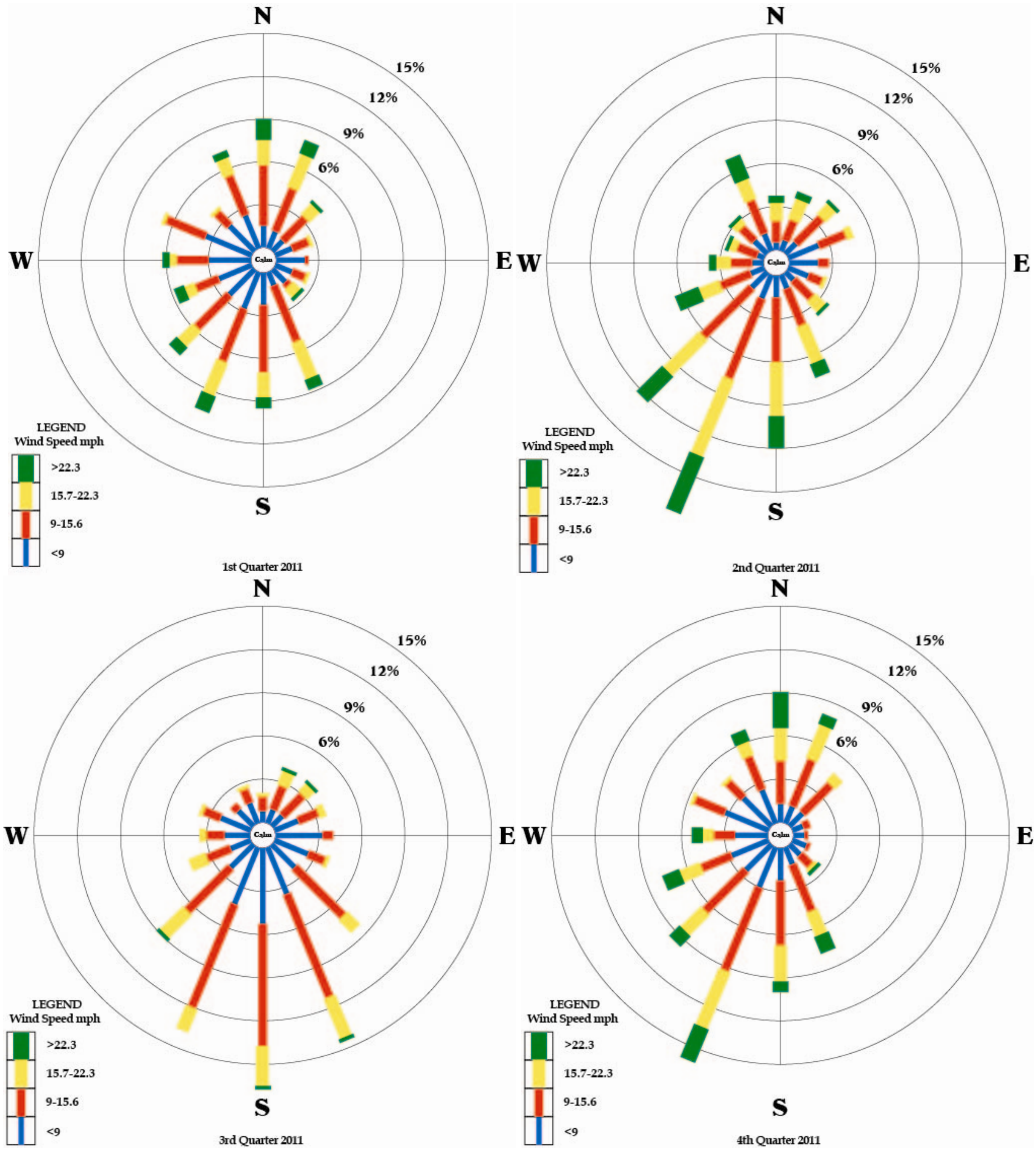


FIGURE 1.3(b) — *Pantex Plant Quarterly Wind Roses for 2011*

Table 1.1 is a compilation of climatological data (temperature, relative humidity, precipitation [including the water equivalent of any snowfall] and wind speed) for 2011 from the Pantex Plant 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 2011 Climatological Data by Month*

Month	Temperature °C (°F)			Mean Relative Humidity (%)	Precipitation[a] mm (inches)	Wind Speed m/s (mph)	
	Maximum	Minimum	Mean Monthly			Mean	Maximum
January	21.1 (70.0)	-16.0 (3.2)	1.1 (34.0)	58	3.30 (0.13)	5.0 (11.1)	15.4 (34.1)
February	25.8 (78.5)	-20.9 (-5.6)	1.8 (35.2)	56	3.05 (0.12)	6.0 (13.3)	21.7 (48.2)
March	30.3 (86.6)	-4.3 (24.3)	9.4 (48.9)	52	0.51 (0.02)	5.8 (12.9)	23.8 (53.0)
April	33.4 (92.1)	0.8 (33.4)	15.2 (59.4)	37	2.03 (0.08)	6.9 (15.3)	19.7 (43.7)
May	38.2 (100.7)	1.6 (34.9)	19.4 (66.9)	31	1.52 (0.06)	6.6 (14.7)	16.3 (36.2)
June	41.7 (107.0)	12.3 (54.1)	27.8 (82.1)	29	1.02 (0.04)	7.1 (15.7)	17.6 (39.1)
July	38.8 (101.9)	17.9 (64.3)	29.0 (84.2)	37	42.16 (1.66)	5.1 (11.4)	13.6 (30.2)
August	38.7 (101.6)	17.7 (63.8)	28.3 (83.0)	41	13.21 (0.52)	4.7 (10.4)	11.6 (25.7)
September	36.4 (97.6)	9.0 (48.2)	20.8 (69.4)	43	20.57 (0.81)	5.0 (11.0)	11.9 (26.5)
October	30.4 (86.8)	-2.2 (28.0)	14.5 (58.1)	53	30.48 (1.20)	5.9 (13.1)	15.9 (35.3)
November	25.7 (78.3)	-6.7 (20.0)	8.2 (46.8)	51	31.75 (1.25)	6.4 (14.3)	18.8 (41.7)
December	21.6 (70.8)	-16.8 (1.8)	0.7 (33.3)	76	35.81 (1.41)	5.5 (12.2)	17.4 (38.7)
Annual[b]			14.7 (58.5)	47	185.42 (7.30)	5.8(12.9)	

[a] Includes water equivalent of snowfall.
[b] Annual mean of parameter (when indicated) except for precipitation. Total 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).

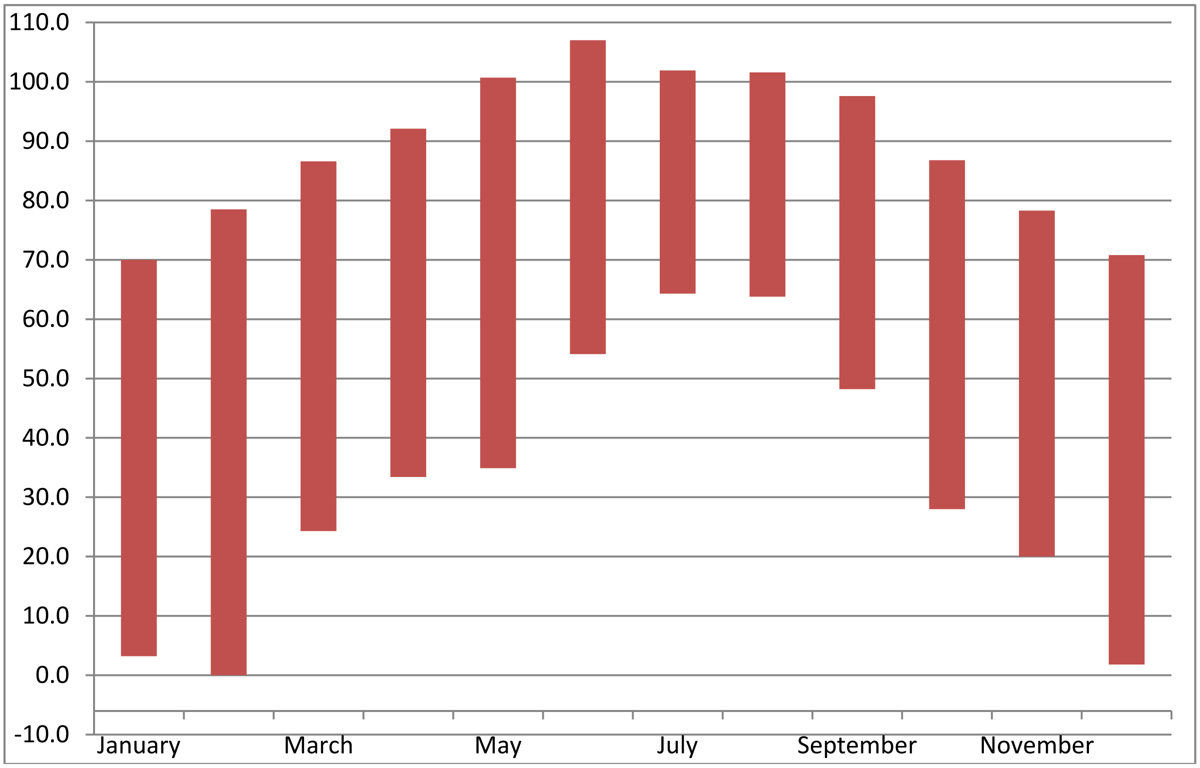


FIGURE 1.4 — *Pantex Plant Monthly Temperature Range during 2011 (ºFahrenheit)*

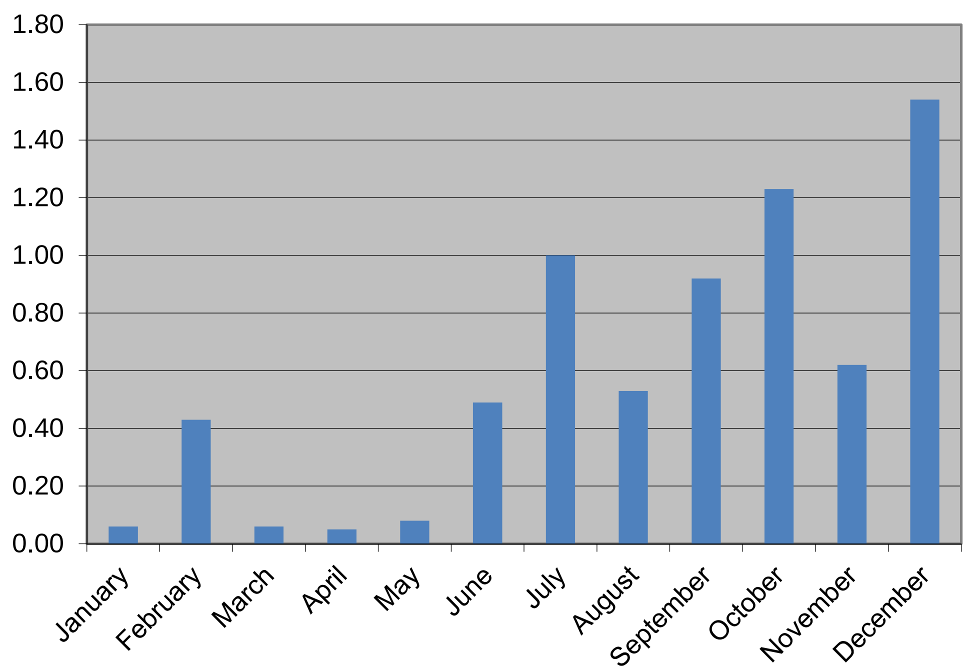


FIGURE 1.5 — *Amarillo National Weather Service (NWS) Precipitation during 2011 (in inches)*

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 onsite playas. Storm water from agricultural areas at the periphery of the Plant drains into offsite 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 vadose, or unsaturated, zone above the Ogallala Aquifer 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 four wells in the northeast corner of the site. In 2011, 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 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. Figure 1.6 shows the population distribution. 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).

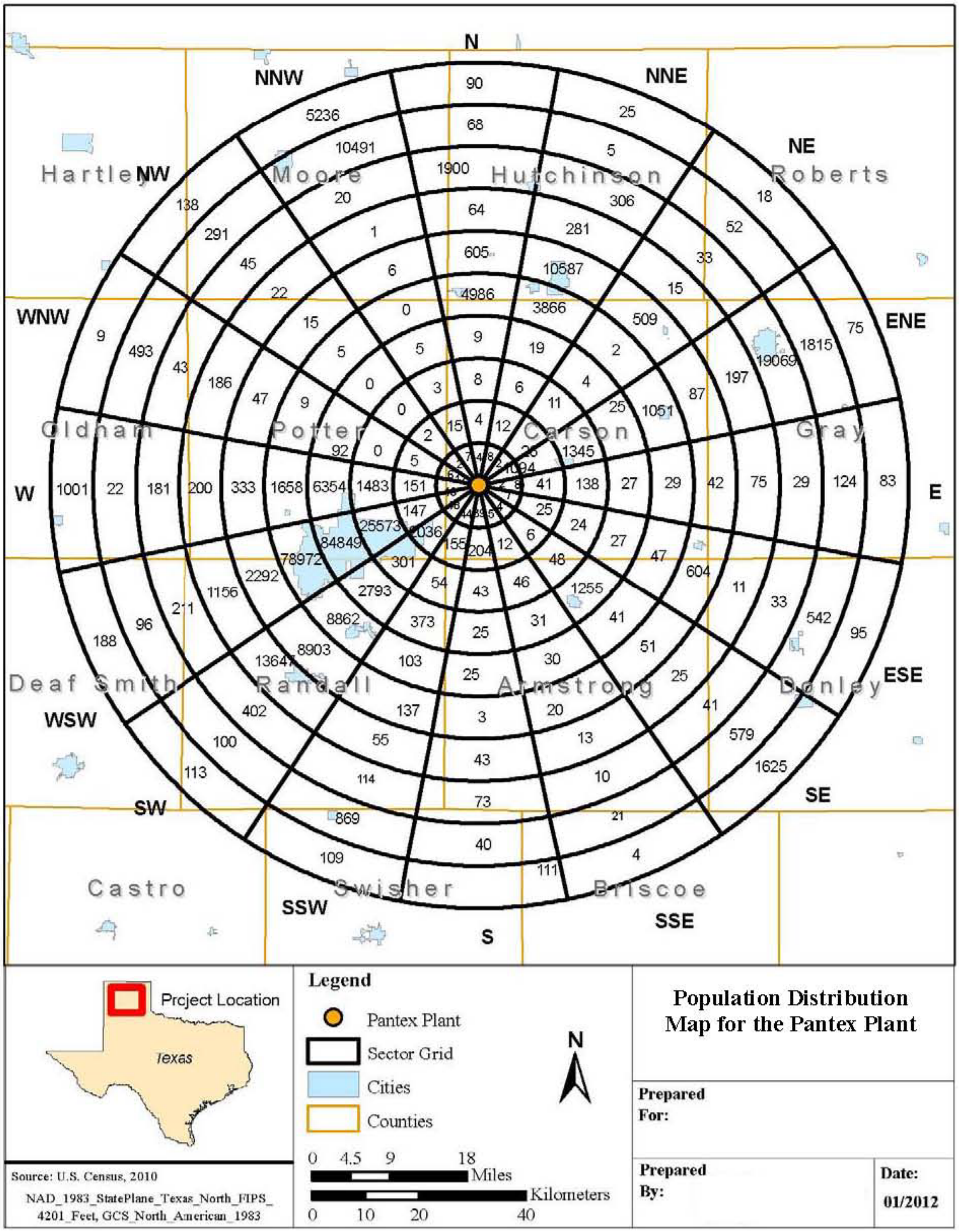


FIGURE 1.6 — ***Population Distribution Within 50 Miles of Pantex Plant (2010)***

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 area can be 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 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 2011 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 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 nonradiological 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 nonradiological data for the 2011 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 (Quality Assurance). The chapter also includes an analysis of quality control samples collected during 2010 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, and Appendix C provides references.

Compliance Issues and Activities

Pantex's policy is to conduct all operations in compliance with applicable environmental statutes, regulations, and the requirements of the various permits issued to the Plant. This chapter reviews current issues and actions related to these requirements. In 2011, 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 Pantex obtaining and maintaining Gold Level status in the TCEQ's Clean Texas Program.

2.1 Environmental Regulations

This chapter summarizes the compliance status of Pantex Plant for 2011. It contains a discussion of initiatives and clean-up agreements in place, as well as 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.	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
Section 107 provides for the protection of natural resources on publicly owned property through designation of Natural Resource Trustees.			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 regulations. The Plant implemented a land-applied chemical use plan in 1996. The plan was most recently updated in 2004.
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, §309, §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 2011, three 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 Decreed that all migratory birds, their parts, and their nests were fully protected. Pantex provides habitat for many migratory bird species protected by federal law.	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. The order provides a driver for management (habitat), research and outreach.
NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) NEPA establishes a broad national policy to conduct federal activities in ways that promote the general welfare and are in harmony with 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 2011, nine Standard NEPA Review Forms, 37 Internal NEPA Review Forms, and six amendments were prepared. No Environmental Assessments (EAs) were prepared.
PROTECTION OF BIRDS, NONGAME SPECIES, AND FUR-BEARING ANIMALS This statute 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.
RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) RCRA and the Texas Solid Waste Disposal Act govern the generation, storage, handling, treatment, and disposal of hazardous waste. These statutes and regulations also regulate underground storage tanks and spill release 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. Permit 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). In 2011, the system was recognized as a Superior Public Water System by the TCEQ.

Regulatory Description	Authority	Codification	Status
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)

All new projects are evaluated to determine the applicability of 40 CFR §61 Subpart H to the project. Under 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). Evaluations, using the most conservative assumptions about the emissions of radionuclides from several Plant locations that have the potential to emit radioactive materials, were conducted during 2011. B&W Pantex has determined that the maximum effective dose equivalent that any member of the public received in 2011 was 3.23×10^{-6} mrem (3.23×10^{-8} mSv), which 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.

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 during the year 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 (Risk Management Planning)

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 maintains fixed and mobile air conditioning systems at the Plant. Technicians conducting 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 and authorizations issued under 30 TAC §106 (Permits by Rule) to authorize operations conducted at the Plant.

On September 21, 2011, the TCEQ amended Air Quality Permit 84802. This action allowed the TCEQ to issue Air Quality Permit 84802 under regulations included in the EPA Approved Texas State Implementation Plan. Permit 84802 includes hourly and annual maximum emission rates for each of the emission points included in the Permit as well as annual maximum emission rates for all of the emission points included in the Permit.

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 2011, Pantex maintained documentation demonstrating that it was not a major source, as defined by the Federal Operating Permit Program. Pantex currently operates under a Potential-to-Emit (PTE) Certification submitted on January 4, 2010, and updated by a registration for a Permit by Rule dated July 7, 2010.

2.2.7 Air Quality Investigation

The TCEQ did not perform an air quality related compliance inspection of Pantex Plant during 2011.

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 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 39, 41, 42	PBR 433 & 452
VMF Fueling Operations	Permit 84802		PBR 412
HWTF Liquid Processing Facility	Registration 48297		PBR 261
Pantex Site-wide Cooling Towers	Permit 84802		PBR 371
Load Leveling Engines	Permit 84802	SE 6	
Standby Emergency Engines	Permit 84802		PBR 511
Painting Facilities	Registration 32674, 52638, 52639	SE 75	
Pressing & Transferring HE & Mock		SE 106 & 118	
Burning Grounds-Soil Vapor Extraction	Registration 70894		PBR 533
Miscellaneous Chemical Operations		NA	
Chemical Transfer Operations	Registration # 72373		PBR 261, 262, & 512
Drum Management Operations	Registration 92876		PBR 533

[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

As stated earlier, Pantex Plant is a Synthetic Minor. The upper threshold of emission limits for a facility to remain in this category is 25 tons per year 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 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.

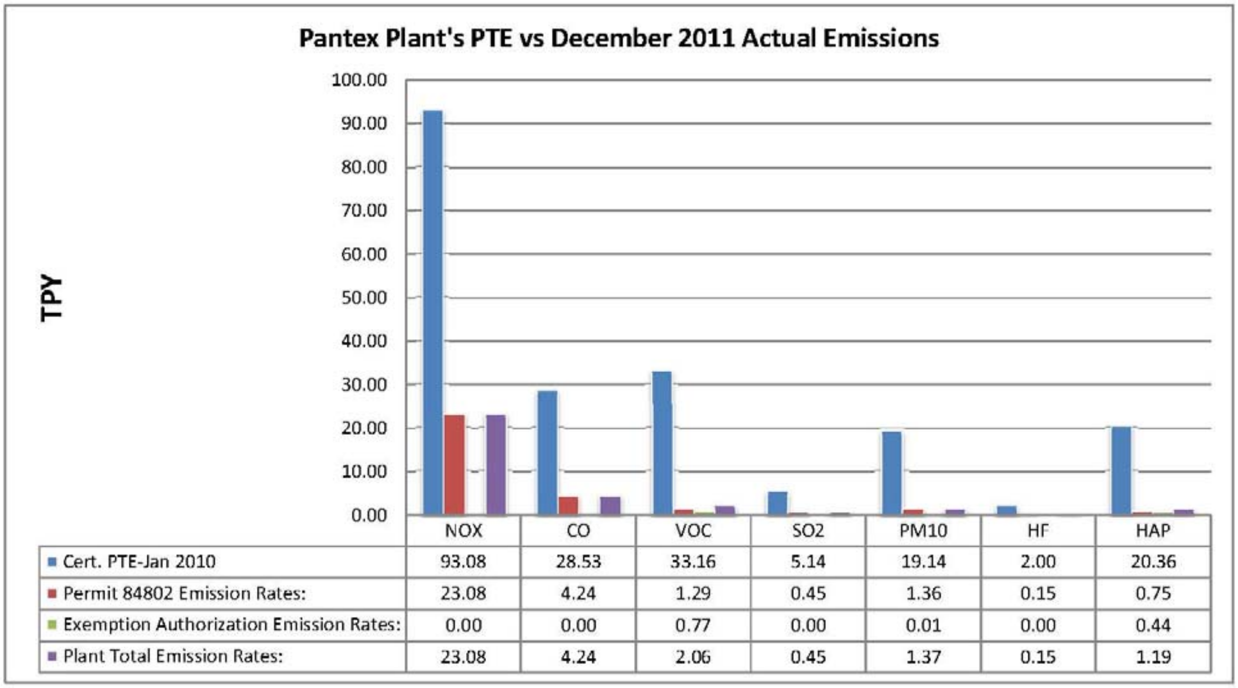
2.2.8.3 Types and Tracking of Emissions

During 2011, 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 plant 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 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.

On June 21 through June 29, 2011, Pantex conducted a series of tests that demonstrated that the Microwave Oven used to sanitize weapon components met the emission standards stated in 40 CFR §61, Subpart C (National Emission Standards for Beryllium).

2.2.8.4 Conclusions of Air Emission Tracking for 2011

Over the 12 months of air emission tracking for 2011, 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 2011, expressed in relation to the PTE certification in Tons per Year. Figure 2.1 is 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	33.16	5.14	19.14	2.00	20.36
Permit 84802 Emission Rates:	23.08	4.24	1.29	0.45	1.36	0.15	0.75
Exemption Authorization Emission Rates:	0.00	0.00	0.77	0.00	0.01	0.00	0.44
Plant Total Emission Rates:	23.08	4.24	2.06	0.45	1.37	0.15	1.19

FIGURE 2.1 — ***PTE versus Actual Yearly Emissions***

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

As 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, B&W 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 for the Plant, 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 2011. 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 (the first in 2013) to ensure periodic comprehensive analyses of the protectiveness of the Selected Remedy.

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. Pantex personnel have confirmed the presence of several species listed by the state and federal governments, as well as the potential presence of others. 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 2011	Federal Status	State Status
Birds				
American peregrine falcon	*Falco peregrinus anatum*		Concern	Threatened[a]
Arctic peregrine falcon	*Falco peregrinus tundrius*		Concern	Threatened
Baird's sparrow	*Ammodramus bairdii*		Concern	Not listed
Bald eagle	*Haliaeetus leucocephalus*	b	Concern	Threatened
Ferruginous hawk	*Buteo regalis*	b	Concern	Not listed
Interior least tern	*Sterna antillarum athalassos*		Endangered	Endangered
Lesser prairie chicken	*Tympanuchus pallidicinctus*		Candidate[c]	Not listed
Mountain plover	*Charadrius montanus*		Concern	Not listed
Western Snowy plover	*Charadrius alexandrinus*		Concern	Not listed
Western burrowing owl	*Athene cunicularia hypugea*	b	Concern	Not listed
Prairie falcon	*Falco mexicanus*	b	Concern	Not listed
White-faced ibis	*Plegadis chihi*	b	Concern	Threatened
Whooping crane	*Grus Americana*		Endangered	Endangered
Mammals				
Big free-tailed bat	*Nyctinomops macrotis*		Concern	Not listed
Black bear	*Ursus americanus*		Concern	Threatened
Black-tailed prairie dog	*Cynomys ludovicianus*	b	Concern	Not listed
Cave myotis bat	*Myotis velifer*		Concern	Not listed
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*		Concern	Not listed
Plains spotted skunk	*Spilogale putorius interrupta*		Concern	Not listed
Swift fox	*Vulpes velox*		Concern	Not listed
Western small-footed bat	*Myotis ciliolabrum*		Concern	Not listed
Reptiles				
Texas horned lizard	*Phrynosoma cornutum*	b	Concern	Threatened

[a] Threatened only based on similarity with *F.p. tundrius.*
[b] Presence documented at Pantex Plant in 2011.
[c] Candidate, threatened.

Several species are listed for Carson or surrounding counties, yet are not included in Table 2.3 because of their dependence on habitat 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 Federal Insecticide, Fungicide, and Rodenticide Act

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.

2.5.1 Agricultural Pesticide Use in 2011

Texas Tech Research Farm submitted 23 agricultural spray requests during the 2011 growing season. Although all 23 agricultural spray requests were reviewed and approved by B&W 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 2003.

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

Year of Pesticide Applications	Texas Tech Research Farm	Maintenance Department	Contractors	Total
2003	22	90	35	147
2004	22	86	28	136
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

2.5.2 Maintenance Department and Contractor Pesticide Use in 2011

The B&W Pantex Maintenance Department made 150 applications of pesticides during 2011. 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 four applications that accounted for the remainder of pesticide use in 2011. The majority of the four 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 any wastewater into or adjacent to waters of the United States; thus, it is not subject to the Federal Water Pollution Control Act. It is 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 2011, Pantex maintained three permits issued by the TCEQ authorizing the disposal of industrial wastewaters. In 2011, 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 300 acres of crops and grassland. 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.

On May 1, 2010, the Pantex Plant submitted an application to renew Permit WQ0002296000. On July 19, 2010, the TCEQ declared Pantex's application to be administratively complete. The public notice of the Application and TCEQ's Executive Director's Preliminary Decision was published on June 23, 2011. Subsequent to the June 23, 2011 Public Notice, a member of the public requested a hearing on the issuance of Permit WQ0002296000. As of December 31, 2011 the Pantex Plant was awaiting the TCEQ's decision on the hearing request and issuance of the Permit.

On May 17, 2010, the Pantex Plant submitted an application to renew and amend Permit WQ0004397000. In addition to requesting the renewal of the Permit, the application requested the addition of 100 acres of subsurface irrigation to the existing 300 acres and changes to the reporting requirements of the permit. On July 7, 2010, the TCEQ declared Pantex's application administratively complete. The public notice of the TCEQ's Receipt of Application and Intent to Obtain Water Quality Permit Amendment was published on July 22, 2010. As of December 31, 2011, the Pantex Plant was in negotiations with the TCEQ on the final terms of the proposed permit.

Pantex maintains a 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 2011 are listed in Table 2.5.

On November 8, 2011 the Pantex Plant submitted a Notice of Intent for coverage under the renewed TPDES Multi-Sector General Permit for discharge of stormwater from industrial sites. The new general permit is a five year permit that will expire in 2016.

At seven of its more remote buildings, Pantex operates "Onsite 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 repaired or replaced, permits authorizing the upgrading or installation of the new system will be acquired from the TCEQ.

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	TX-4890110527 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
Underground Injection TLAP associated ER Program	5W2000017 5X2600215 5X2500106	TCEQ TCEQ TCEQ	11/29/2004 10/23/2001 11/28/2005	When cancelled. When cancelled. When cancelled.
Water				
Texas Water Quality Permit	WQ0002296000	TCEQ	06/24/2008	When the Application to renew Permit WQ0002296000 is approved (which would set a new expiration date) or denied.
Texas Land Application Permit	WQ0004397000	TCEQ	10/06/2003	When the Application to renew Permit WQ0004397000 is approved (which would set a new expiration date) or denied.
TPDES Multi-Sector (Industrial) Storm Water Permit	TXR05P506	TCEQ	8/14/2011	08/14/2016
TPDES Storm Water General Permit for Construction Activities High Pressure Fire Loop Replacement	TXR150000 TXR15OT07	TCEQ TCEQ	03/05/2008 10/07/2009	03/05/2013 When completed.

Building or Activity	Permit Number	Issuing Agency	Effective Date	Expiration Date
Project Irrigation System Upgrade/Expansion High Explosive Pressing Facility	TXR15QC95 TXR15SL51	TCEQ TCEQ	06/16/2010 08/07/2011	When completed. When completed
Natural Resources				
Scientific Permit	SPR-1296-844	TXPWD	12/05/1997	12/05/2011
Letter of Authorization: Trap and Release Fur-bearing Animals		TXPWD	07/28/2000	Renewed annually.
Bee Removal Permit		BR-12-128	08/10/2010	Renewed annually.
Intrastate Bee and Equipment Permit	01/12/003	Texas Apiary Inspection Service	08/10/2010	Renewed annually.

2.6.1 Wastewater Discharge Permit Inspections

During 2011, the Plant had no exceedances of permit limits of either Permit No. WQ0002296000, which regulates wastewater discharges to an onsite playa lake, or Permit No. WQ0004397000, which regulates disposal of treated wastewater through a subsurface irrigation system. The TCEQ did not conduct a Comprehensive Compliance Investigation for either permit.

2.7 Medical Waste

Medical waste at Pantex Plant is regulated by the 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. A contract was issued in 2011 to prepare the required SA.

In 2011, 9 Standard NRFs (Categorical Exclusion determinations), 37 Internal NRFs, and nine amendments were prepared and approved. Categorical Exclusion determinations for the nine Standard NRFs and three amendments were posted on the Pantex website.

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

In October 2004, NPO, B&W 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, 58 projects were evaluated in 2011 under the PA/CRMP. Of these projects, 41 did not involve either National Register-eligible properties or possible adverse effects, or design modifications were suggested and incorporated to avoid impacts to National Register-eligible properties. A number of modification projects are continuing at the Plant, involving historic eligible National Register properties. The modifications would not adversely impact the historical characteristics of the properties. Continued use and reuse of buildings is the strongest and most effective preservation possible at Pantex.

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 2011 are summarized in Table 2.6. Overall, the amount of waste generated in 2011 increased 26.7 percent from 2010. This is due

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

Waste Type	1993	2008	2009	2010	2011	% Increase or (Decrease) from 1993	% Increase or (Decrease) from 2010
Non-hazardous Industrial Solid Waste	10,885	22,934.93	7,962.7	6,045.0	7,931.7	(27.1)	31.2
Sanitary Waste	612	1,465.56	1,230.1	1,040.1	980.5	60.2	(5.7)
Hazardous Waste	369.6	411.9	506.6	541.4	828.9	124.3	53.1
Low-Level Waste	287	34.01	21.6	57.3	29.8	(89.6)	(48.0)
Mixed Waste	37.5	0.076	0.14	0.08	0.4	(98.9)	400.0
TSCA Waste	112.9	115.2	64.3	81.7	69.0	(38.9)	(15.5)
Universal Waste [a]	-	16.3	6.2	5.2	8.5	-	63.5
Total	12,304	24,977.98	9,791.64	7,770.8	9,848.7	(20.0)	26.7

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

primarily to increased activity in the deactivation and decommissioning of excess facilities and construction projects.

During 2011, Pantex Plant generated 828.9 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 RCRA permit authorized waste management units. Some hazardous wastes, such as explosives, were processed onsite before the process residues were shipped offsite for final treatment and disposal. During the year, environmental restoration projects, deactivation and decommissioning of excess facilities, and construction projects contributed 21.4 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 2011, Pantex Plant generated 7,931.7 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 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 offsite 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 onsite 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, deactivation and decommissioning of excess facilities, and construction projects contributed 58.9 percent of the total non-hazardous industrial solid waste generated during 2011. In addition, during the year, Pantex Plant generated 980.5 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 offsite landfills.

Pantex Plant generated 69.0 m^3 of wastes regulated by TSCA, during 2011. 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 88.7 percent of the total TSCA waste generated. All TSCA wastes were shipped offsite for final treatment and disposal.

During 2011, Pantex Plant generated 8.5m^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, deactivation and decommissioning of excess facilities contributed 1.2 percent of the total universal waste generated. These wastes are shipped offsite for final treatment, disposal, or, as applicable, recycling.

Pantex Plant generated 29.8 m^3 of low-level radioactive waste, during 2011. 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 2011, Pantex Plant generated 0.4m^3 of mixed waste. The mixed wastes generated at the Plant were generated by weapons-related activities.

2.10.2 Hazardous Waste Permit Modifications

Pantex did not amend Permit HW-50284 during Calendar Year 2011.

2.10.3 Annual Resource Conservation and Recovery Act Inspection

From February 22 through February 23, 2011, 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 17 consecutive years with no 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 the Permit CP-50284 (TCEQ, 2010) and Article 16.4 of the Pantex Interagency Agreement, were submitted in 2011. The annual report contained a full reporting of all monitoring information for 2011. Quarterly progress reports were submitted in 2011 in accordance with the schedule in the approved Sampling and Analysis Plan, Long-Term Monitoring Design, and Table VII of Permit CP-50284. Those reports focus on the continued operation of the remedies and on monitoring results from key wells.

2.10.5 Underground Storage Tanks

The Plant operated five regulated underground Petroleum Storage Tanks (PSTs) during 2011. 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, storing unleaded gasoline, diesel, and a gasoline – ethanol mix (E-85).

On March 29, 2011, the TCEQ conducted a PST Focused Energy Act Investigation for Release Detection, Corrosion Protection, Financial Assurance, Spill Containment, and Overfill Prevention. No areas of concern or violations were alleged as a result of the investigation of Pantex's PST program.

2.11 Safe Drinking Water Act

The Plant operates non-community, non-transient Public Drinking Water System No. 0330007, 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 onsite 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 method eliminated the storage and use of large amounts of chlorine gas at the Pantex Plant.

2.11.1 Drinking Water Inspection

On July 7, 2011, the TCEQ Region 1 office conducted a Comprehensive Compliance Inspection of the Pantex Drinking Water System. Samples of the system were also collected. No program deficiencies were noted in the TCEQ's inspection and the analytical results indicated that the system was providing water of appropriate quality to the Plant population. On September 8, 2011, a TCEQ subcontractor conducted required sampling of the system. No problems were noted in the results from sampling.

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 Drinking Water System Rating are recognized for their overall excellence in all aspects of operating a PWS. To be recognized, a PWS must go above and beyond the minimum standards in protecting public health and ensuring reliable operation. PWSs receiving this award have demonstrated no violations for chemical or microbiological quality parameters during the past two years. The system must have implemented a source water protection program, be staffed and maintained by trained operators, and designed to exceed the minimum storage and production requirements of the State of Texas.

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 it is 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.

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. Use of these resources must be determined to be appropriate, relative to the degree of impacts involved. 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 2011, 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. No floodplain assessments were required in 2011.

TABLE 2.7 — *2011 Activities for Compliance with the Emergency Planning and Community Right-to-Know Act*

Requirement	Applicable	Comment
Planning Notification (SARA 302-303)	Yes	Six chemicals were stored at Pantex in quantities above the threshold planning quantities in 2011.
Extremely Hazardous Substance Notification (SARA 304)	Yes	Two chemicals were stored at Pantex in quantities above the threshold planning quantities in 2011.
Material Safety Data Sheet/Chemical Inventory (SARA 311-312)	Yes	This requirement was satisfied by the Texas Tier Two Report.[a] Eleven chemicals were listed in the report for 2011.
Toxic Chemical Release Inventory Reporting (SARA 313)	Yes	A Toxic Chemical Release Inventory Report was required for calendar year 2011.

[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.

Environmental Management Information

To implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by U.S. Department of Energy (DOE) 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

The Pantex EMS 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. Feedback and continuous improvement are integrated into a structure that includes scope definition, hazards identification and analysis, development and implementation of hazard controls, and performance of work within scope of identified controls (Figure 3.1).

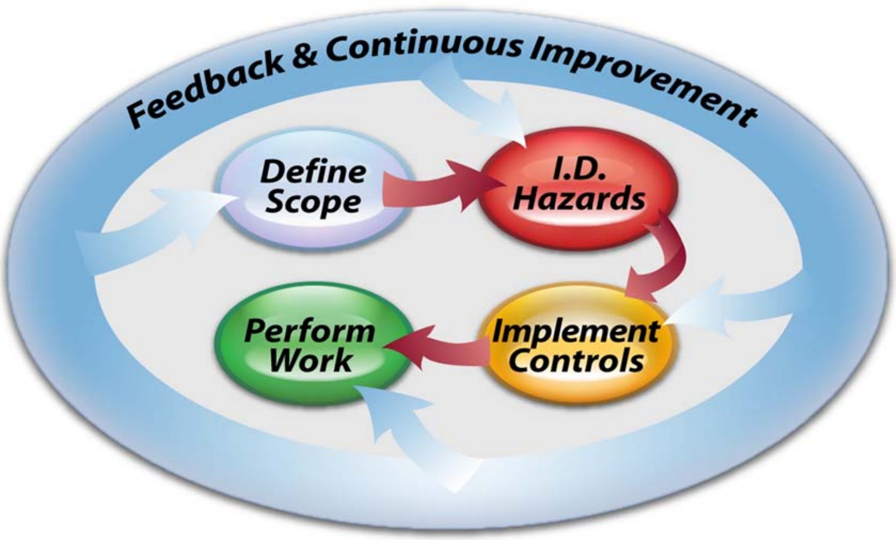


FIGURE 3.1 — *Work Activity Structure of the Pantex Integrated Safety Management System*

On October 8, 2009, Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, became effective. 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 is intended to supplement 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). (Please see the *Executive Summary*, pp. xxxiv and xxxv, for the official B&W Pantex and NPO Environmental Policies.) The EMS provides for systematic planning, integrated execution, and evaluation of programs for: 1) public health and environmental protection, 2) pollution prevention (P2), 3) recycling, and 4) 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. Measurable environmental goals, objectives, and targets are reviewed annually and updated as appropriate. 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 environmental aspects related to Pantex activities, products, and services. By adopting objectives, B&W Pantex commits to achieving the management goals and ensures that appropriate resources (technical, organizational, infrastructure, financial, human, and special skills) will be made available to accomplish the environmental targets. Appropriate authority and responsibility are assigned to each relevant function and level within the organization to meet the objectives. During 2010, the aspects review team developed and recommended five objectives/targets to be pursued in 2011. Table 3.1 represents the final status of Objectives and Targets for 2011.

TABLE 3.1 – *B&W Pantex Objectives and Targets for 2011*

Objective	Target(s)	Status/Comments
Locate and identify building utility meters for Balance of Plant (BOP) Facility Managers.	Develop data base for BOP Facility Managers to use to record utility meter readings.	Information derived from this activity was used to assist in the development of the Pantex Metering Plan. TARGET MET
Reduce water usage from once through water cooled vacuum pumps.	Locate and determine usage of water cooled vacuum pumps.	Ten facilities, with detailed equipment information, were identified. Estimated use was > 11 million gallons per year. TARGET MET
Reduce energy consumption by replacing existing perimeter intrusion detection and assessment system (PIDAS) bed lighting with LED alternative lighting.	Develop and submit cost estimate to retrofit PIDAS bed lighting with alternative LED lighting.	Continuing to work with Security to derive the optimal solid state lighting for specific application. Security had commissioned a lighting study performed by Sandia. TARGET PENDING
Reduce vehicle and combustion engine use.	Develop and submit a cost estimate to install and operate an automatic car wash system.	Optimization of estimate now in review. TARGET MET

Objective	Target(s)	Status/Comments
Re-certification of EMS Program to meet DOE Order 450.1A.	Receive a three year renewal certification of Environmental Management System.	Independent auditor assessment was completed May 20, 2011. Declaration letter was provided to DOE/Headquarters on September 8, 2011. TARGET MET

EMS Accomplishments for 2011

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 & 13514 the Pantex EMS was the subject of a required formal audit by a qualified auditor outside the control or scope of the EMS. 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. Pantex maintained “Gold Level” status membership with the TCEQ Clean Texas Program. This level of participation places Pantex as one of the elite environmentally protective organizations in the State.

Issues for continuous improvement continue to be identified from regularly scheduled environmental walk downs. These walk downs focus on EMS principles, energy and water conservation, recycling, safety, and pollution prevention. Special attention has been provided to assist DOE and B&W Pantex subcontractors to maintain compliance with EMS expectations.

Pantex was acknowledged by the National Nuclear Security Administration (NNSA)/DOE in 2011 for implementation of a strategy to replace the use of an acutely hazardous product to achieve compliance with drinking water quality standards. Chlorine, a toxic gas that may be fatal if inhaled or absorbed through the skin, was removed as an option to disinfect Pantex water supplies in favor of a mixed oxide process that achieves the same goal.

EO 13423 requires that federal facilities reduce the fleet’s total consumption of petroleum products by two percent annually, using 2005 as a baseline, through the end of fiscal year 2015, while increasing the total fuel consumption that is non-petroleum-based by ten percent annually. Pantex has reduced the use of gasoline by greater than 40 percent and increased the use of alternative fuel by greater than 220 percent.

3.1.1 Energy

Continued success is realized from energy savings activities performed at Pantex. Some of the positive management techniques used include: lighting up-grades, using more energy efficient equipment, including the use of Energy Star products, continuous building commissioning, using an energy management control system, and upgrading energy reliability at one of the Plant’s groundwater recovery systems. In 2010, Pantex Plant began an alternate work schedule (9X80s) which helped reduce energy consumption for a large number of administrative type personnel. Also, the Plant is using more building setbacks to control building heating, ventilating, and air conditioning systems (HVACs) and provide more efficient lighting.

To date, Pantex Plant has been successful in reducing energy intensity compared to the FY 1985 baseline. From the early days of energy management, the Plant has reduced energy intensity at least 40 percent. EO 13423 mandates Pantex to reduce energy intensity by 30 percent by the end of FY 2015, relative to the required baseline of the agency's energy use in FY 2003 (Figure 3.2). Presently, the Plant maintains a 28 percent reduction in energy intensity from the 2003 baseline in anticipation of achieving the reduction goal.

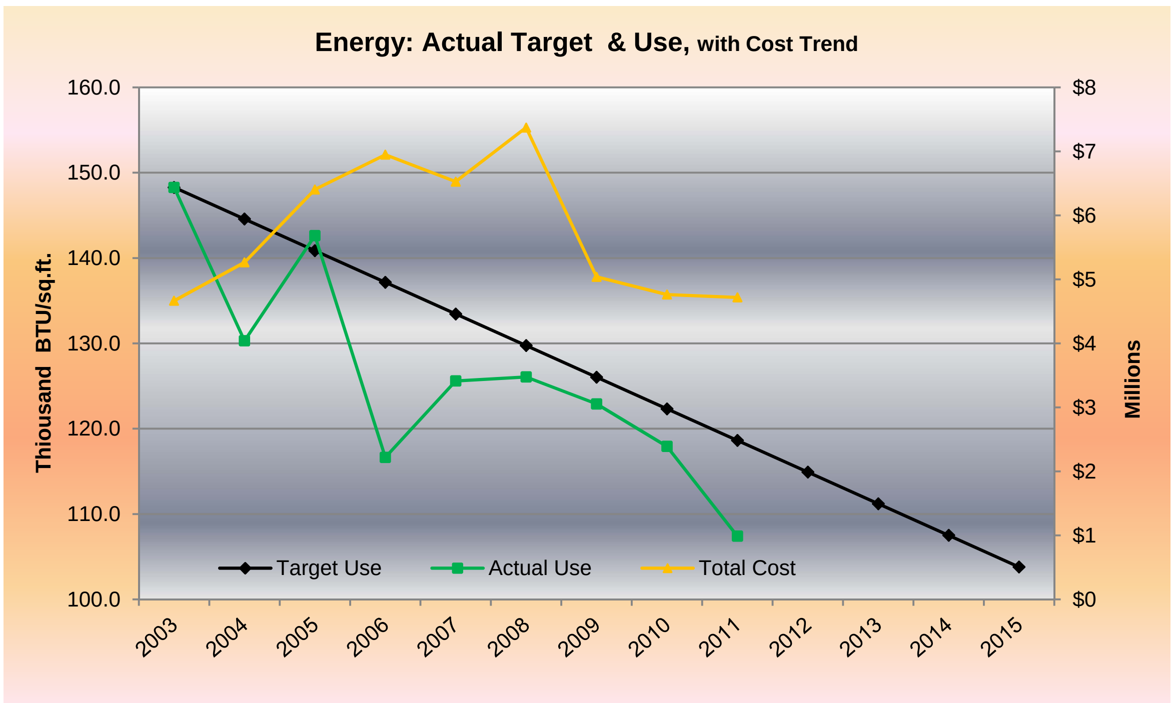


FIGURE 3.2 — *Energy Use Versus Required Target Reduction Rate with Cost*

Greenhouse gases (GHGs) accredited to Pantex Plant by the Federal Energy Management Program (FEMP) in the FY 2008 inventory are primarily generated through the use of purchased energy for Plant operations. Of most significance are the gases from the purchase and use of electricity and natural gas. These combined purchases apparently yielded more than 77,668 metric tons CO_2 equivalent of GHGs in 2008. By reducing energy consumption by 40 percent over the years, Pantex has reduced the generation of GHGs significantly. During 2011, Pantex generated 74,427 metric tons CO_2 equivalent of GHGs, which was a reduction of four percent since 2008.

Since petroleum fuel use also generates noticeable amounts of GHGs, the Plant will continue to improve operations of the Pantex fleet by reducing petroleum fuel use, using more hybrid vehicles for better gas mileage or Alternative Fuel Vehicles (AFVs) and by ensuring the fleet is the right size for operations.

The actions above should help reduce Scope 1 (direct GHG emissions from Federally owned or controlled sources) and Scope 2 emissions (direct GHG emissions resulting from the generation of electricity, heat, or steam purchased by a Federal agency). Scope 3 emissions (GHG emissions from sources not directly owned or controlled by a Federal agency but related to agency activities) are being evaluated to determine the amount of GHG emissions generated by travel, energy transportation and distribution losses, commuting, and other normal activities (Figure 3.3). Once better understood, actions are possible to attempt to reduce levels of Scope 3 generated GHG emissions.

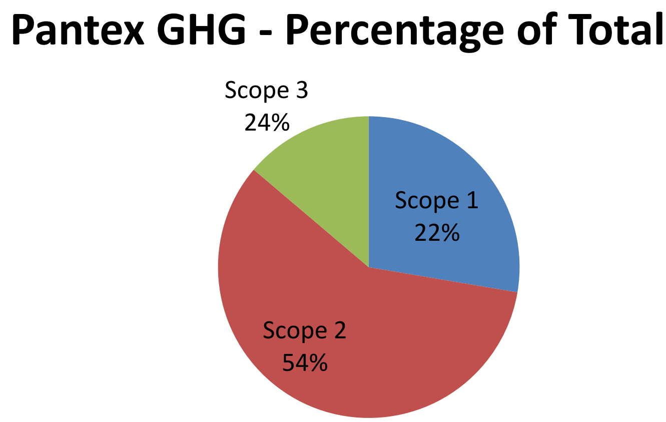


FIGURE 3.3 – *Scope Percentage of GHGs at Pantex*

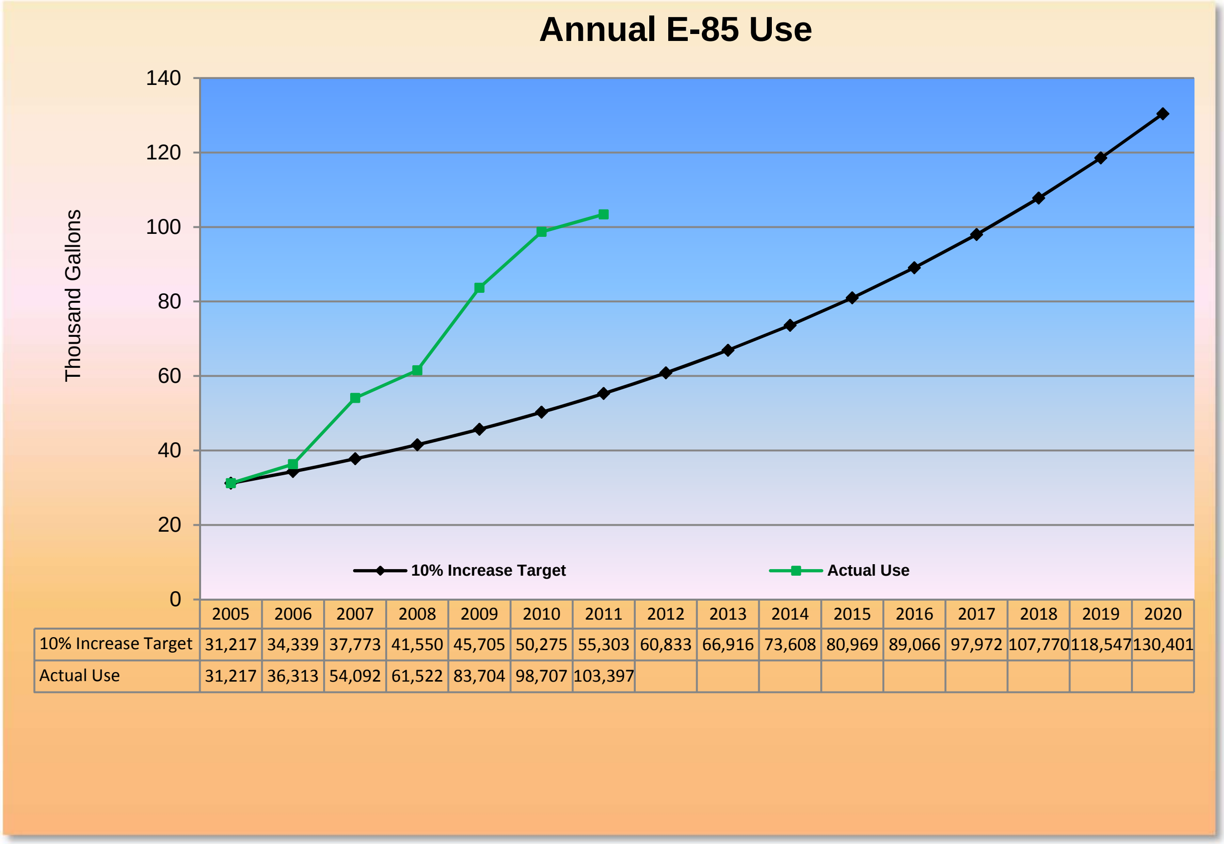
3.1.2 Water

EO 13423 required Pantex, beginning in FY 2008, to reduce water intensity relative to the baseline of the agency's water consumption in FY 2007. The challenge was to focus on awareness and life-cycle cost-effective measures to reduce annual use by two percent 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 26 percent overall. Through FY 2010 Pantex had reduced water consumption by approximately 19 percent. In FY 2011, water use was impacted due to major water upgrade projects (draining/flushing/filling). Upon completion of these projects and successful completion of the FY 2011 environmental targets, it is expected that the water reduction goal will be back on track.

Repair of leaking WWII vintage water lines, reconfiguration or replacement of equipment using inefficient water cooled equipment, elimination of chlorine from use with water systems through permitting strategies and installation of a "mixed oxidant" system, along with general awareness of water use strategies assisted Pantex in exceeding the reduction goal.

3.1.3 Fuel

Relative to FY 2005, EO 13423 promotes the use of alternative fuels ("increases the total fuel consumption that is non-petroleum-based by ten percent annually") (Figure 3.4), while reducing the use of petroleum products ("reduces the fleet's total consumption of petroleum products by two percent annually through the end of fiscal year 2015"). EO 13514 extended the timeframe for reduction of petroleum product to FY 2020 (Figure 3.5). Pantex Plant continues to successfully meet and exceed these goals.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
10% Increase Target	31,217	34,339	37,773	41,550	45,705	50,275	55,303	60,833	66,916	73,608	80,969	89,066	97,972	107,770	118,547	130,401
Actual Use	31,217	36,313	54,092	61,522	83,704	98,707	103,397									

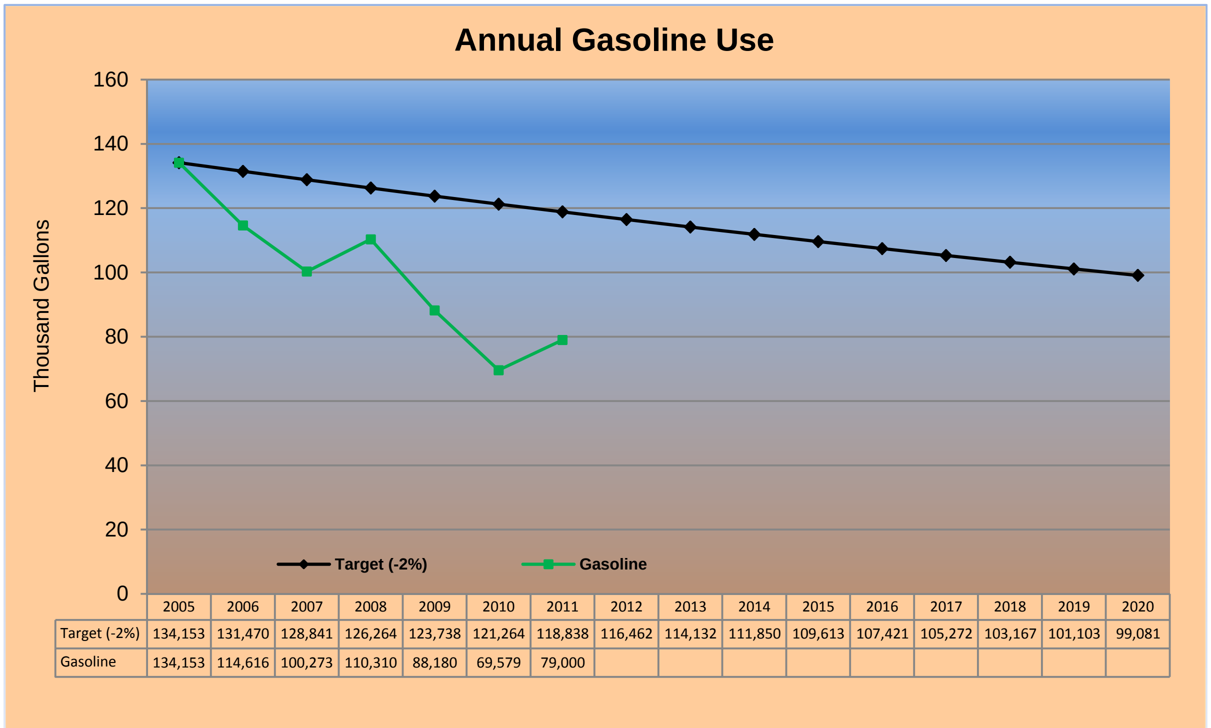
FIGURE 3.4 - ***Alternative Fuel Use versus Target Increase Rate***

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 2011 are discussed in Chapter 2 of this document.

State of Texas. The results of compliance inspections conducted by various state agencies in 2011 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.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Target (-2%)	134,153	131,470	128,841	126,264	123,738	121,264	118,838	116,462	114,132	111,850	109,613	107,421	105,272	103,167	101,103	99,081
Gasoline	134,153	114,616	100,273	110,310	88,180	69,579	79,000									

FIGURE 3.5 - ***Gasoline Use versus Target Reduction Rate***

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 2011; 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. P2 opportunity assessments (PPOAs) are conducted on Plant processes to identify new ideas for waste reduction. At Pantex, the team that performs the PPOA works with the owner of the process to implement the waste reduction recommendations. In 2011, ten PPOAs were performed.

Efforts to reduce and eliminate waste from routine operations at Pantex Plant have resulted in significant waste reductions over the last 20 years. From 1987 to 2011, 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 efforts were successful in reducing the generation of hazardous waste by more than 99 percent.

In 2009, 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 P2 into a site's EMS. Goals set by EO 13514 include promoting P2 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 use 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 GHG reduction with the requirements of Sections 301 through 313 of the Emergency Planning and Community Right-to-Know Act of 1986.

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 P2 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 2011 are shown in Table 3.2.

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 33,842 pounds of electronics during 2011.

TABLE 3.2 — *Pantex Plant Site-wide Recycling for 2011*

Recycled Material	2011 Totals	
	Pounds	Kilograms
Non-Suspension Scrap Metals	584,155	268.706
Office and Mixed Paper	156,020	70,769
Asphalt	113,700	51,573
Corrugated Cardboard	116,680	52,925
Batteries	98,485	44,672
Activated Carbon	27,175	12,326
Tires/Scrap Rubber	25,155	11,410
Engine Oils	31,640	14,352
Computers & Other Electronics	33,842	15,350
Newspapers/Magazines	30,827	13,983
Aluminum Cans	8,241	3,738
Plastic	9,000	4,082
Fluorescent Bulbs	2,257	1,024
Oil Filters	3,525	1,599
Total	**1,240,702**	**566,509**

3.4 Natural Resources

Flora and Fauna. As across most of the Southern High Plains, cultivation and other development 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 were 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 2011 growing season were extremely dry with only one third of normal rainfall for the entire year. The onsite 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 onsite 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 15 species (Table 3.3) of mammals were recorded at Pantex Plant in 2011 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 2011*

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	X	X	X
Cottontail	*Sylvilagus spp.**	X	X		X		X
Coyote	*Canis latrans*		X		X	X	X
Easter fox squirrel	*Sciurus niger*					X	X
Mule deer	*Odocoileus hemionus*						X
Porcupine	*Erethizon dorsatum*						X
Pronghorn	*Antilocapra americana*				X	X	X
Raccoon	*Procyon lotor*					X	X
Red fox	*Vulpes vulpes*						X
Striped skunk	*Mephitis mephitis*		X			X	X
Virginia opossum	*Didelphis virginiana*						X
White-tailed deer	*Odocoileus virginianus*		X		X		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 15 species".

In 2011, a survey of black-tailed prairie dog (*Cynomys ludovicianus*) colonies conducted with the assistance of Global Positioning Satellite (GPS) equipment revealed that the colonies occupied about 165.9 hectares (410 acres) at the Plant and Pantex Lake. Figures 3.6 and 3.7 show the locations of prairie dog colonies on the Plant site. Areas of operational concern were treated with aluminum phosphide in 2011 to remove black-tailed prairie dogs.

Spotlight surveys for nocturnal species have been conducted since 2000. These are conducted during three evenings each October, November, or December. The 24-mile survey route transverses 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 2011 were black-tailed jackrabbits (*Lepus californicus*), bobcats (*Lynx rufus*), cottontails (*Sylvilagus spp.*), coyotes (*Canis latrans*), raccoons (*Procyon* lotor) striped skunks (*Mephitis mephitis*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*O. virginianus*). All of these species are 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 at the playas. The all-time bird list for Pantex includes 199 species.

Sixty-two species of birds were recorded on the Plant during 2011 (Appendix B). Observations of one or more brown towhees (*Pipilo fuscus*), and a gray catbird (*Dumetella carolinensis*) were first-time sightings at Pantex. Record drought occurred in 2011 and, thus, waterbird numbers were much lower than the very wet 2010. The number of waterbird species (shorebirds, wading birds, waterfowl) observed on or near playas in 2011 was 20, compared to 30 in 2010. Other potential factors affecting variability between

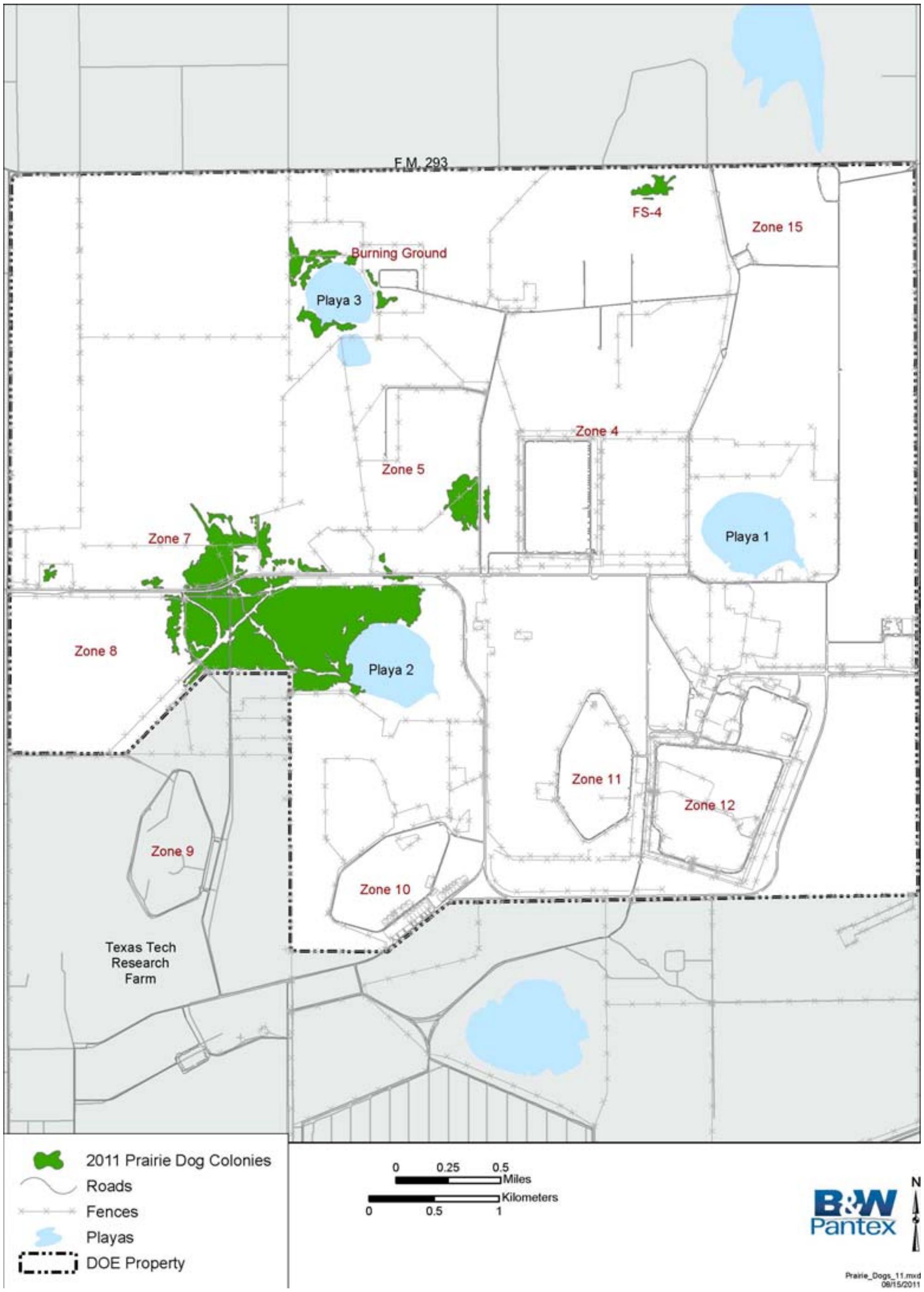


FIGURE 3.6 — ***Locations of Prairie Dog Colonies at Pantex Plant***

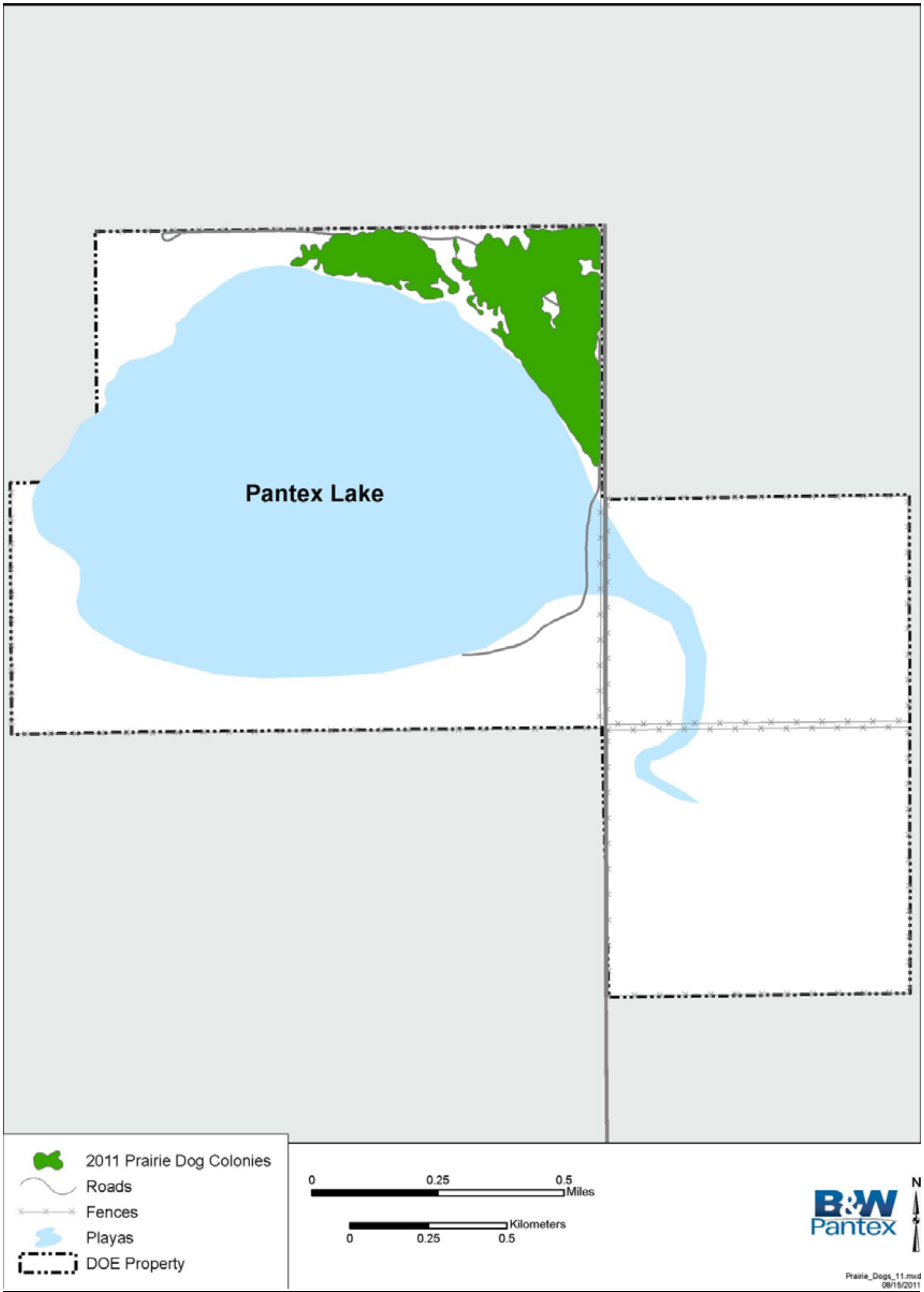


FIGURE 3.7 — *Location of the Prairie Dog Colonies at Pantex Lake*

areas and years include grazing differences among areas, presence of prairie dogs, operational areas versus rangeland, areas with trees and other structure versus areas without structure, frequency of visits among areas, objectives of contracts, competing priorities, and conflicts with activity at the Weapons Tactical Training Facility (Surface Danger Zones).

Pantex continues to promote bird conservation through public outreach, such as presentations, and the Purple Martin Outreach Program. In 2011, drought affected nestling survival and thus banding was suspended much earlier than normal. One hundred and seven nestling purple martins (*Progne subis*) were banded at four residences in two communities in the Texas Panhandle.

Fauna (Reptiles and Amphibians). Eight species of reptiles and amphibians were recorded at Pantex in 2011 during field activities, research projects, and nuisance animal responses (Table 3.4). None of the species documented were new to the Panhandle or Pantex. The all-time list of amphibians and reptiles at Pantex includes 28 species.

TABLE 3.4 — *Reptiles and Amphibians Identified at Pantex Plant During 2011*

Common Name	Scientific Name	Playa 1	Playa 2	Playa 3	Pantex Lake	East Property	Other Area
Bullsnake	*Pituophis melanoleucus sayi*						X
Central Plains milk snake	*Lampropeltis triangulum gentilis*						X
Checkered garter snake	*Thamnophis marcianus marcianus*						X
Eastern yellowbelly racer	*Coluber constrictor flaviventris*	X	X				X
Plains leopard frog	*Rana blairi*				X		X
Prairie rattlesnake	*Crotalus viridis viridis*	X			X		X
Red-eared slider	*Trachemys scripta elegans*	X					X
Texas horned lizard	*Phrynosoma cornutum*	X	X				X

Texas Horned Lizard Study

A project is on-going at Pantex to evaluate abundance, habitat use, and seasonal activity patterns of Texas horned lizards at Pantex Plant, as well as a general herpetological survey at Pantex Plant (Figure 3.8). Results from the first portion of the study were reported in a final project report, as well as various annual reports. The focus of current work includes an evaluation of the importance of sink holes and other "artificial burrows" as wintering habitat for herpetofauna not associated with prairie dog towns, and further investigate the association of Texas horned lizards to two-track travel lanes. Objectives are also incorporated to evaluate the response of herptofauna to prescribed burning or wildfire, should such fires occur.

Biological and Nuisance Aspects of Bobcats at Pantex

Evaluation of biological and nuisance aspects of bobcats at Pantex was initiated in 2009. Trapping is conducted several times per year. First, known bobcat focus sites are trapped, and then trapping is extended to outlying Pantex areas, Texas Tech property and locations outside of the home ranges of monitored bobcats. Trail cameras are utilized in conjunction with scent stations and other situations, as a tool to determine presence of marked and unmarked cats that do not carry radio-collars (Figure 3.9). Several nearby private landowners are also cooperating, allowing access for trapping, radio-tracking, and trail camera installation.

FIGURE 3.8 — ***Preparing a Texas Horned Lizard for Powder-tracking***

FIGURE 3.9 — ***Female Bobcat Photographed by a Trail Camera***

Any captured bobcats are marked with unique combinations of ear tags, and adults are equipped with GPS radio-collars. 2011 was the first year that tissue samples were collected and DNA analyzed for parental relationships. In 2011, three adult female bobcats were captured including the third recapture of the "Eastside Female," second recapture of the "Tech Female," and the first capture of a bobcat on the East Property (Cockrell Homestead). The three home ranges are shown in Figure 3.10. Home range sizes are 15, 22, and 75 miles^2 for the Eastside, Texas Tech, and Cockrell female bobcats, respectively. The large home range size for the Cockrell Female is influenced by an isolated trek to the north and west. Females continue to demonstrate clear avoidance of each other's home ranges, but may readily "fill in" with the loss of an adjoining female.

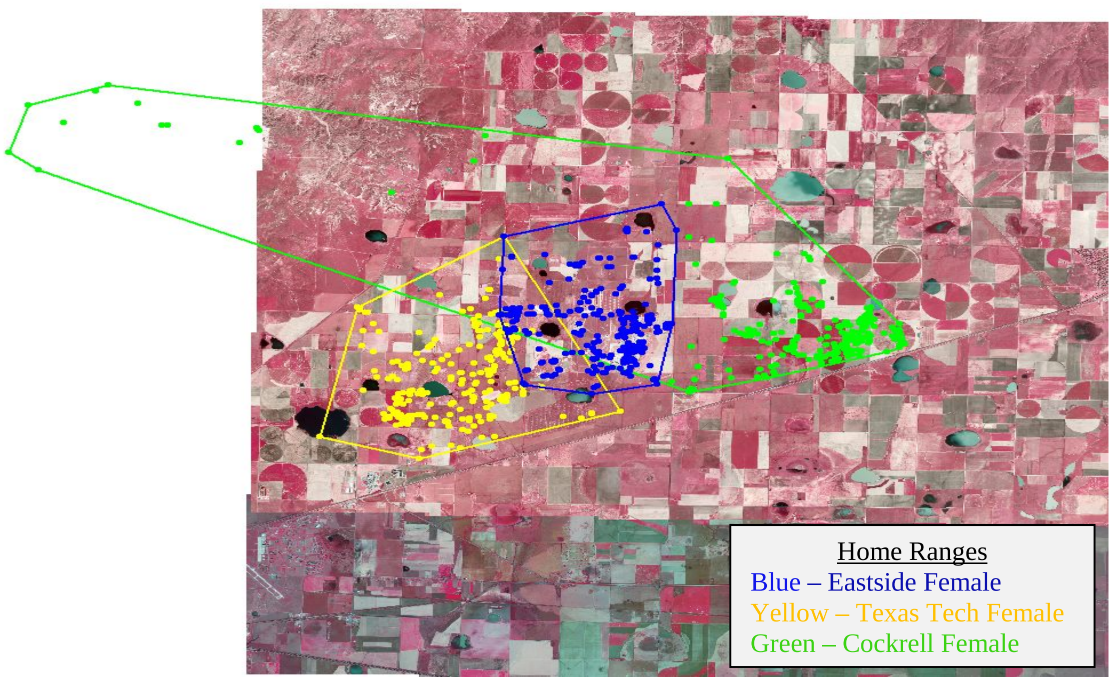


FIGURE 3.10 — *Locations and Home Ranges of Three Adult Female Bobcats Tracked at Pantex*

Assess Impacts of Wind Turbine Generators to Wildlife and Habitat at Pantex Plant

Pre-, post-, and control-site monitoring associated with the *Pantex Renewable Energy Project* was conducted in 2011. 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, but also bird avoidance of wind farm sites and road kill mortality on associated roadways. Due to a number of active Swainson's hawk (*Buteo swainsoni*) nests observed near the proposed Pantex field and existing neighboring turbine fields, a new objective was to pre- and post-monitor nesting pairs for habitat use and productivity (in relation to the PREP).

Raptor surveys were conducted during the spring, and surveys for other birds and their nests were conducted during spring and summer. In 2011, effects of drought were evident in summer bird plots, and there were several species in lower abundance or absent altogether, when compared to 2010. For example, there were fewer grasshopper sparrows (*Ammodramus savannarum*) detected, and lark buntings (*Calamospiza melancorys*) and dickcissels (*Spiza americana*) were absent from study plots.

Several dozen Swainson's hawk nests were located and monitored in the proposed and existing turbine field areas. In addition, monitoring was conducted that radiated outwards to include hawks that would likely be unassociated with turbine fields. All ten available radio transmitters were attached to hawks and eight of those stayed around to nest. First-year home ranges demonstrate a clear avoidance of the existing wind turbine field (northeast of Pantex), despite the fact that several of the hawks were captured on its perimeter. Two of the radio marked hawks were detected during migration in the Corpus Christi area by observers with radio receivers.

<u>Nuisance Animal Management.</u> Nuisance wildlife problems in the areas of health, safety, and interferences with operations continued at Pantex Plant in 2011. Feral pigeons, domestic dogs, and eight species of wildlife were documented in nuisance situations. The primary species causing problems was the striped skunk. Nuisance skunks are captured and removed. Seventy-five striped skunks were trapped and delivered to the Amarillo Animal Control Facility for euthanization. This was the second highest number taken since 1997, which was partly due to skunks being captured in conjunction with bobcat trapping. Other fur-bearing species are relocated to other onsite locations in accordance with a letter of authority issued to Pantex Plant by the Texas Parks and Wildlife Department. Sightings of feral cats were uncommon in 2011. None were trapped and delivered to the Amarillo Animal Control Facility.

In the vicinity of the PIDAS beds, cottontail rabbits and black-tailed jackrabbits are routinely controlled by the Pantex Security Department. However, none were taken by Security in 2011. Future control of the rabbits will occur on an as needed basis.

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. In 2011, no pigeons were controlled 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 that 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 2011.

Archeology. The Pantex Plant lies within the southern Great Plains archeological province, and specifically, in that part that lies 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 on surveys, a site-location model has been 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 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. 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. This year, a paleontology site was discovered when workers excavating at the new High Explosives Pressing Facility construction site uncovered the jawbone of an ancient peccary, similar to a prehistoric pig related to modern javelinas. The guidelines pertaining to archeological standards were followed until a determination was made to find out what type of site had been discovered. The bones were identified as those from a Platygonus, an extinct genus of herbivorous peccary of the family Tayassuidae that roamed the area in ancient times. Platygonus were similar to modern species of peccaries (also known as javelinas) but were larger, likely reaching 290-360 pounds. The prehistoric species became extinct at least 11,000 years ago, but the bones could be as old as 23 million years old. The bones were excavated and donated to West Texas A&M University (Figure 3.11).

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.

FIGURE 3.11 — *Peccary Bones—a Paleontology Discovery*

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 a completed historical display in the Visitor Center (Figure 3.12) 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. An interactive multimedia audio and touch screen display features computer-driven exhibits that enhance the Visitor Center's capacity and introduce the voices and faces of "real" people. Visitors are able to reach out, touch the screen, and select and listen to the oral histories of former World War II Pantex employees. Included in the multi-media exhibit is a collection of scanned 1942 and 1943 newsletters, containing vintage World War II history that documents the stories, photographs, and the work performed.

Cold War. The National Historic Preservation Act 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 the 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.

FIGURE 3.12 — *Visitor Center*

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 fundamentally 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.

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." One of the facilities received a new roof and a new heating-ventilation-air conditioning (HVAC) system this year. New conduit for a new power feed for the new HVAC equipment to by-pass the old electrical switchgear in the basement was also installed. These projects strengthened operational use of the facility and two departments set up operations in the historical facilities, which confirms Pantex's pledge for implementing preservation activities. Also, historical equipment has been inventoried and moved into a secure area of the facility until funding can be obtained for a classified museum.

Under the Cold War context, six Cold War era railcars were preserved and an exhibit has been developed to interpret the significance of the railcars and the role they played (Figure 3.13). The railcars were significant for their role in the transportation of weapons on and offsite. Media exposure has generated interest and the number of railcars tours increased in 2011.

FIGURE 3.13 —*Railcar Exhibit*

In 2011, Pantex updated the Visitor Center by adding more descriptive information and videos to the multimedia center. In the exhibit area, a few new panels were added for more clarity on specific topics relating to Pantex history. Also, an extension of the Visitor Center into the main lobby area of 16-12 (Figure 3.14) was created, enhancing a visitor's first contact with Pantex. This new 16-12 entry exhibit focuses on DOE/NNSA and Pantex Operational Management history.

FIGURE 3.14 — *16-12 Entry Exhibits*

3.6 Educational Resources and Outreach Opportunities at Pantex Plant

Pantex continued its efforts in public outreach and P2 education during 2011. Through increased emphasis on public outreach, Pantex efforts have resulted in a positive impact on the local community with regard to P2 and recycling. 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 seventh annual Pantex Earth Day Event was held offsite at Wildcat Bluff Nature Center on a beautiful Saturday in April. Pantex co-sponsored "Earth Fest 2011" with Xcel Energy and Wildcat Bluff. Personnel from across the Plant, along with other volunteers, contributed their time and efforts to make the event a huge success. Activities included Frisbee toss, basketball throw, ring toss, Earth Day *Jeopardy*, bird feeders, an energy conservation quiz, and other Earth Day games. This event provided more than 2,000 children and their parents the opportunity to learn more about recycling, waste reduction, resource conservation, and things everyone can do to help protect the environment.

Pantex scientists continued to donate their time and talent to area schools by speaking to students about science careers and helping stimulate student 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

Environmental Restoration at Pantex is conducted in accordance with CERCLA and RCRA, as discussed in Chapter 2. During 2011 Pantex continued operation and maintenance of remedial actions. A summary of that information is included in this section.

Historical waste management practices at the Plant resulted in impacts to onsite 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 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 solid waste management units 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 are 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 3.15 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 of perched groundwater and reduction of perched water levels to protect the underlying drinking water aquifer;
- Cleanup of soil gas and residual non-aqueous phase liquid (NAPL) in 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.

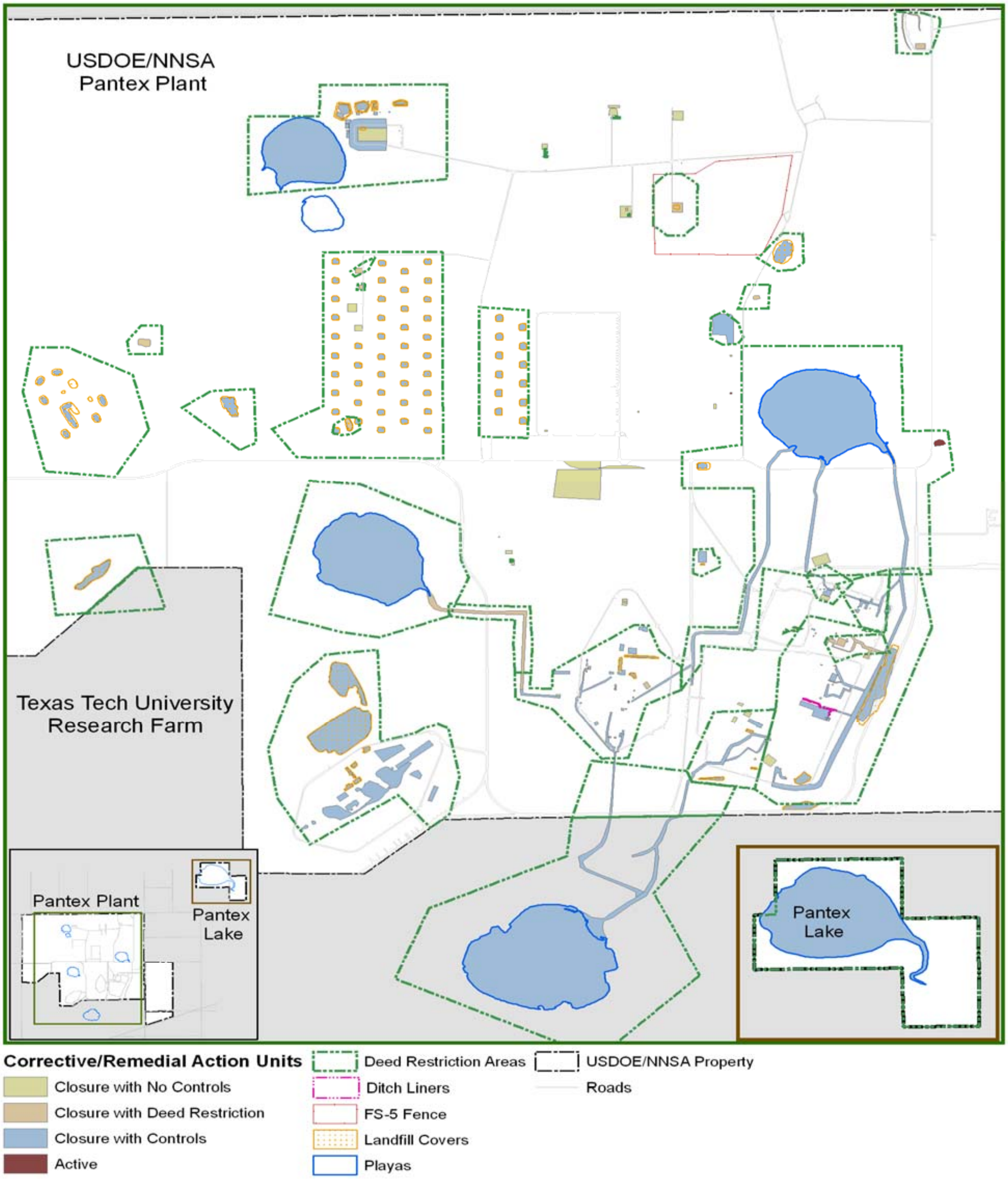


FIGURE 3.15 —*Location and Status of Solid Waste Management Units*

Environmental Restoration Milestones. During 2011, 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. Groundwater remediation systems at Pantex are depicted in Figure 3.16. Major milestones associated with various remedial actions for 2011 were:

- The Pump and Treat Systems were operated as planned, and upgrade projects for the wellheads at the Southeast Pump and Treat were completed. The wellhead project provided for better freeze protection, upgraded components, and more efficient well operation.

- An irrigation system upgrade was installed to provide an additional 100-acre tract for beneficial use of treated water resulting from groundwater remediation.

- The Southeast Pump and Treat System (SEPTS) was modified during 2011 to align operations with the goal of reducing saturation in the perched aquifer while the irrigation system upgrade occurred. Throughput was decreased to limit injection of treated water into the perched groundwater when Pantex was unable to beneficially use the treated water through the irrigation system.

- Zone 11 ISB received a third amendment injection.

- Both ISB systems demonstrated treatment of target chemicals of concern (COCs) near or below the Groundwater Protection Standard (GWPS) at most down-gradient monitoring wells.

- The Burning Ground Soil Vapor Extraction (SVE) System was operated as planned. Pantex recommended and planned for a more efficient small-scale catalytic oxidation (CatOx) treatment unit to replace the current GAC system. The CatOx system is planned for installation in 2012.

- The landfill covers and SWMUs were inspected, maintained, or scheduled for maintenance.

> **Remedial Actions at Pantex**
>
> Groundwater Remedies:
>
> 2 Pump & Treat Systems
> - Playa 1 Pump and Treat
> - Southeast Pump and Treat
>
> 2 In-Situ Bioremediation (ISB) Systems
> - Zone 11 ISB
> - Southeast ISB
>
> Institutional Controls
>
> Soil Remedies:
>
> Ditch Liner
> Soil Covers on Landfills
> Institutional Controls
> Soil Vapor Extraction System

<u>Pump and Treat Systems.</u> 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

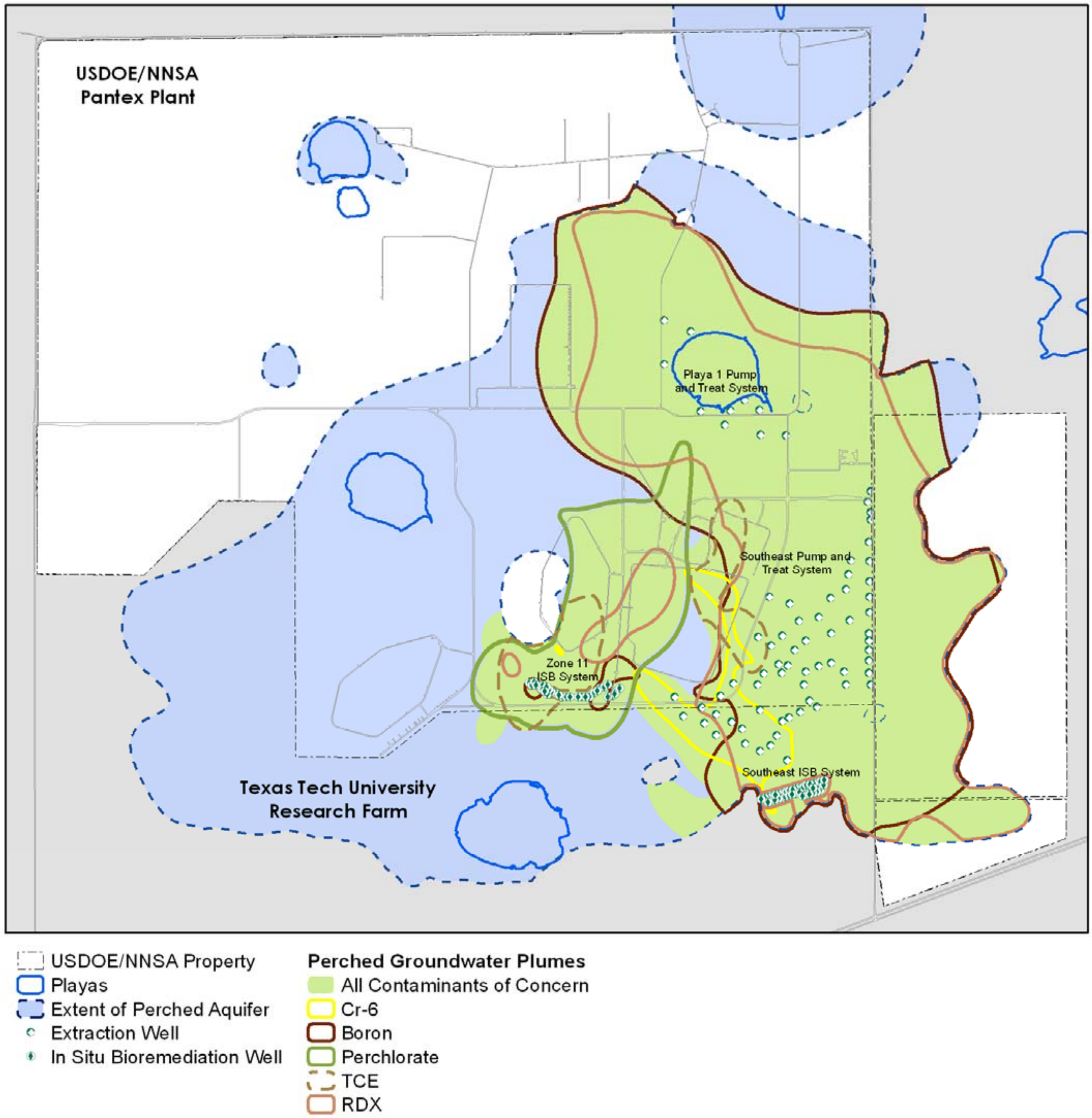


FIGURE 3.16 - ***Perched Groundwater Plumes and Treatment Systems***

remove contaminant mass from the water before the effluent is sent to the Wastewater Treatment Facility (WWTF) and irrigation system for beneficial use, 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 become the final remediation system for 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.

Each of the systems is evaluated in annual and quarterly progress reports that can be found on the Pantex website (http://www.pantex.com/about/environment/erDocs/index.htm). The evaluation of the systems operations is summarized below.

To reach the goal of reducing saturated thickness, the Pump and Treat Systems have a goal of operating 90% of the time and at 90% of treatment capacity. The Pump and Treat Systems performance for 2011 is depicted in Figure 3.17. The throughput goals for the SEPTS were relaxed during 2011 because of the irrigation system upgrade, although the 90% goal is depicted for reference. The SEPTS exceeded the operational and treatment goal for 2011 by operating 96% of the time and treated an average of 309,000 gallons per day (gpd) (72 percent of capacity) of impacted perched groundwater. The P1PTS operated 86% of the time and treated an average of about 266,000 gpd (74 percent of capacity) during 2011.

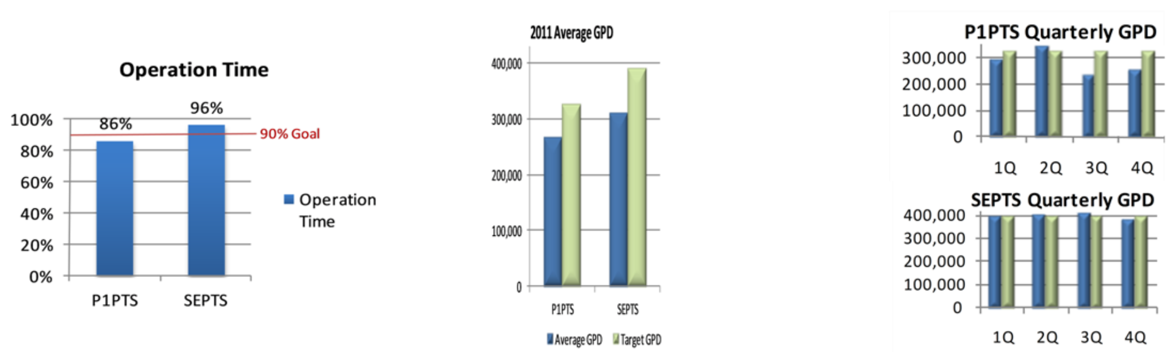
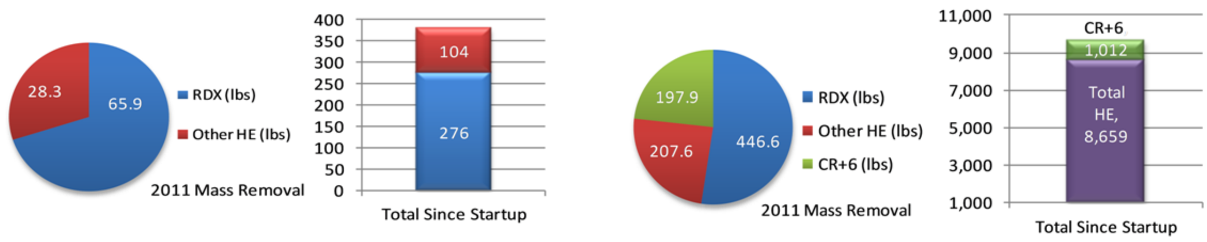


FIGURE 3.17 – ***Pump and Treat Systems Performance***

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 3.18 provides the mass removal for HEs and chromium for 2011, 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.

<u>ISB Systems.</u> 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. These systems use injected amendment to set up reducing zones where COCs are degraded. The amendment provides a food source for naturally occurring bacteria that break down



P1PTS Mass Removal **SEPTS Mass Removal**

FIGURE 3.18 – *Pump and Treat Systems Mass Removal*

the COCs. Monitoring wells were installed down-gradient of the groundwater flow from the treatment systems to monitor whether the system is effectively degrading the COCs. Injection of amendment is anticipated every twelve to eighteen months for both systems. The effectiveness of the treatment zone and down-gradient performance monitoring well information is included in Chapter 6.

As part of the O&M of the ISB systems, the Zone 11 ISB received an amendment injection during 2011. The Southeast ISB does not require as frequent of injections because there is less saturated thickness, and the water velocity through that area is slower than at Zone 11. Based on results of sampling, the food source at Zone 11 was declining before injection. Injection was completed early in October 2011 at the Zone 11 ISB. The Southeast ISB treatment zone also demonstrated a declining food source during the last half of 2011 although reducing conditions also continue to be present. An injection event is planned for the Southeast ISB early in 2012.

Burning Ground SVE. An SVE system was installed and has been operating at the Burning Ground since February 2002. A small-scale SVE was installed at the Burning Ground in late 2006 after the large-scale system became inefficient at continued removal of soil gas and residual NAPL once the larger area had been remediated. This small-scale system focuses on treating residual NAPL and soil gas at a single well (SVE-S-20), where soil gas concentrations continue to remain high. The current system consists of a series of activated carbon drums and a small blower motor for extraction.

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. Pantex installed, inspects and maintains a fence around FS-5 to control access to and use of an area that is impacted by depleted uranium that was dispersed through testing of high explosives. Pantex installed a ditch liner along a ditch system in Zone 12 where investigations indicate that the ditches continue to act as a recharge source to perched groundwater. Installation of the ditch liner will mitigate migration of contamination because it prevents rain water from infiltrating into soils.

Pantex conducts reviews of projects that will disturb SWMU soils. Projects were reviewed to ensure that workers used necessary protective equipment and that soils were managed appropriately. In 2011, eight SWMU interference permits for new construction projects in or near remedial action units were approved. Of the eight, four were completed in 2011 and the other four are ongoing or have been placed on hold.

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 monitoring information collected is evaluated and reported in annual and quarterly progress reports and is summarized in Chapter 6 of this report.

> **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

As noted previously, Pantex has developed an EMS modeled on ISO 14001, 2004 in order to comply with DOE Order 436.1. The standard includes requirements for planning the monitoring of all activities which potentially impact the environment. As in previous years, the plans for 2011 monitoring were implemented using a consistent system for collecting, assessing, and documenting environmental data of known and documented quality in order to: detect, characterize and respond to releases from DOE activities; 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; and demonstrate compliance with applicable regulatory and permit limits. The potential pathways along which contaminants could travel are illustrated in Figure 3.19.

Sample collection locations and frequencies for the various environmental media were based upon several factors including specification of sampling locations and frequencies by a regulatory body (such as TCEQ or EPA), in a permit issued to the Pantex Plant, 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 feasible, samples were taken 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. Table 3.5 identifies the number of onsite and offsite sampling locations for calendar year 2011.

Several data assessment processes were employed by B&W 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 validation. Media-specific descriptions, as well as the results of the monitoring program for samples collected during 2011, are contained in the remaining chapters of this report.

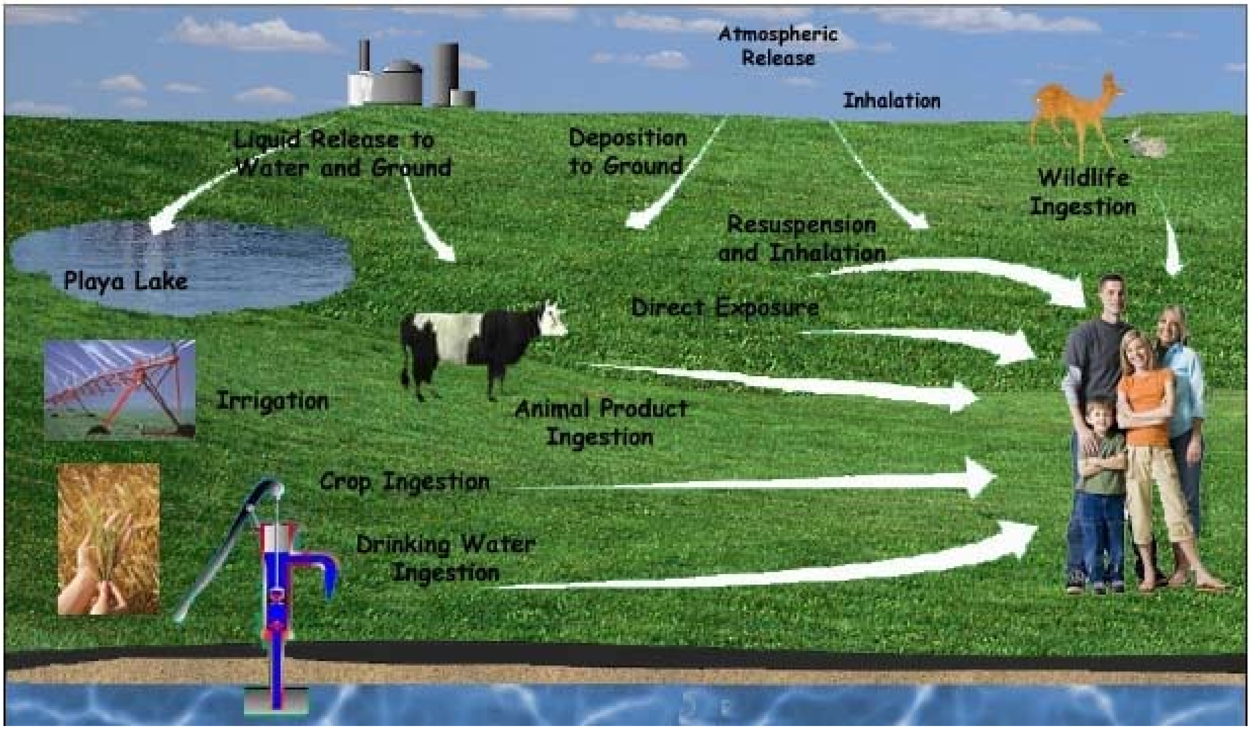


FIGURE 3.19— *Potential Pathways for Environmental Transport of Contaminants*

TABLE 3.5 — *Number of Environmental Media Sampling Locations in 2011*

Media	Onsite	Offsite
Air[a]	4	11
Ambient External Radiation (TLDs[b])[a]	5	12
Drinking Water	32	0
Fauna[c]	9	1
Groundwater	166	44
Soil/Sediment	14	0
Surface Water	12	0
Vegetation (crops, native species)	23	11
Wastewater	2	0
Total	267	79

[a] Includes fence line and “background” control locations.
[b] Thermoluminescent dosimeters.
[c] Onsite number includes one sampling location at Pantex Lake.

Environmental Radiological Program

Monitoring results for the environmental radiological pathways in 2011 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 2011, 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 offsite 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.[1] Tritium emits beta particles. Gamma radiation emissions from these radionuclides were also monitored and evaluated.

Based on the 2011 operational data, Pantex emitted a dose to the maximally exposed member of the general public of 3.23×10^{-6} mrem/yr. 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 2011.

4.2 Radiological Units and Reporting

Radiological results are reported in units that are specific to different types of exposure and environmental 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"[2] 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[3] 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

[1] 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-spectroscopy 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 $^{239/240}Pu$).

[2] 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).

[3] 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 1.25×10^{-3} mCi as 1.25×10^{-6} Ci, or even as 1.25 µCi.

usually been "background corrected" by subtracting the naturally occurring radionuclides and cosmic radiation detected by laboratory instrumentation from the raw sample measurement. For this reason, negative values may occur when the laboratory 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)[4] or millisievert per year (mSv/yr).[5]
- Population dose[6] 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).[7]

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, TX, 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.

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[4] 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. Thus, for example, 0.00125 mrem could also be written as 1.25×10^{-3} mrem, as 1.25×10^{-6} rem, or even as 1.25 μrem. Additionally, 1.25×10^{-6} mSv could also be written as 1.25 nSv. However, to afford comparison with the dose limits established in DOE Order 458.1, doses will be reported as indicated.

[5] 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.

[6] 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.

[7] 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 from effective dose conversion factors and other parameters 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.

4.3.1.2 Air Pathway

DOE Order 458.1 further requires that internal doses[8] 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 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)[9] member of the general public by the use of the CAP88-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[10] 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 (3.42E-09 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.[11] 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
2.31E-02 (8.55E+08)	7.24E-13 (2.68E-02)	None	6.59E-14 (2.44E-03)	None

Based on the results of the CAP88-PC modeling, the maximally exposed individual for 2011 (located approximately 5,230 meters [3.25 miles] north [N] of Building 12-42) would have received a dose of 3.23 x 10^{-6} mrem (3.23 x10^{-8} mSv). This dose equivalent is 3.23 x 10^{-6} percent of the DOE Public Dose Limit for all pathways and is 3.23 x 10^{-5} percent of the effective dose equivalent standard specified in 40 CFR 61, Subpart H. Based upon the same CAP88-PC modeling results, the collective population dose equivalent received by those living within 80 kilometers (50 miles) of Pantex Plant would have been 7.90 x 10^{-6} person-rem/year (7.90 x 10^{-8} person-sievert/year) in 2011. 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.

[8] Doses to organs or tissues of an organism due to intake of radionuclides by ingestion, inhalation, or dermal absorption as contrasted to external doses, which are doses to organs or tissues of an organism due to radiation sources outside the body (NCRPd).

[9] 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.

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

[11] The overwhelming majority (99.9%) of these emissions arose from activities conducted in Buildings 12-42 and 12-53 within the southern portion of Zone 12. The balance of the emissions arose from sanitization activities conducted at the Burning Ground and Firing Sites.

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 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.[12] 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 2011.

4.3.1.4 Other Pathways

The Pantex Plant has also 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 (as discussed in more detail in Chapter 11) and monitoring of native vegetation and crops (as discussed in more detail in Chapter 12), did not indicate releases to either pathway from Pantex activities during 2011.

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 2011, the 2011 collective population dose, and the 2011 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 represents that for *all* pathways as well as the *air* pathway.

TABLE 4.2 — *Pantex Radiological Doses in* 2011

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)
3.23×10^{-6} (3.23×10^{-8})	9.68×10^{-3}	7.90×10^{-6}	7.90×10^{-8}	296,000	29,600

[12] The current average annual concentration of tritium tabulated in 40 CFR 141.66 which is assumed to produce the same 4 mrem dose equivalent is 20,000 pCi/L (or 2.0×10^{-5} µCi/mL) equal to 1% of the ingested water DCS for tritiated water listed in DOE-STD-1196-2011[DOEk]).

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 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[13].

B&W Pantex has used a calculation tool (RAD-BCG) provided with the technical standard to compare existing radionuclide concentration data from co-located sampling locations for surface water, sediments and soils on and around the Pantex site during 2011 to biota concentration guide (BCG) limits in the technical standard. Available concentration data for radionuclides in each environmental medium were entered into the calculation tool. 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 7.96×10^{-3} and 7.81×10^{-4} 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 2011*

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)
^{3}H	53.10	2.65 E+08	2.00 E-07	0.42	3.74 E+05	1.12 E-06	1.32 E-06
^{234}U	0.85	2.02 E+02	4.19 E-03	0.82	5.27 E+03	1.56 E-04	4.35 E-03
^{235}U	0.03	2.17 E+02	1.40 E-04	1.53 E-03	3.73 E+03	4.11E-07	1.41 E-04
^{238}U	0.67	2.23 E+02	3.01 E-03	0.96	2.49 E+03	3.86 E-04	3.40 E-03
^{239}P	0.01	1.87 E+02	5.36 E-05	0.03	5.86 E+03	5.12 E-06	5.87 E-05
Sum of Fractions			7.40 E-03			5.48 E-04	7.96 E-03

[a] In both Table 4.3a and 4.3b, the sediment/soil concentration values for U-235 are estimated and are the product of an isotope–specific solid/solution distribution coefficient (50.0 mL/g) and the concentration of the isotope in the water sample.

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[13] 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 2011*

Nuclide	Water Concentration (pCi/L)	BCG (Water) (pCi/L)	Partial Fraction (Water)	Soil Concentration (pCi/g)	BCG (Soil) (pCi/g)	Partial Fraction (Soil)	Sum of Fractions (Water & Soil)
^{3}H	53.10	2.31 E+08	2.30 E-07	0.42	1.71 E+05	2.45 E-06	2.68 E-06
^{234}U	0.85	4.04 E+05	2.09 E-06	0.82	5.13 E+03	1.59 E-04	1.62 E-04
^{235}U	0.03	4.19 E+05	7.28 E-08	1.53 E-03	2.83 E+03	5.40 E-07	6.12 E-07
^{238}U	0.67	4.06 E+05	1.66 E-06	0.96	1.58 E+03	6.09 E-04	6.11 E-04
^{239}P	0.01	2.00 E+05	4.99 E-08	0.03	6.12 E+03	4.35 E-06	4.40 E-06
Sum of Fractions			4.10 E-06			7.76 E-04	7.81 E-04

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.)[14]. The estimated total average annual effective dose equivalent to any individual member of the U.S. population from ubiquitous[15] background (formerly known as natural background) sources is 3.11 mSv[16] (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.[17] 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

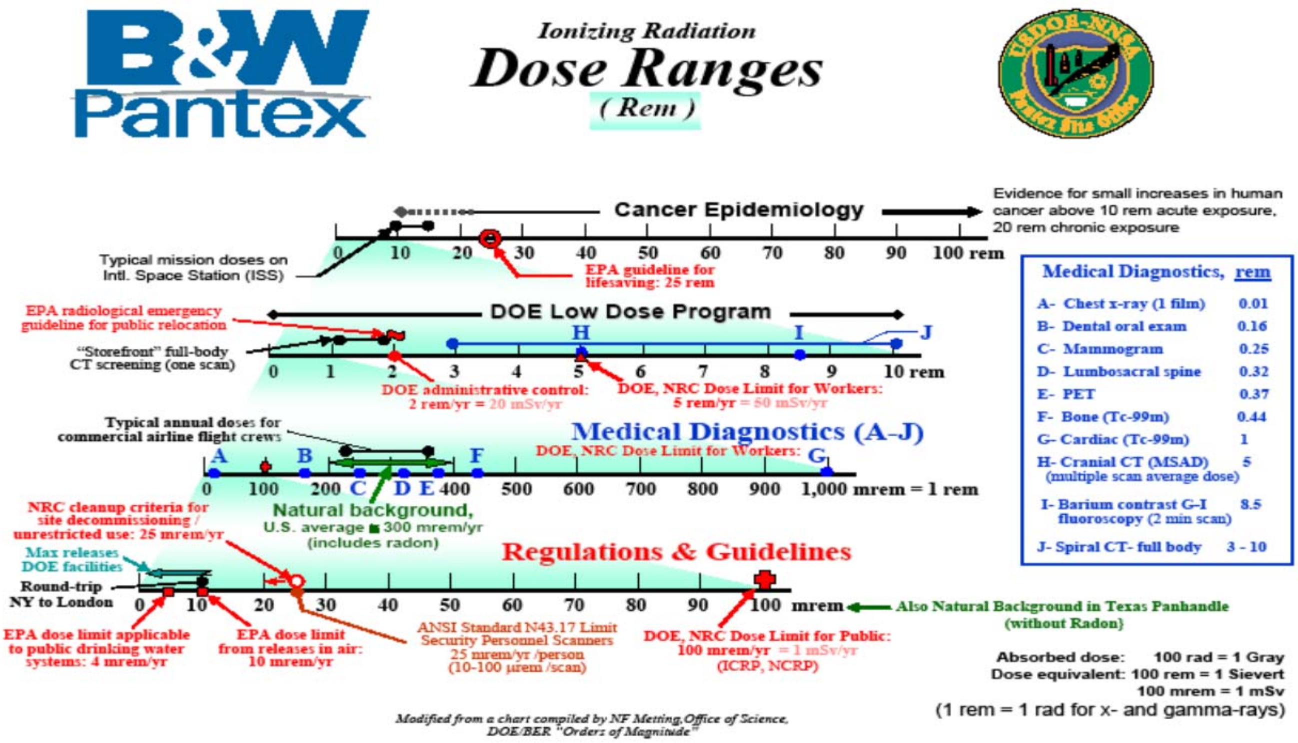
[14] A detailed report on exposures from these and other types of radiation sources can be found in NCRP Report No. 160 "Ionizing Radiation Exposure of the Population of the United States" (NCRPd).

[15] 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).

[16] 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.

[17] DOE Order 458.1 superseded DOE Order 5400.5 in February 2011. It provides additional detailed guidance for radiological property release and waste management not included in the older order.

FIGURE 4.1 – *Comparison of Ionizing Radiation Dose Ranges*



are replaced or revised by Pre-Approved Authorized Limits issued under the new Order. At the present time, 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.

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 2011 is discussed in Chapter 2. As there were no releases of real property containing residual radioactive material during 2011, those values represent the quantities of property released from the Pantex Plant in 2011.

4.5 Unplanned Releases

No unplanned releases of radioactive material occurred at Pantex Plant during 2011.

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 2011.

During 2011, Pantex Plant and TDSHS co-sampled at nine locations (one onsite, seven along the perimeter fence, and one offsite). The Plant also monitored independently at four other locations onsite and four offsite or perimeter locations while TDSHS monitored independently at four other offsite or

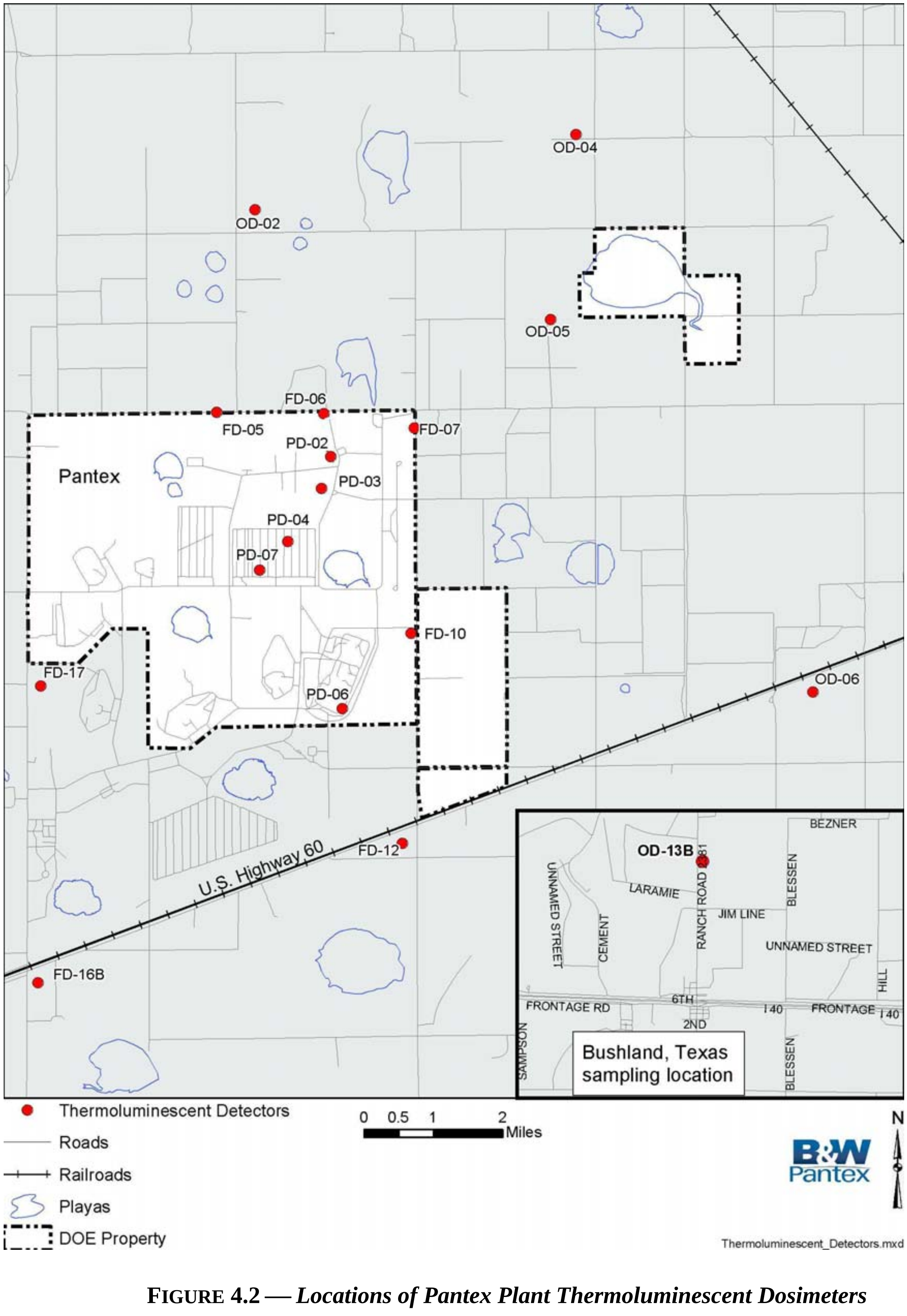


FIGURE 4.2 — *Locations of Pantex Plant Thermoluminescent Dosimeters*

perimeter locations. Pantex Plant's TLDs are generally placed at the same locations where Pantex Plant operates air monitors, as discussed 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 the approximately 90 days of uninterrupted deployment they receive while exposed to the environment at the various locations.

Table 4.5 lists results for 2011 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 onsite locations during 2011 was approximately 19.9 mrem. The equivalent average annual dose is 79.5 mrem/year (0.76 mSv/year). The average quarterly dose at TLD monitoring locations, which are located in the direction of the predominant wind direction at the Pantex Plant, was 20.9 mrem (equivalent to 83.5 mrem/year or 0.84 mSv/year), while the quarterly dose at upwind locations averaged 21.1 mrem (equivalent to 84.5 mrem/yr or 0.84 mSv/year).

TABLE 4.5 — *Environmental Doses Measured by Thermoluminescent Dosimeters in 2011 in millirem*[18]

Location	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Avg. Qtr
Onsite					
PD-02	18.0	17.5	23.0	19.0	19.4
PD-03	18.0	15.5	19.0	17.0	17.4
PD-04	22.0	19.5	24.0	21.0	21.6
PD-06 [a]	21.0	18.5	24.0	21.0	21.1
PD-07	21.0	17.5	22.0	19.0	19.9
Upwind					
FD-10 [a]	22.0	18.5	24.0	21.0	21.4
FD-12 [a]	23.0	19.5	24.0	21.0	21.9
FD-16B [a]	19.0	17.5	22.0	20.0	19.6
FD-17[a]	21.0	19.5	24.0	21.0	21.4
OD-06	22.0	19.5	24.0	20.0	21.4
Downwind					
FD-05 [a]	22.0	19.5	24.0	20.0	21.4
FD-06 [a]	22.0	20.5	25.0	23.0	22.6
FD-07 [a]	19.0	17.5	20.0	20.0	19.1
OD-02	21.0	18.5	24.0	20.0	20.9
OD-04 [a]	19.0	18.5	22.0	20.0	19.9
OD-05	22.0	18.5	24.0	21.0	21.4
Control					
OD-13B	25.0	20.5	25.0	23.0	23.4
Blank Correction	3.0	1.5	2.0	1.0	

[a] Locations co-sampled with TDSHS. Results for the TDSHS monitoring program during 2011 at the indicated co-sampling locations were not available at the time this document was prepared.

[18] 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.

The average of quarterly measurements at no location exceeded the quarterly average dose of 23.4 mrem (equivalent to 93.5 mrem/year or 0.94 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.[19]

4.6.2 Other Environmental Measurements of Radiation

Gamma monitoring within Zone 4 West, which was discussed in the *2005 Site Environmental Report*, using Reuter-Stokes™ gamma radiation detectors/monitors (pressurized ionization chambers) was discontinued in 2006. A review of records from the periodic surveys conducted within and near the several magazines within Zone 4 during 2011 continued to indicate evidence of seasonality between the several quarterly measurements as the measurements taken during the winter quarter (when the northern hemisphere is closest to the sun and levels of cosmic radiation are highest) are generally higher than those taken during the remainder of the year. However, in a similar manner to measurements taken during the last several years, the background dose rate baseline (15.2 µrem/hr) from the survey conducted in 1994 at the time the (then) Secretary of Energy signed a Record of Decision (ROD) for the *Interim Storage of Plutonium Components at Pantex* was not exceeded during 2011.

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 Plant.

[19] 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).

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Air Monitoring

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 onsite and offsite 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[1] 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 Non-radiological Monitoring

Pantex ceased using non-radiological ambient air monitors in 2003. However, a qualitative monitoring system has continued to operate at the Pantex Plant. During 2011, the Plant had two people certified to perform Visual Emission Evaluations (VEE). A VEE is conducted to visually determine the opacity of emissions from stationary sources (exhaust stacks). During 2011, one VEE was conducted.

In addition to the VEE, effluent ("stack") monitoring was conducted to determine emission factors for Beryllium (Be) associated with the operation of a microwave oven used to sanitize weapon components. As all results were less than the detection limit of the monitoring system, results demonstrated that the microwave oven met the emission standards stated in 40 CFR §61, Subpart C (National Emission Standards for Beryllium).

5.3 Routine Radiological Air Monitoring

5.3.1 Collection of Samples

During 2011 air monitors were operated according to the schedule shown in Table 5.1, wherein several monitors were operated continuously (the four onsite locations as well as the control location), others operated less frequently, and a few were not operated at all during the year.

[1] 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 — 2011 *Schedule for Air Sampling and Analysis*

Location	Month											
Onsite	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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	X			X			X			X		
FL-AR-02												
FL-AR-03	X			X		X			X		X	X
FL-AR-04												
FL-AR-05		X			X			X		X		
FL-AR-06												
FL-AR-07			X			X	X				X	X
FL-AR-08												
FL-AR-09												
FL-AR-10		X	X		X			X			X	
FL-AR-11												
FL-AR-12B[a]												
FL-AR-13			X		X	X			X			X
FL-AR-14												
FL-AR-15	X			X			X			X		X
FL-AR-16												
FL-AR-17												
Offsite												
OA-AR-02	X			X		X		X		X		X
OA-AR-04		X	X		X		X		X			X
OA-AR-05												
OA-AR-06		X		X		X		X	X		X	
Control												
OA-AR-13B	X	X	X	X	X	X	X	X	X	X	X	X

[a] Due to highway construction beginning in 2008, operation of the monitoring equipment at the location designated as FL-AR-12 was discontinued. A new location to replace the former FL-AR-12 has not yet been selected.

A total of 15 air monitoring stations were used to monitor for radionuclides in the air in 2011. Four onsite monitoring stations designated as PA-AR-XX (for Plant air) in the tables and as PA on the figures, are placed near operating areas where airborne releases could potentially occur (Figure 5.1). Stations PA-AR-03 and PA-AR-04 are located around the firing sites primarily to monitor areas where testing and sanitization of nuclear weapons components contaminated with tritium are conducted. (These stations were originally placed at their respective locations to monitor areas contaminated with depleted uranium that was released during test firing of uranium containing components, which ceased in 1986). Station PA-AR-04 is adjacent to the north fence of Zone 4 East. Since the predominate wind direction is from the south-southwest, this station is also used to monitor ambient air for potential releases of radioactive material during 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 so that it can monitor potential releases of radioactive material during shipping and receiving operations conducted in Zone 4.

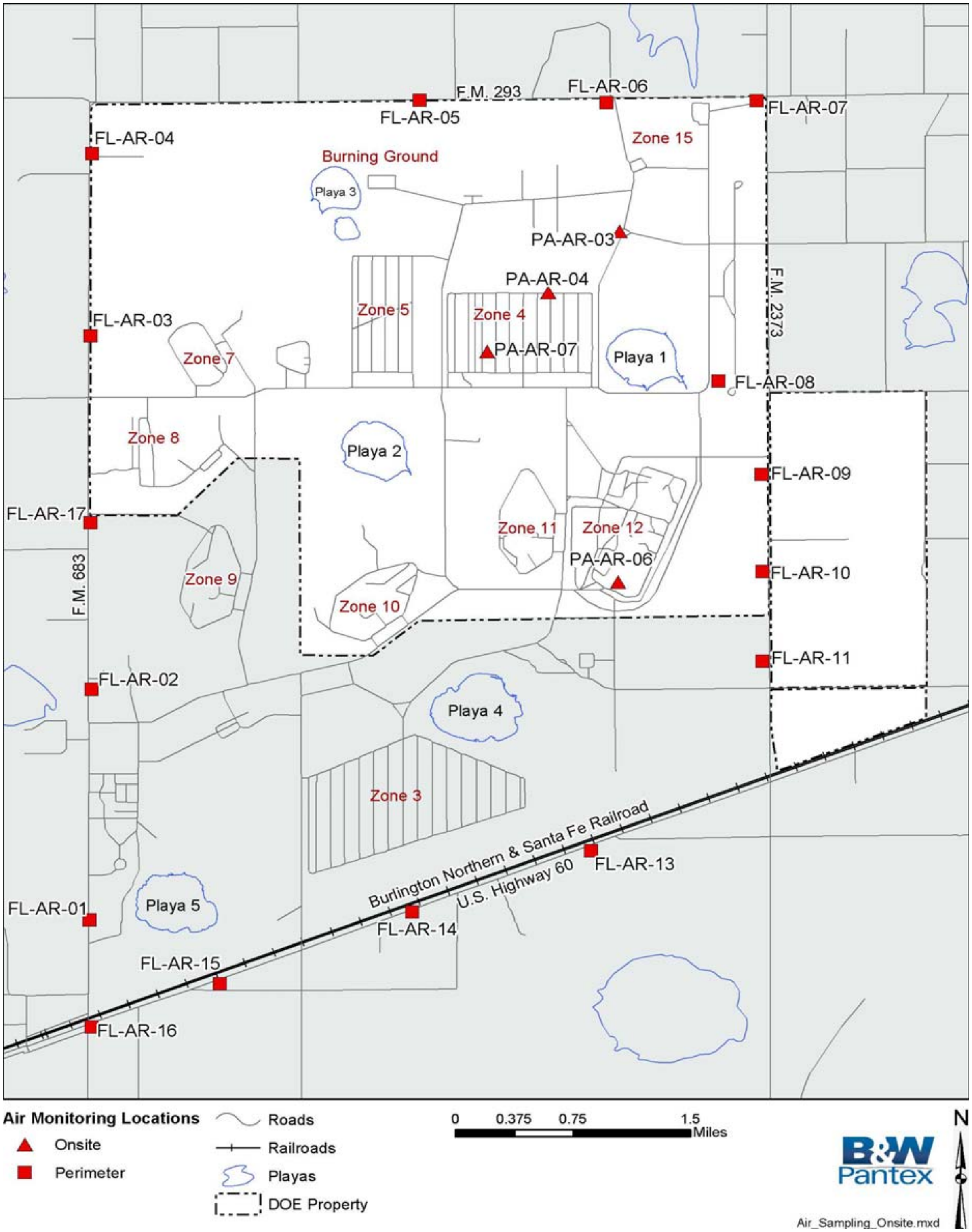

FIGURE 5.1 — ***Locations of Onsite and Fence Line Air Monitoring Stations***

Seven of the 16 available fence line radiological monitoring stations[6], designated as FL-AR-XX (for Fence line), along the Plant perimeter (as it existed prior to the purchase of property east of FM 2373 in the latter part of 2008) provided coverage for 2011 in the principal compass directions and in directions where residences are located. 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.

Five offsite 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 offsite station, designated as OA-AR-13B, is a control station and is located upwind at Bushland, Texas[7]. Four of the five offsite stations (including the control station) were used in monitoring activities in 2011.

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[8]. Several fence line monitoring stations (those designated as FL-AR-03, -05, and -07 in addition to those designated as OA-AR-02, and -04) are located in the direction of the predominant wind direction at the Pantex Plant (the expected direction in which theoretical releases of radiological material from Pantex would be expected to travel) and were operated more frequently than those which are located in the direction opposite to the predominant wind direction (i.e., those located upwind from the Pantex Plant). Monitoring stations designated as FL-AR-01, -10, -11, -13, and-15 as well as that designated OA-AR-06, 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.

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.

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[6] A seventeenth station (FL-AR-12) was disassembled due to construction of a highway overpass at the intersection of FM 2373 and U.S. Highway 60.

[7] A "Land Use Agreement" negotiated between B&W Pantex and Texas AgriLife Research allows access to a control site located on the James Bush Farms approximately 2 miles north of Bushland, TX.

[8] This schedule is modified annually in a manner to ensure that each location other than the four onsite locations and the control location, is scheduled for sample collection <u>at least</u> once every three years.

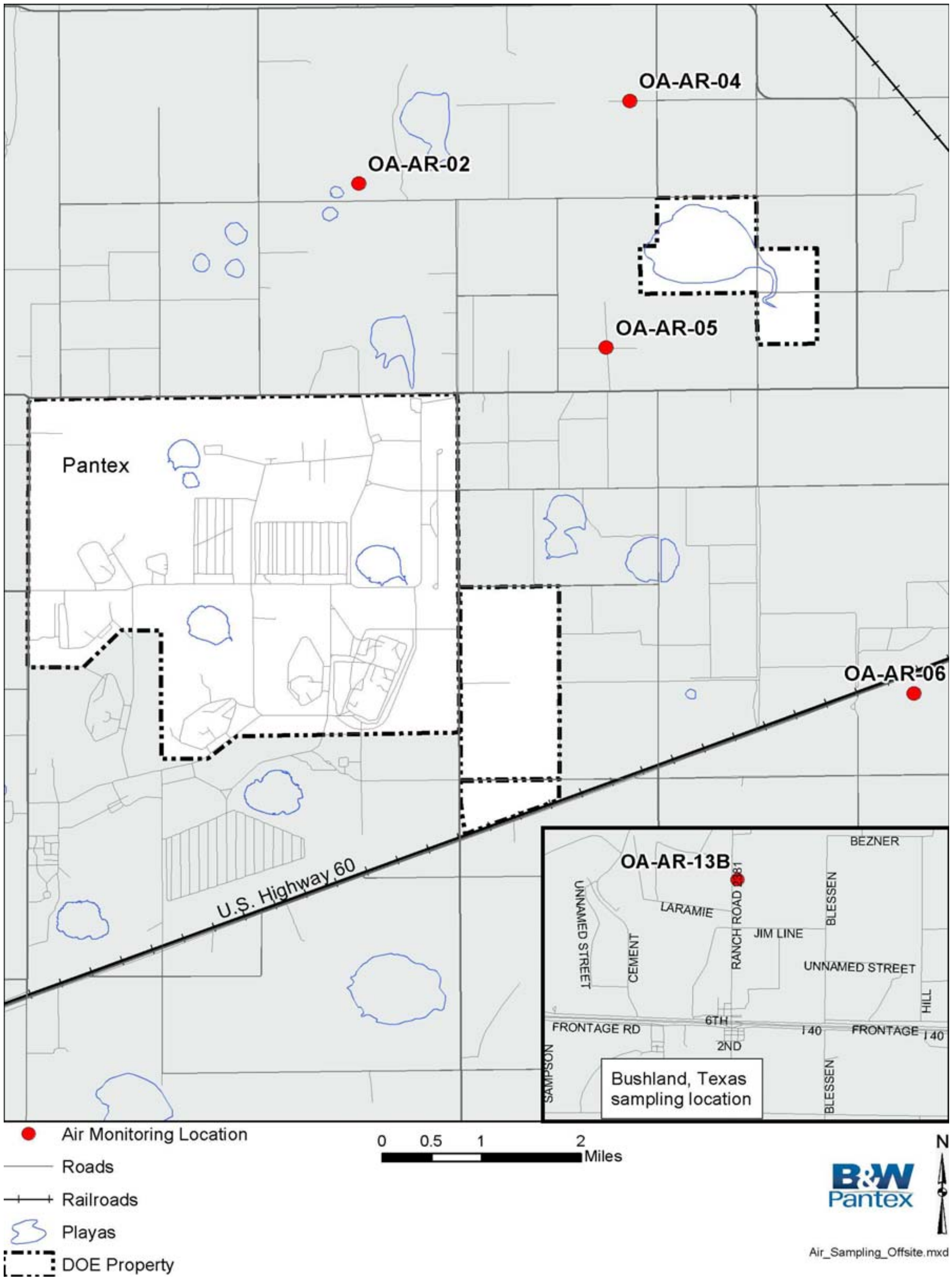

FIGURE 5.2 — *Offsite Air Sampling Stations*

FIGURE 5.3 – ***Typical Air Monitoring Site***

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 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***

5.3.2 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 Section 1.4.

Table 5.2 summarizes several values for each of the several analytes in each of the four categories of monitoring stations (onsite, 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[9] and the Derived Concentration Standard (DCS)[10] for comparison. Pantex collected approximately 91 percent of the planned samples at onsite and upwind locations, 83 percent at downwind locations and 89 percent at the Bushland control location. Resource constraints, intermittent power losses or motor failures, and low "moisture content" for tritium samples during the summer resulted in less than 100 percent sample collection.

TABLE 5.2 —*Concentrations of Radionuclides in Air[a] for 2011 at (a) Onsite Locations; (b) Upwind Locations; (c) Downwind Locations; and (d) Background Location*

a.

Radionuclide	Number of Samples Collected/Planned	Mean ±Std. Dev.	Max ± Counting Error	Historical Background	DCS
^{3}H	187/208	5.67 ± 13.54	100.38 ± 9.05	13.22	140,000
$^{233/234}U$	44/48	34.26 ± 17.19	75.64 ± 10.27	108.26	400,000
^{238}U	44/48	32.95 ± 18.41	68.88 ± 9.64	105.48	470,000
$^{239/240}Pu$	44/48	0.40± 0.37	1.30 ± 0.83	0.69	34,000

b.

Radionuclide	Number of Samples Collected/Planned	Mean ±Std. Dev.	Max ±Counting Error	Historical Background	DCS
^{3}H	98/108	2.38 ± 4.22	21.28 ± 10.18	13.22	140,000
$^{233/234}U$	23/25	33.83 ± 17.36	66.31 ± 9.12	108.26	400,000
^{238}U	23/25	32.83 ± 17.35	69.11 ±11.93	105.48	470,000
$^{239/240}Pu$	23/25	0.38 ± 0.36	1.08 ± 0.87	0.69	34,000

[9] 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 2007-2009. 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 % confidence that a user of the data is willing to accept (usually 95%) for statistical conclusions drawn from the data. When used to derive an "historical background", a user will have 95% confidence that any single analysis result from a non-control location which is greater than the derived value is "different than background".

[10] 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.

c.

Radionuclide	Number of Samples Collected/Planned	Mean ±Std. Dev.	Max ±Counting Error	Historical Background	DCS
^{3}H	95/116	3.65 ± 7.63	15.28 ± 9.60	13.22	140,000
$^{233/234}U$	23/27	26.64 ± 15.41	60.82 ± 9.73	108.26	400,000
^{238}U	23/27	24.62 ± 14.01	53.69 ± 9.04	105.48	470,000
$^{239/240}Pu$	23/27	0.36 ± 0.28	0.86 ± 0.77	0.69	34,000

d.

Radionuclide	Number of Samples Collected/Planned	Mean ±Std. Dev.	Max ±Counting Error	Historical Background	DCS
^{3}H	42/52	2.23 ± 4.55	15.28 ± 9.60	13.22	140,000
$^{233/234}U$	12/12	27.75 ± 11.72	47.20 ± 7.40	108.26	400,000
^{238}U	12/12	25.42 ± 9.96	40.76 ± 6.86	105.48	470,000
$^{239/240}Pu$	12/12	0.25 ± 0.28	0.85 ± 0.70	0.69	34,000

[a] Units in all tables are x 10^{-13} µCi/mL for ^{3}H measurements and x 10^{-18} µCi/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 2011 occurred during periods of rapid changes in barometric pressure with the highest value (10.04 ± .90 pCi/mL) recorded on March 3, 2011. 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. These measurements, however, continue a relative downward trend from those measured during the first few years after the 1989 release near this location.

5.3.3. 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 (onsite [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[11]. 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 2011 exceeded the applicable DCS for the radiological materials analyzed.

5.4 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.

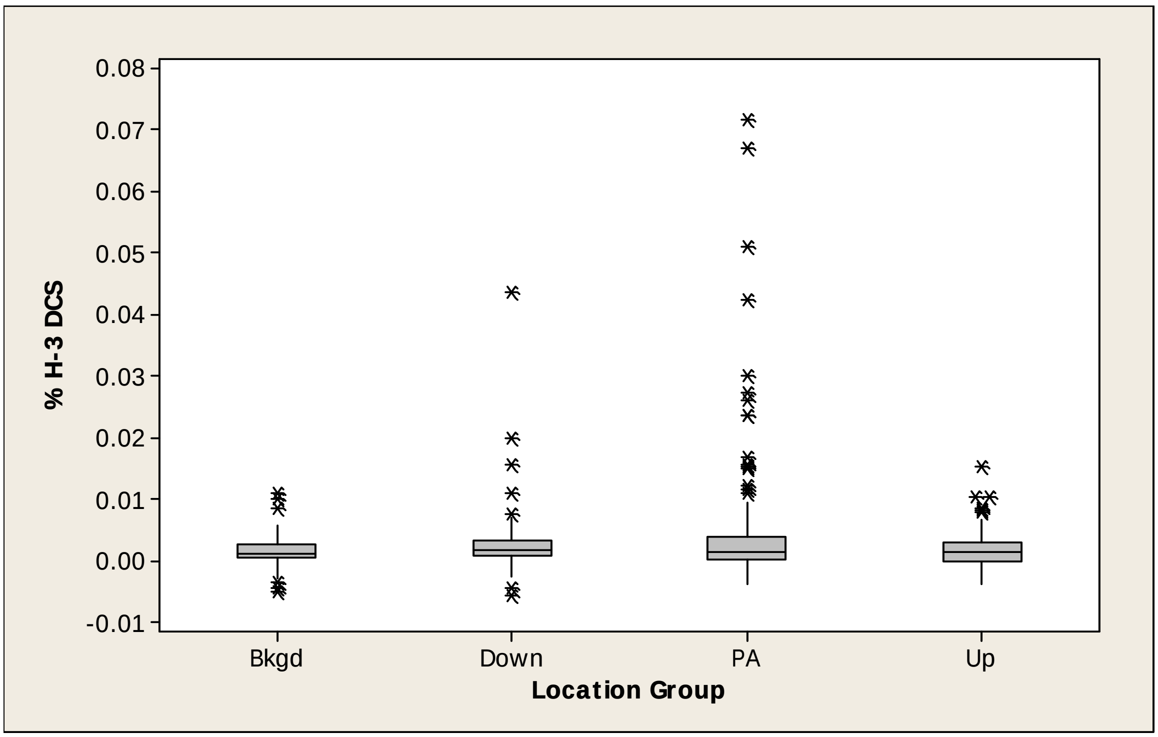

FIGURE 5.5a - ***Comparison of "Normalized" Tritium Data by Location***

[11] In these several "boxplots" presenting the data, the 25th percentile (equal to that value greater than 25% 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% 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.

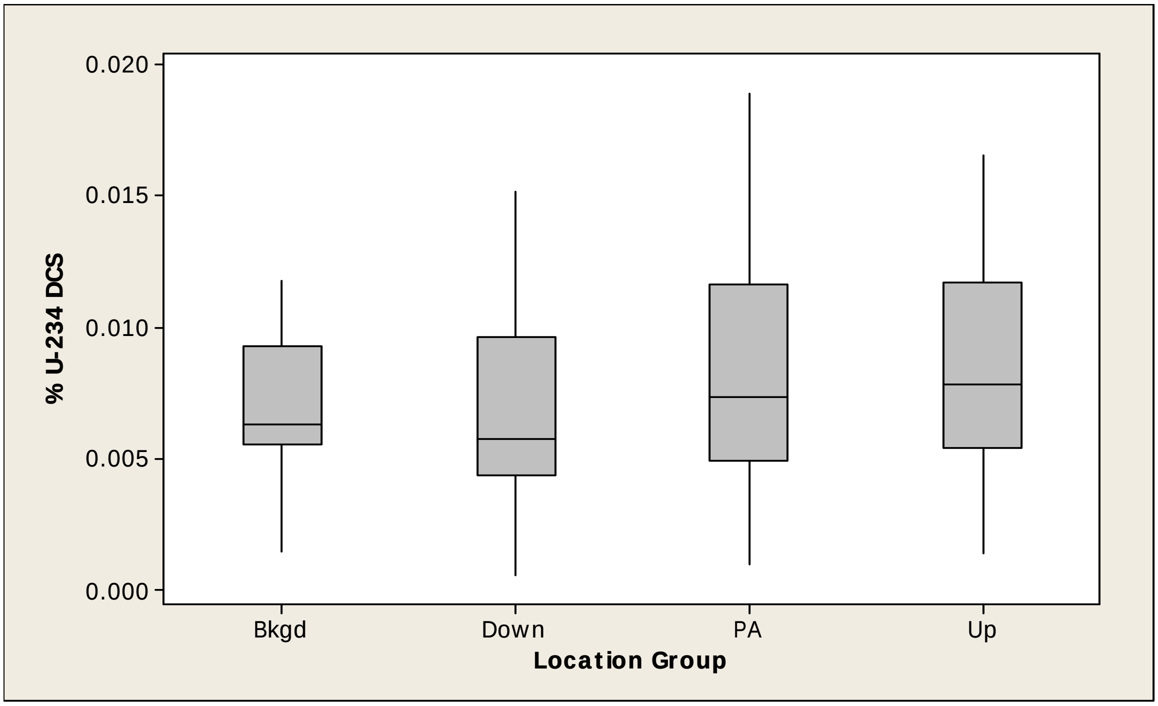

FIGURE 5.5b - ***Comparison of "Normalized" ^{234}U Data by Location***

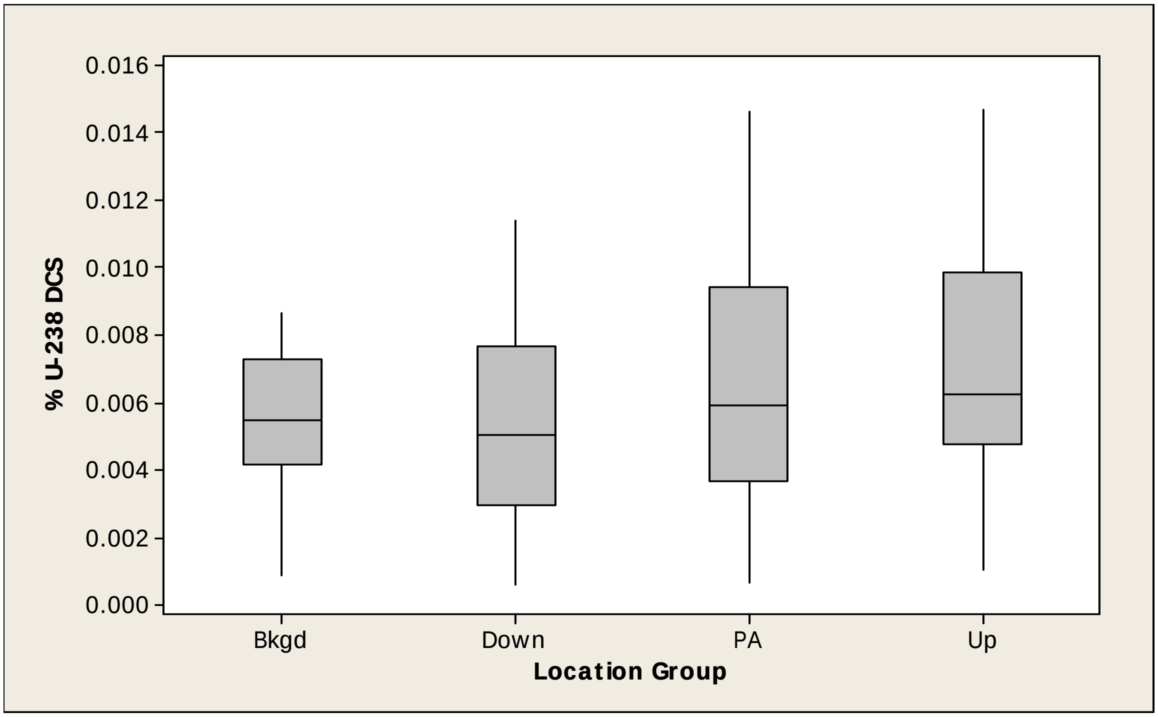

FIGURE 5.5c - ***Comparison of "Normalized" ^{238}U Data by Location***

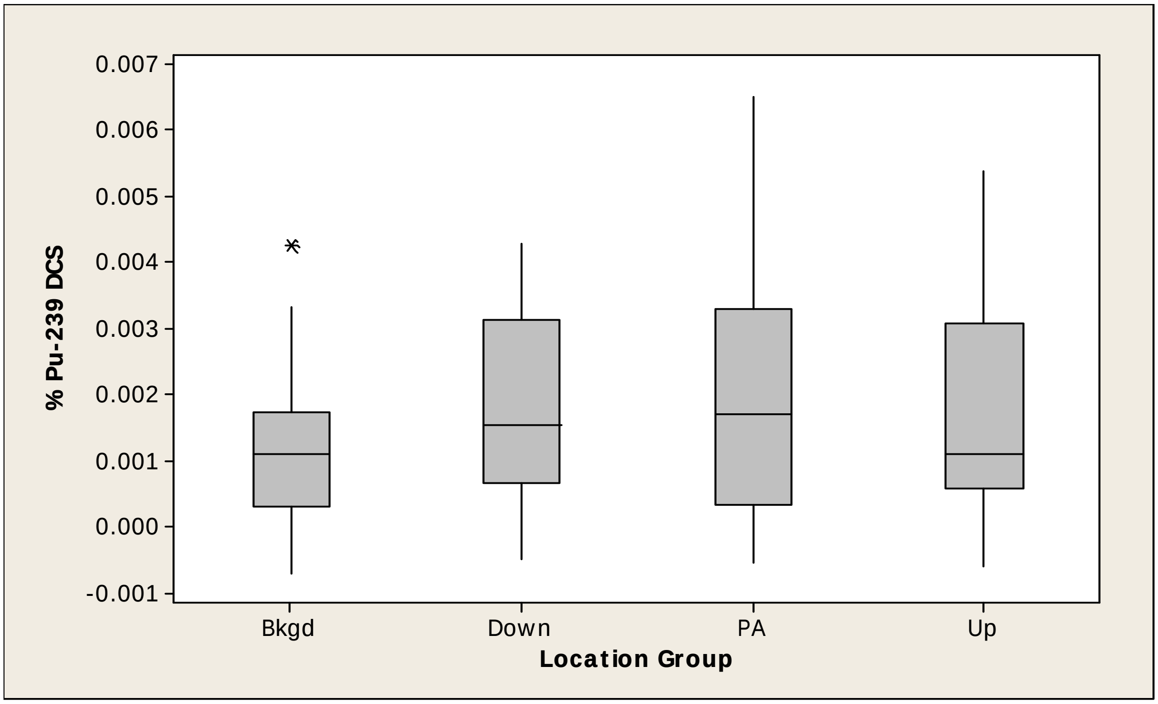

FIGURE 5.5d - *Comparison of "Normalized" ^{239}Pu Data by Location*

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Groundwater Monitoring

Groundwater monitoring at Pantex Plant began in 1975, when the first investigative wells were installed. B&W 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 action systems: two pump and treat systems, with 72 operating extraction wells and 3 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 2011 demonstrated that current remedial actions continue to operate as expected.

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.

The second water-bearing zone, known as the High Plains Aquifer, is located below the fine-grained zone in the Ogallala and Dockum Formations. The High Plains Aquifer is a primary drinking and irrigation water source for most of the High Plains. The groundwater surface of the High Plains 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 High Plains Aquifer is north to northeast due to the influence of the City of Amarillo's well field located north of the Plant.

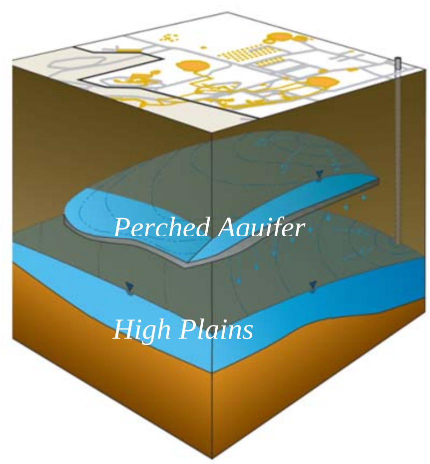

Figure 6.1 - *Groundwater Beneath Pantex*

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 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 supply well north of Pantex Plant, no public or private 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.

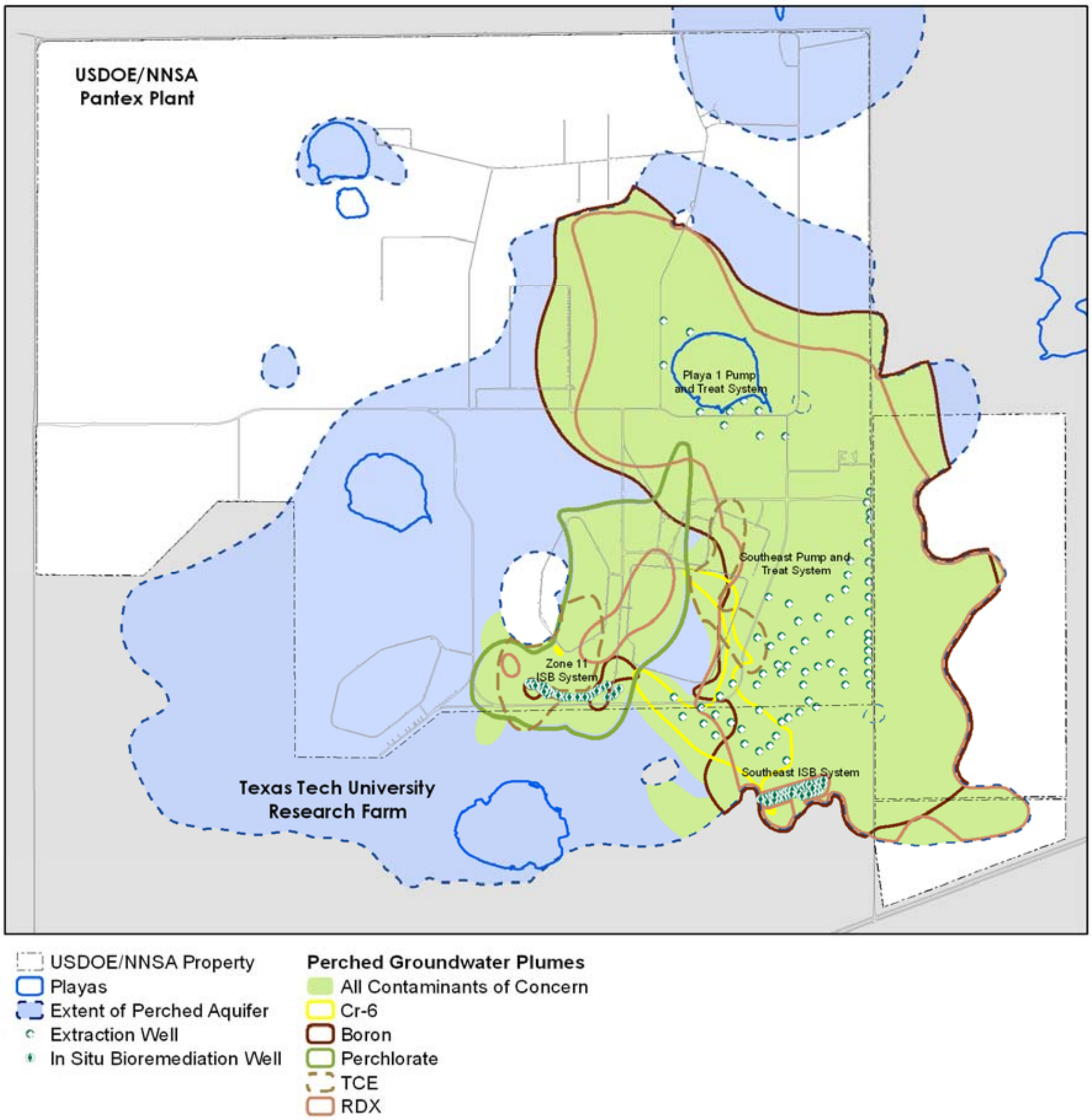

FIGURE 6.2 — *Perched Groundwater Plumes and Remediation Systems*

Because concentrations of contaminants in the perched groundwater beneath the Plant's property and offsite to the south and east currently exceed drinking water standards, the water is not safe for domestic or industrial use. Onsite use of perched groundwater is restricted by Pantex Plant. TTU and one offsite 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	❖ Remedial action effectiveness
❖ Achieve cleanup standard for perched COCs	❖ Plume stability
❖ Prevent growth of perched groundwater contaminant plumes	❖ Uncertainty management
❖ Prevent COCs from exceeding cleanup standards in the drinking water aquifer	❖ 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. Those reports will be updated as the monitoring data are evaluated and changes are required.

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. Those reports can be found online, as they become available, at www.pantex.com/about/environment/erDocs.

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. A *Long-Term Monitoring 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.

Table 6.1 summarizes the number of wells sampled in 2011 by function that are currently used in monitoring of the remedial actions and the total number of analytes assessed. The total numbers include additional wells (seven perched wells) and modified 40 CFR 264 Appendix IX analytes collected for the data collection effort of the 5-year review.

TABLE 6.1 — *Summary of Well Monitoring in 2011*

Well Type	Drinking Water Aquifer		Perched Groundwater	
	# Wells	# Analytes Assessed	# Wells	# Analytes Assessed
Long-Term Monitoring Well	30	2,023	97	7,859
Parked Wells (water level monitoring)	2	--	51	--
Pump & Treat Extraction Well	--	--	67	1,027
***In Situ* Bioremediation Injection Well**	--	--	21	2,442
Total	32	2,023	236	11,328

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 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, and this injection capability will remain available while Pantex upgrades the WWTF and irrigation system to receive more water.

The pump and treat systems' operation and throughput were variable in 2011. Because of the impact of an irrigation system upgrade, Pantex obtained regulatory agreement to relax system throughput goals during 2011. The Playa 1 pump and treat system (P1PTS) operation and treatment throughput was less than 90 percent during 2011. The SEPTS exceeded operational goals for 2011; however, treatment throughput was less than 90 percent because of the irrigation system upgrade. The upgrade was complete in 2011 with the exception of final inspection and acceptance. As part of the irrigation system upgrade, Pantex submitted a permit modification request to the TCEQ to include an additional 100-acre tract to be used for subsurface irrigation and cropping. Pantex is expecting the additional 100-acre tract to be available for use in 2012. Operational and treatment throughput is expected to meet goals once the additional tract becomes available for use.

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 release to the subsurface irrigation system began in May 2005. Despite some continued injection of treated water, water levels are beginning to decline in the areas down gradient of the pump and treat systems, with declines exceeding 1 ft/yr in several wells as depicted in Figure 6.3.

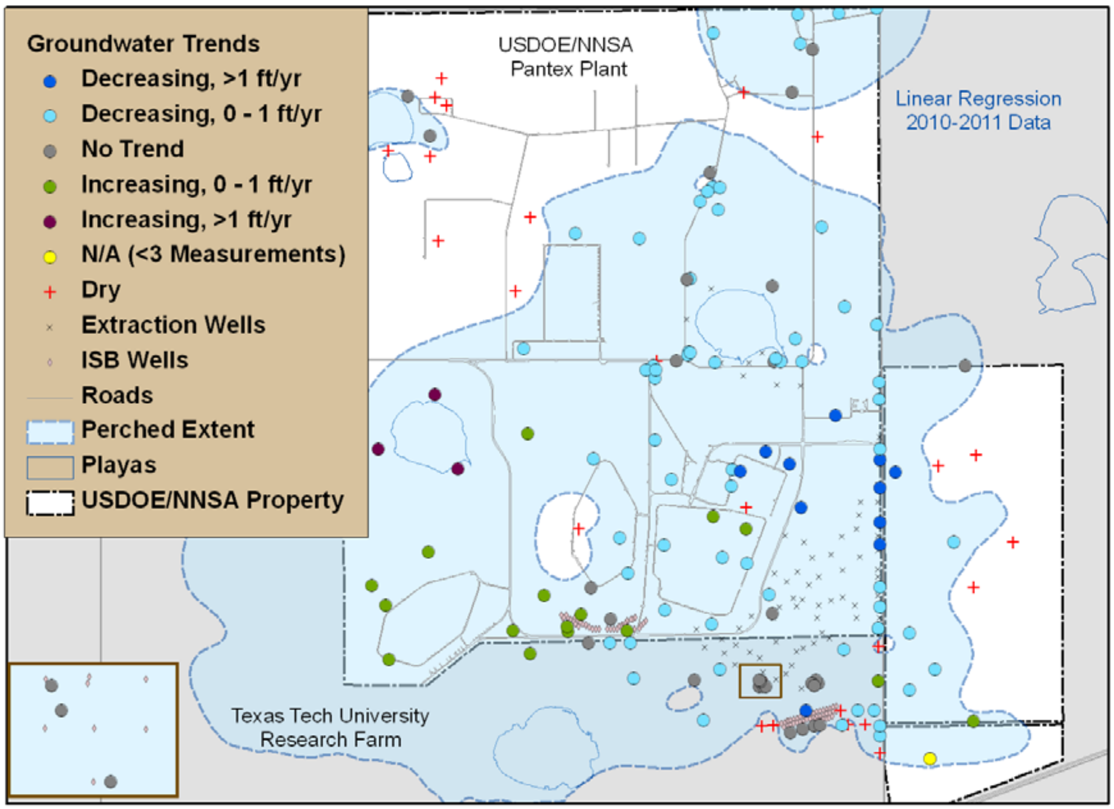

FIGURE 6.3 – ***Water Level Trends in the Perched Aquifer***

A greater decline in water levels was observed south of Playa 1 and along the eastern fence line. Several wells did not demonstrate a trend in water levels and all but one well that was previously dry in 2010 remained dry. A newer well on the southeast edge of the perched groundwater was dry during 2009 and 2010, but about two feet of water was observed in the well during 2011. These observations indicated that the systems are effective in reducing perched water levels within the influence of the pump and treat systems and will assist with plume stability. The wells demonstrating an increasing trend were outside the influence of the pump and treat systems.

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 the same general shape from 2010 to 2011, with the following notable exceptions:

- The perchlorate plume boundary has slightly shifted to the south due to the decreasing perchlorate concentration near Playa 1. Perchlorate concentration near Playa 1 dropped below the laboratory practical quantitation limit (PQL) in 2011.
- TCE concentrations in the southern half of the southeast plume have dropped below the laboratory PQL. This could be due to SEPTS effects or natural attenuation of the TCE in this area.
- The hearts of the RDX plume in the east and southeast portions of the perched aquifer appear to be continuing to move down gradient. However, these regions are not currently under the effect of a remedial action and this plume movement is not unexpected. The heart of the RDX plume within the SEPTS well field appears to be contracting.
- All plumes exhibit slight variations at their boundaries, likely due to minor variations in concentration over time 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 using the last four measurements. A summary of concentration trends are as follows:

- RDX concentration trends indicate that RDX is decreasing, stable, 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. One well is exhibiting increasing trends in RDX near a source area, but this increasing trend is due to very small changes in RDX concentration as all recent measured values are less than 1 µg/L.
- The SEPTS has had some effect on the plume as the majority of COC concentrations are declining or stable along the outer margins of the system, indicating that the plume is not continuing to move out towards the extent of the perched groundwater. The Southeast ISB has had some effect on wells to the south on TTU property as concentrations in those wells are stable or declining. 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.
- Overall, five monitoring wells exhibited increasing trends in RDX using data from the last four measurements, as depicted in Figure 6.5. However, two of the monitoring wells are located in the far southeastern lobe of the perched aquifer and one monitoring well is located on the western edge of Zone 12, which are areas that are not under the influence of any remedial action at this time. The other three monitoring wells exhibiting increasing RDX trends are located on the periphery of the SEPTS well field and may or may not be under the influence of the system.

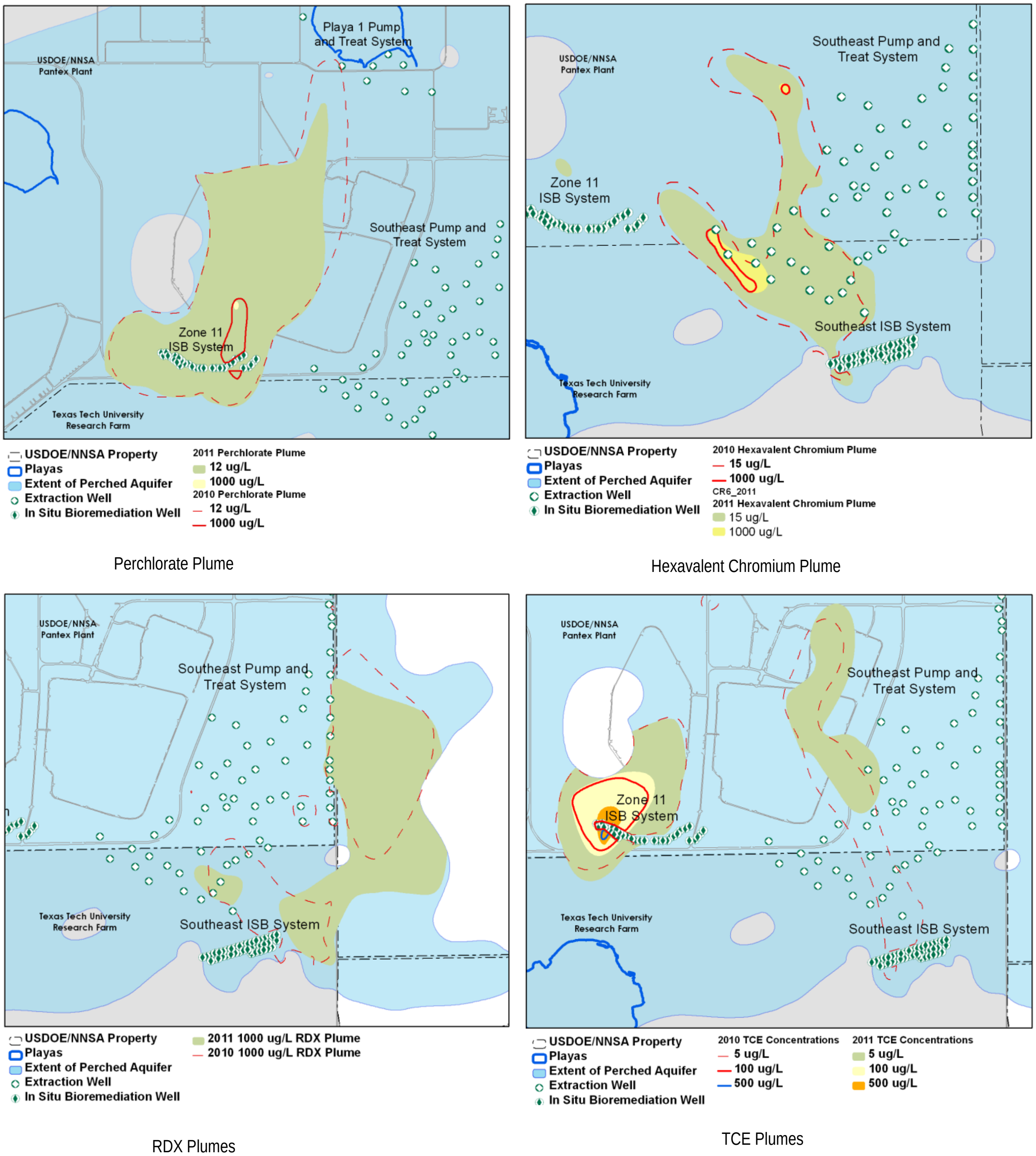

FIGURE 6.4 – ***2010 - 2011 Plume Movement - Perchlorate, Hexavalent Chromium, RDX, and TCE***

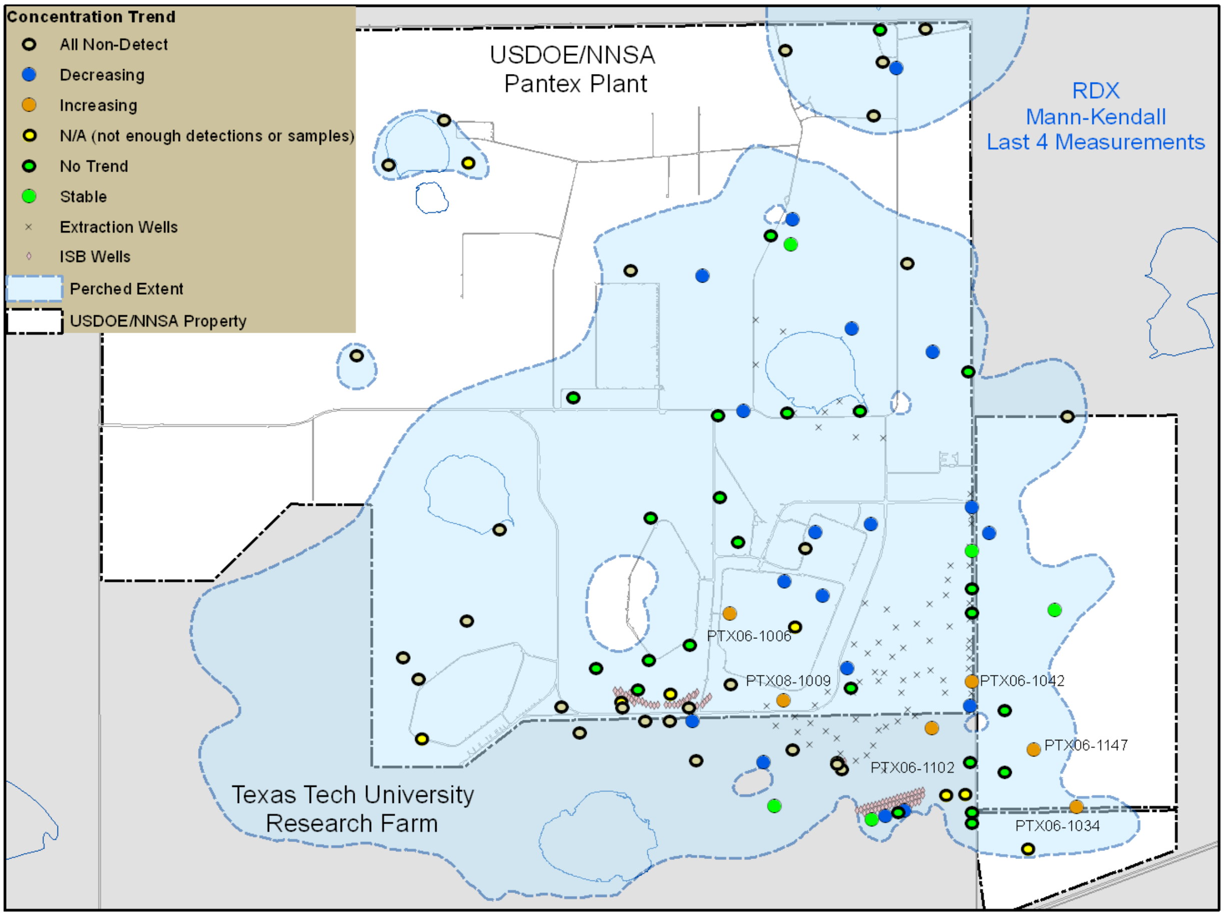

FIGURE 6.5 –*RDX Concentration Trends in the Perched Aquifer*

Concentration trends for the remaining major COCs (perchlorate, TCE, and hexavalent chromium) are discussed in the 2011 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 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.

The Southeast ISB was installed in 2007, with injection complete by March 2008. A second amendment injection was completed during the third quarter of 2010. 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.

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	Strong	Yes*	Perchlorate in 3 wells TCE in 1 well	Yes
Southeast ISB	Strong	Decreasing	RDX in 2 wells Hexavalent Chromium in 3 wells	Yes

Mild conditions = 0 to -50 mV

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

*Two wells have not yet demonstrated increasing concentrations of TOC or volatile fatty acids since injection.

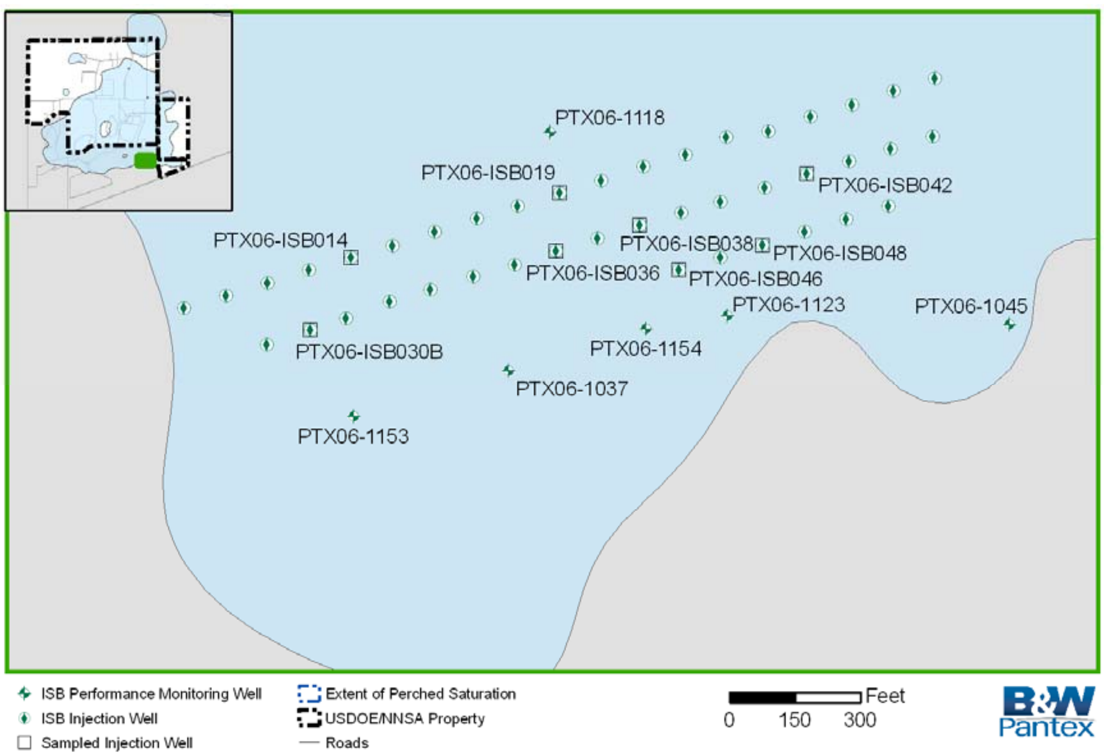

FIGURE 6.6 – *Wells Sampled at Southeast ISB*

Three of the closest 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 in those monitoring wells. One downgradient well has hexavalent chromium present in concentrations above the GWPS. The RDX concentrations in this well are lower than baseline concentrations from the treatment zone; however, they remain around 200 µg/L. This well is downgradient of a lower velocity zone and may be slower in demonstrating complete treatment. Because of the increase in hexavalent chromium, Pantex collected analytical and field data from additional upgradient wells on the western end of the Southeast ISB. All but one dry well demonstrate that a strong reducing condition is present on the western side of the Southeast ISB. The downgradient performance monitoring well information is included in Table 6.3.

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

	Hexavalent Chromium					RDX				
Well ID	**Max**	**1Q2011**	**2Q2011**	**3Q2011**	**4Q2011**	**Max**	**1Q2011**	**2Q2011**	**3Q2011**	**4Q2011**
PTX06-1037	**108.5**	**<15**	**<15**	**<15**	**<15**	**2800**	**11**	**3.9**	**4.5**	**1.9**
PTX06-1123	**4.4**	**<15**	**<15**	**<15**	**<15**	**4300**	**13**	**6.1**	**4.9**	**7**
PTX06-1153	**136**	**33**	**49**	**113**	**124**	**320**	**200**	**210**	**240**	**190**
PTX06-1154	**13**	**13**	**12**	**<15**	**9**	**630**	**0.2**	**0.27**	**0.12**	**<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 are 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. Both RDX and TNX have been reduced to concentrations near the GWPS 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 may further reduce with time. RDX concentrations have been reduced from historic high values exceeding 500 µg/L to concentrations near or 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. Injection was completed in the new wells in November 2009. A second injection was completed in all wells in the third quarter of 2011 and data in this report reflect post-injection results. Eleven treatment zone wells and three downgradient ISPM wells are used to evaluate the Zone 11 ISB system (Figure 6.8).

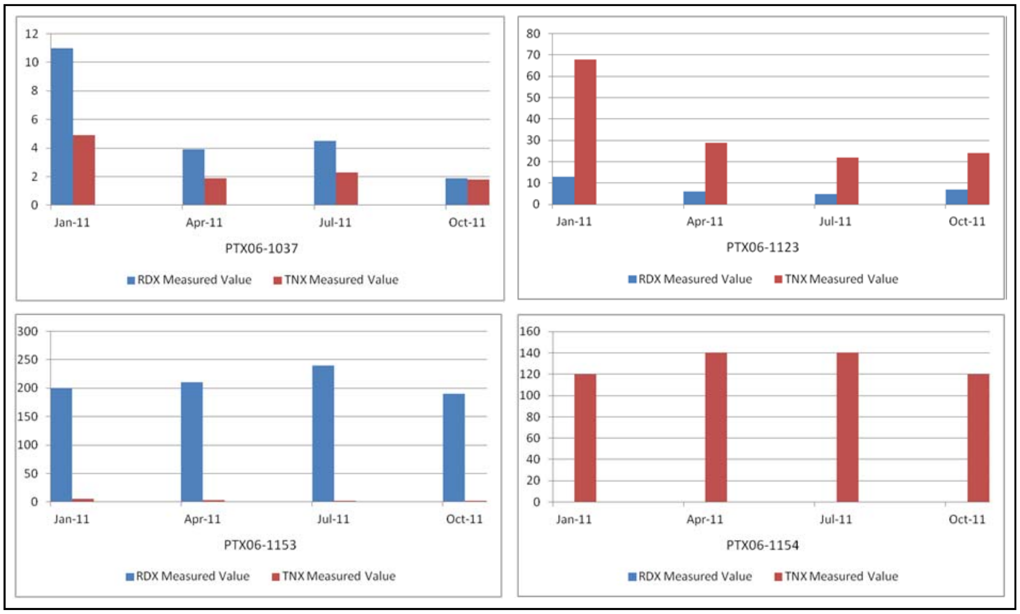

FIGURE 6.7 – ***RDX and TNX Concentrations in Parts per Billion (ppb) from Southeast ISB Downgradient Performance Monitoring Wells***

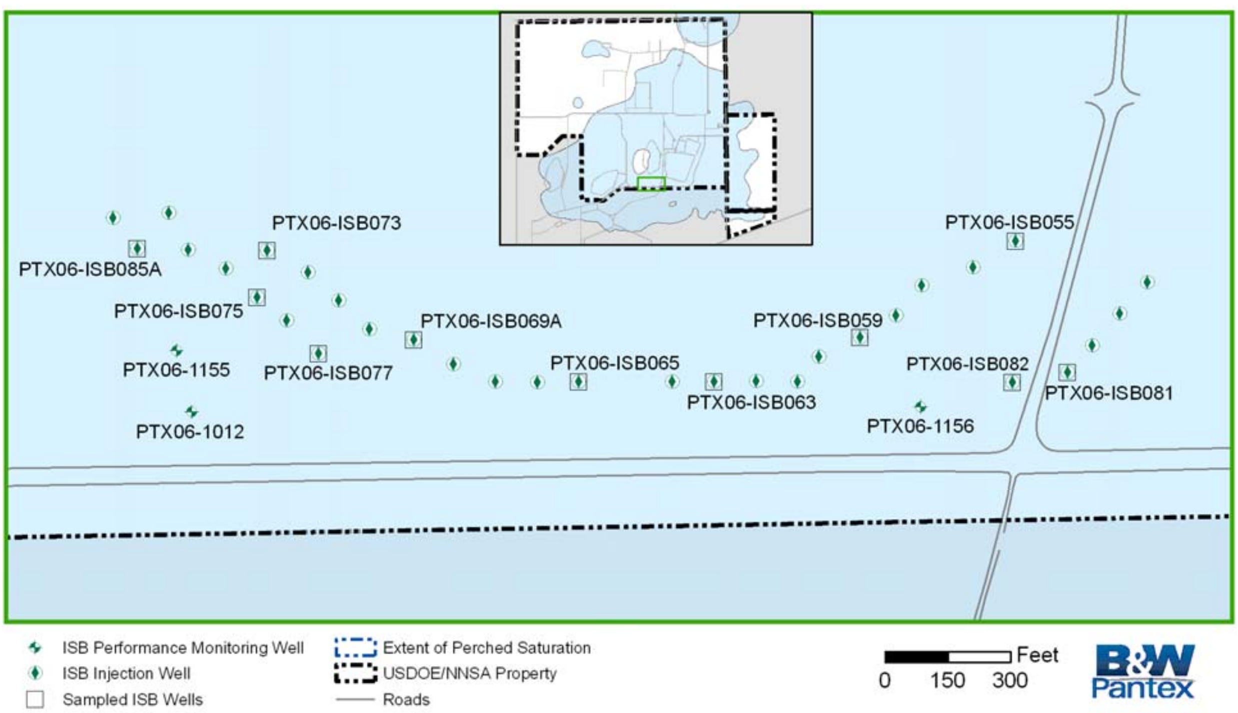

FIGURE 6.8 – *Wells Sampled at Zone 11 ISB*

Data collected in 2011 indicate that a strong reducing zone has been established and maintained over time. Conditions favorable for reductive dechlorination (important for TCE reduction) are present as nitrate and sulfate concentrations have declined. Evaluation of COC data collected in the treatment zone (Table 6.4) indicate that COC concentrations are below the GWPS and most are non-detect with the exception of perchlorate at three wells and TCE in four wells. As shown in Table 6.4, the three perchlorate detections occurred in the first quarter and all subsequent perchlorate concentrations were non-detect. All but one of the TCE detections had subsequent non-detect results in later quarters.

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

	Perchlorate					TCE				
Well ID	Max	1Q2011	2Q2011	3Q2011	4Q2011	Max	1Q2011	2Q2011	3Q2011	4Q2011
PTX06-1012	341	251	162	7	<20	580	380	370	580	570
PTX06-1155	487	4.2	<20	5.1	<20	660	660	530	520	510
PTX06-1156	2140	2040	447	<20	<20	7.4	5	4.5	3.4	2.6

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.

As shown in Table 6.4, downgradient monitoring wells do not yet reflect reduced TCE concentrations from the ISB. However, perchlorate concentrations have been reduced to concentrations below the GWPS in all downgradient ISPM wells. TCE degradation is expected to be slower as deeper reducing conditions are required. This type of reducing condition was not expected after the first injection so concentrations of TCE are expected to decline in all downgradient ISPM wells over time as treated groundwater continues to move downgradient.

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 High Plains aquifer wells used in this evaluation for 2011. 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

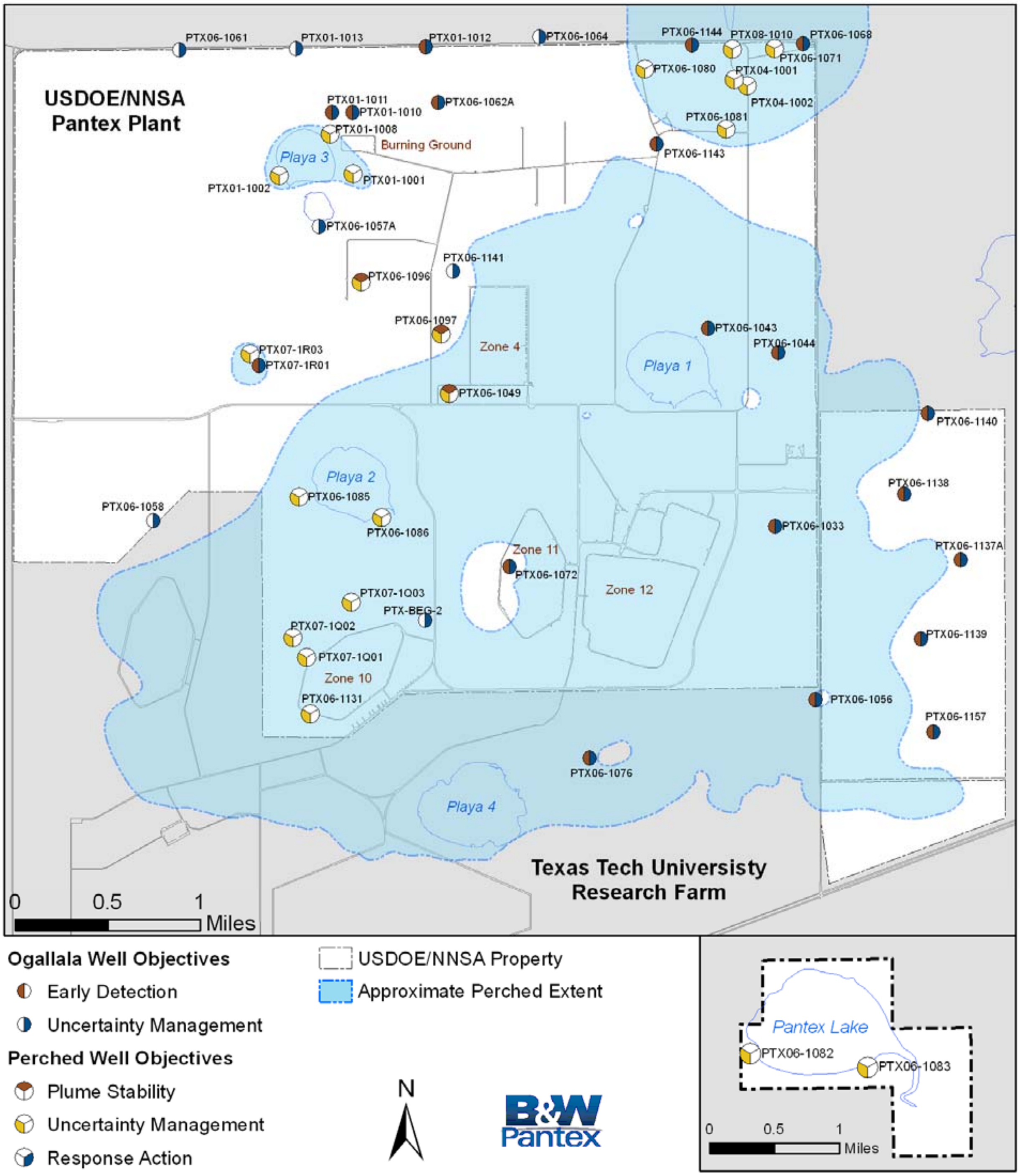

FIGURE 6.9 – ***Uncertainty Management and Early Detection Wells***

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.

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.

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	4/26/2011	TCE	0.96 J	N	N	Y[1]
PTX06-1049	4/14/2011	4-Amino-2,6-Dinitrotoluene	1.81	Y	Y	Y[2]
PTX06-1049	4/14/2011	TCE	5.69	Y	Y	Y[2]
PTX06-1049 Resample	6/22/2011	TCE	0.9 J	N	N	Y[2]
PTX06-1049	4/14/2011	RDX	0.43	Y	N	Y[2]
PTX06-1049	4/14/2011	cis-1,2-Dichloroethene	1.61	Y	N	Y[2]
PTX04-1001	7/13/2011	HMX	0.13	N	N	Y[3]
PTX04-1001	7/21/2011	1,4-Dioxane	2.4	Y	N	Y[3]
PTX04-1001	7/21/2011	TCE	0.48	N	N	Y[3]
PTX04-1002	7/13/2011	HMX	0.7	Y	N	Y[3]
PTX04-1002 Duplicate	7/13/2011	HMX	0.7	Y	N	Y[3]
PTX04-1002	7/13/2011	RDX	0.18	N	N	Y[3]
PTX04-1002 Duplicate	7/13/2011	RDX	0.19	N	N	Y[3]
PTX04-1002	7/13/2011	1,4-Dioxane	1.4	Y	N	Y[3]
PTX04-1002 Duplicate	7/13/2011	1,4-Dioxane	2.5	Y	N	Y[3]
PTX04-1002	7/13/2011	TCE	0.6	N	N	Y[3]
PTX04-1002 Duplicate	7/13/2011	TCE	0.63	N	N	Y[3]
PTX06-1071	7/21/2011	1,4-Dioxane	1.3	Y	N	Y[3]
PTX06-1081	7/18/2011	TCE	0.49	N	N	Y[3]
PTX08-1010	7/21/2011	RDX	0.73	Y	N	Y[3]
PTX01-1001	**11/29/2011**	**RDX**	**0.245**	**N**	**N**	**N[4]**
PTX01-1001	11/29/2011	TCE	0.59	N	N	Y[1]

Well ID	Sample Date	Analyte	Measured Value (ug/L)	Above PQL?	Above GWPS?	Expected Condition?
PTX06-1049	11/3/2011	RDX	0.76	N	N	Y[2]
PTX06-1049	11/3/2011	4-Amino-2,6-Dinitrotoluene	2.32	Y	Y	Y[2]
PTX06-1049	11/3/2011	TCE	0.56	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] TCE has been detected in this well previously. TCE has declined below the PQL and the GWPS.
[2] TCE and 4-amino-2,6-dinitrotoluene were detected in PTX06-1049 after the start of the Remedial Action. Concentrations of TCE increased to slightly above the GWPS in the second quarter. A confirmation sample was collected on 6/22/2011, and the TCE detection was confirmed, but the concentration was below the PQL and GWPS. RDX and cis-1,2-dichlorethene were also detected at low levels in the second quarter. These COCs do not represent a new contaminant source as this is likely a part of the Playa 1 plume that is moving into this area.
[3] 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, with the exception of 1,4-dioxane at PTX04-1001 where it had not been previously analyzed. The 1,4-dioxane concentrations are consistent with other detections in this area. These detections are similar to past detections, although two wells show signs of slightly increasing concentrations.
[4] RDX was detected below the PQL and GWPS for the first time. RDX was not detected in the analysis of the TCEQ co-sample.

Seven perched monitoring wells had detections of COCs in 2011. Two of those conditions (TCE in PTX01-1001 and TCE, RDX, and 1,4-dioxane in the OSTP wells) were expected, as those wells or wells in the area had previous similar detections of the COCs. These wells will continue to be monitored over time to trend the concentrations.

PTX06-1049 has had sporadic detections of TCE since 2006 and is now exhibiting consistent concentrations below the 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. The well also had first-time detections of RDX and cis-1,2-dichloroethene in 2011. 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 had a first-time detection of RDX below the PQL and the GWPS in November 2011. This well, which is located in a separate zone of perched groundwater below the burning ground where RDX has not been identified as a COC. This well will continue to be monitored over time according to the *SAP* and *Ogallala Aquifer and Perched Groundwater Contingency Plan*.

6.5.2 High Plains 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. Fourteen High Plains Aquifer (Ogallala/Dockum) wells had detections in 2011. Thirteen 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 High Plains Aquifer Wells*

Well ID	Sample Date	Analyte	Measured Value (µg/L)	Ratio MV/ Background	Above Background?	Above PQL?	Above GWPS?	Expected Condition?
PTX01-1011	2/24/2011	Boron	216	1.1	Y	NA	N	Y[1]
PTX06-1033	2/23/2011	Boron	217	1.1	Y	NA	N	Y[5]
PTX06-1043	2/23/2011	Boron	199	1	Y	NA	N	Y[1]
PTX06-1044	2/22/2011	Boron	222	1.1	Y	NA	N	Y[1]
PTX06-1044	**2/22/2011**	**Chromium, Hexavalent**	**8**		**NA**	**N**	**N**	**N[2]**
PTX06-1056	3/1/2011	Boron	214	1.1	Y	NA	N	Y[1]
PTX06-1062A	2/24/2011	Boron	199	1	Y	NA	N	Y[1]
PTX06-1062A Duplicate	2/24/2011	Boron	213	1.1	Y	NA	N	Y[1]
PTX06-1068	**2/21/2011**	**PCE**	**0.6 U**		**NA**	**N**	**N**	**N[3]**
PTX06-1072	**2/28/2011**	**RDX**	**0.338 J**		**NA**	**Y**	**N**	**N[4]**
PTX06-1137A	**2/21/2011**	**RDX**	**0.576 J**		**NA**	**Y**	**N**	**N[4]**
PTX06-1137A	2/21/2011	Boron	195 J	1	Y	NA	N	Y[1]
PTX06-1137A	**2/21/2011**	**PCE**	**0.59 U**		**NA**	**N**	**N**	**N[3]**
PTX-BEG2	2/22/2011	Boron	203	1	Y	NA	N	Y[1]
PTX06-1139-2	6/6/2011	Boron	195	1	Y	NA	N	Y[1]
PTX06-1140	6/16/2011	Boron	195	1	Y	NA	N	Y[1]
PTX06-1140-2	6/6/2011	Boron	198	1	Y	NA	N	Y[1]
PTX06-1140-3	6/23/2011	Boron	200	1	Y	NA	N	Y[1]
PTX06-1140-4	6/23/2011	Boron	199	1	Y	NA	N	Y[1]
PTX06-1144-2	6/27/2011	Boron	195	1	Y	NA	N	Y[1]
PTX06-1157	6/7/2011	Boron	195	1	Y	NA	N	Y[1]
PTX06-1157-2	6/7/2011	Boron	266	1.4	Y	NA	N	Y[1]
PTX06-1157-3	6/8/2011	Boron	225	1.2	Y	NA	N	Y[5]
PTX01-1012	7/28/2011	Boron	220	1.1	Y	NA	N	Y[1]
PTX06-1033	7/28/2011	Boron	248	1.3	Y	NA	N	Y[5]
PTX06-1043	8/8/2011	Boron	196	1	Y	NA	N	Y[1]
PTX06-1056	8/8/2011	Boron	236	1.2	Y	NA	N	Y[5]
PTX06-1064	7/28/2011	Boron	218	1.1	Y	NA	N	Y[1]
PTX06-1137A	7/28/2011	Boron	248	1.3	Y	NA	N	Y[1]
PTX06-1072	**7/11/2011**	**Toluene**	**1.05**		**NA**	**Y**	**N**	**N[6]**

Well ID	Sample Date	Analyte	Measured Value (µg/L)	Ratio MV/ Background	Above Background?	Above PQL?	Above GWPS?	Expected Condition?
PTX06-1072 Confirmation	9/8/2011	Toluene	<1		NA	N	N	NA
PTX06-1139	11/17/2011	Boron	213	1.1	Y	NA	N	Y[1]
PTX06-1140	11/17/2011	Boron	220	1.1	Y	NA	N	Y[1]

Background values for naturally occurring constituents from the *Risk Reduction Rule Guidance to the Pantex RFI* (PANTEXl).
PQL = Practical quantitation limit reported from the laboratory.
GWPS = Groundwater protection standard published in the *Record of Decision* (Pantex Plant and Sapere, 2008).
Well names with a numbered extension indicate the depth interval from which the sample was taken.
Wells with unexpected conditions are in bold.
[1] 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.
[2] This detection is considered to be a false positive as the total chromium value (5.39) is less that the hexavalent chromium value. This well will continue to be monitored according to the *SAP*.
[3] PCE was also detected in the associated method blank. These detections were qualified as non-detect.
[4] A confirmation sample was collected on April 18, 2011. The confirmation sample result was non-detect and did not verify the original detection.
[5] PTX06-1033 and 1056 are installed in deeper segments of the High Plains Aquifer, have consistently demonstrated boron concentrations above background established for the High Plains Aquifer, and are believed to be influenced by the lower Dockum formation. The background for the High Plains Aquifer of 194 ppb was set based on samples collected across the entire saturated thickness and may not be representative of samples collected at discrete intervals. Because of this, boron concentrations slightly above background are expected in deeper segments of the High Plains Aquifer.
[6] Toluene was detected slightly above the PQL in this sample. This well was resampled in accordance with CP-50284, and the toluene detection was not confirmed.

Several wells, including PTX01-1011, PTX06-1043, PTX06-1044, PTX06-1062A, PTX06-1056, PTX06-1064, PTX06-1137A, PTX06-1139, and PTX06-1140 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 also 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*. PTX06-1157 also exhibited boron concentrations above background values. PTX06-1056 and PTX06-1033, which are installed into the deeper zone of the High Plains Aquifer, have consistently demonstrated boron concentrations above background. The higher boron concentrations in these deeper wells are possibly due to influence of the lower Dockum formation. This Dockum formation influence is supported by the fact that boron concentrations increased with depth in several multi-level wells.

Hexavalent chromium was detected in PTX06-1044 at a concentration lower than the laboratory PQL and GWPS. The measured value of 8 µg/L was higher than the total chromium concentration of 5.49 µg/L for the same sampling event so this detection is considered to be a false positive, which is common with the current colorimetric method. Several wells had slight detections of organic compounds:

- Tetrachloroethene (PCE) was detected in PTX06-1068 and PTX06-1137A at concentrations below the laboratory PQL and GWPS. However, these two detections were qualified as non-detect due to similar concentrations found in the laboratory method blanks.

- RDX was detected at concentrations slightly above the laboratory PQL at PTX06-1072 and PTX06-1137A. Evaluation of field and laboratory methods revealed that cross contamination likely occurred either during sampling or during sample preparation at the laboratory. Corrective actions have been implemented to prevent recurrence. Confirmation sampling indicated that RDX is not present in either well. Pantex will continue to sample these wells according to the *SAP*.
- Toluene was detected at a concentration that slightly exceeded the PQL in PTX06-1072. The detection of 1.05 µg/L was well below the GWPS of 1,000 ug/L. The well was resampled and toluene was not detected in the confirmation sample. Pantex will continue to monitor this well according to the *SAP*.

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.

> **Natural Attenuation Processes**
>
> - Biodegradation – soil microbes can cause the contaminants to break down to less harmful products
> - Sorption – the contaminants are bound to soil particles so that movement through groundwater is stopped or is slower allowing time for other processes to work
> - Dispersion – the contaminants are dispersed through the groundwater as they move away from the source so that concentrations are diluted

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 the older portions of the TNT plume 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.

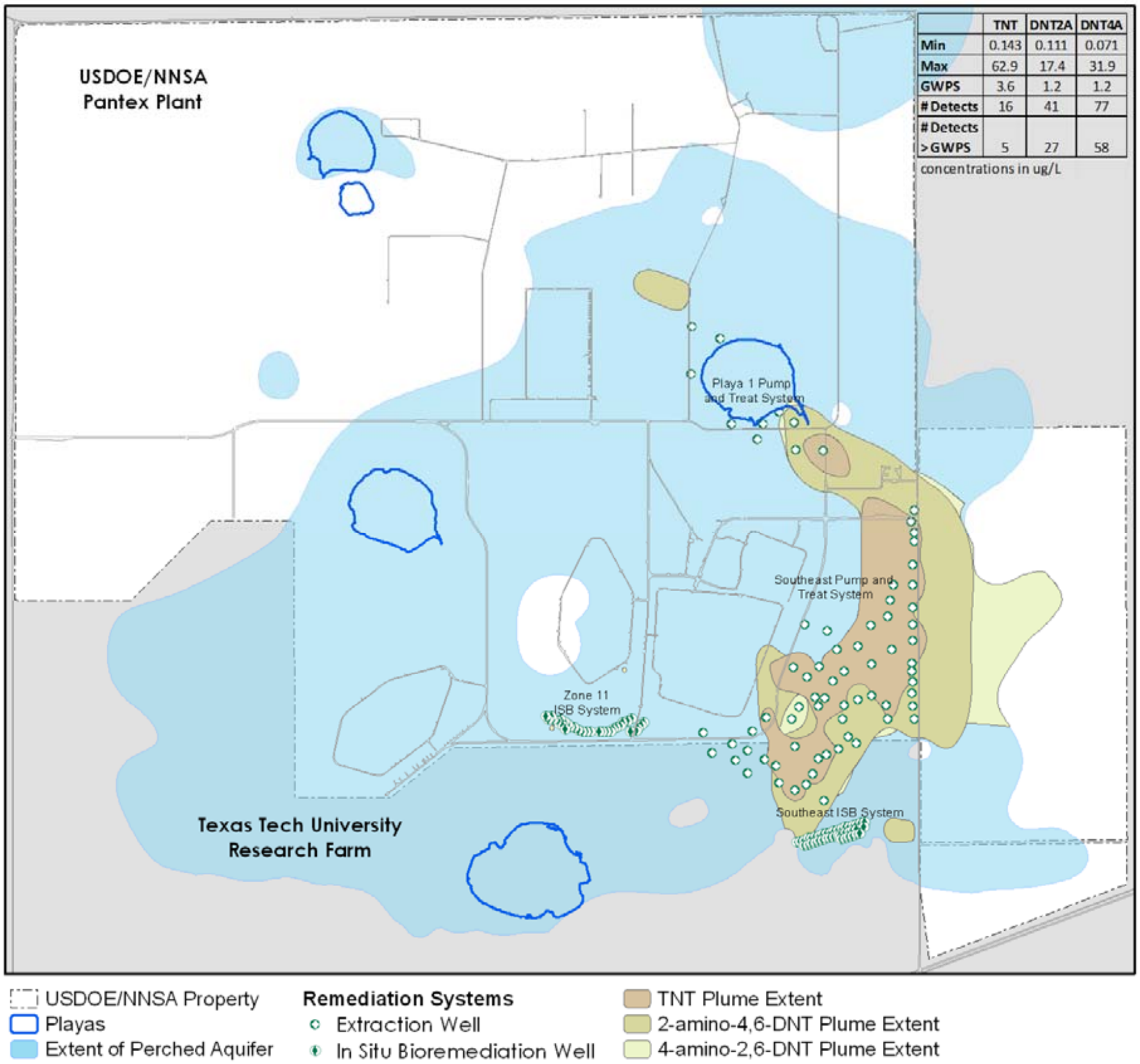

FIGURE 6.10 – *TNT and Degradation Product Plumes*

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.

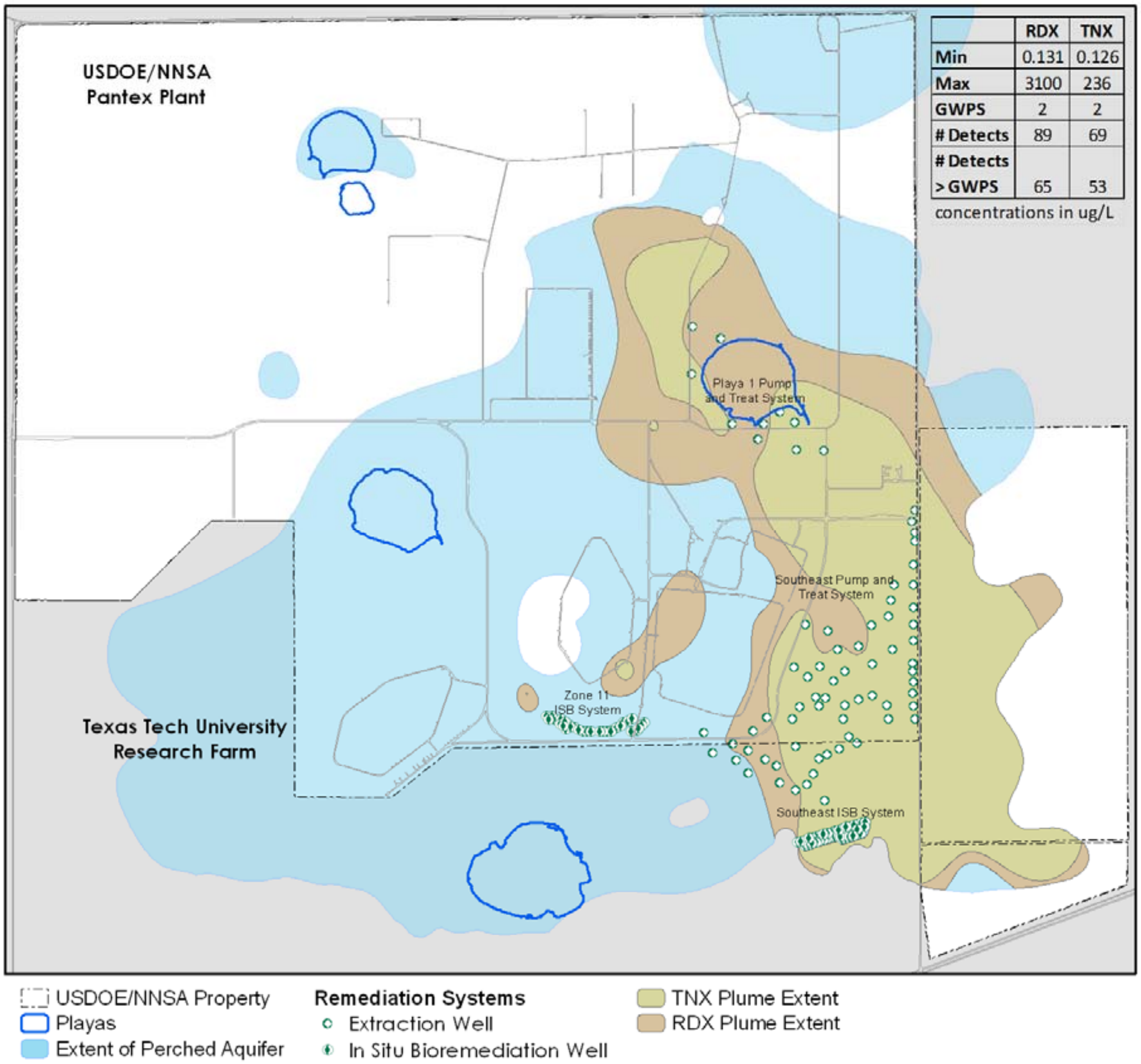

FIGURE 6.11 – ***RDX and Degradation Product Plumes***

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.

Drinking Water

Results from routine drinking water compliance monitoring in 2011 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

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 supply (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. In addition, the wells provide water to Texas Tech University for domestic and agricultural use. Before being transferred to the distribution system, all water is treated to provide disinfection protection throughout the system.

Samples from the drinking water system were collected and analyzed monthly for biological contaminants, and quarterly and/or annually for chemical and radiological contaminants identified in 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 2011 are listed in Appendix A. Sampling locations were chosen to meet regulatory requirements and to provide system operators with data that will assist their evaluation of the system's integrity.

7.2 New Requirements and Program Changes

During 2011, the Texas Commission on Environmental Quality (TCEQ) revised the rules for lead and copper monitoring and public notification rules. The revised rules require that all Public Water Systems (PWS) seek approval from the Executive Director to modify the monitoring location(s) and changes must be noted in the PWS's drinking water monitoring plan. In the event that the PWS exceeds the maximum permissible level for lead, and/or copper, the TCEQ issued new guidelines for making public notification.

7.3 Water Production and Use

In 2011, Pantex Plant pumped approximately 511 million liters (135 million gallons) from the Ogallala Aquifer. This is an increase of 105 million liters (28 million gallons) compared to water produced in 2010. The increase was due, in part, to the high-pressure fire-loop system upgrade project. This project consisted of replacement of two 410,000 gallon storage tanks and replacing several of the water lines. After each pipe segment was replaced, a system flow/pressure test was conducted. Testing involved the discharge of a significant amount of water. Completion of the system upgrade is scheduled for late 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 program effectiveness include the procurement of more efficient industrial cooling equipment such as water re-circulating systems.

7.4 Sampling

During 2011, a TCEQ contractor collected compliance samples for water quality parameters, herbicides, and pesticides from the Pantex water system. In addition, some samples were collected for non-regulated compounds. The purpose of non-regulated contaminant monitoring is to assist the EPA in determining whether future regulation is warranted.

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. Not all sampling locations are designated with the "DR[1]" code because the sampling locations are periodically changed to assure adequate Plant coverage.

7.5 Results

In general, results for drinking water monitoring in 2011 were similar to those reported for 2010. 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. Radiological monitoring results for 2011 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. All detected radiological constituents for 2011 were below the MCL.

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 2011 were within ranges observed in

[1] "DR" indicates an historic designation for drinking water monitoring locations.

TABLE 7.1 — *Drinking Water Sampling Locations, 2011*

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.

previous years. Table 7.2 shows a tabular representation of drinking water results from Pantex compared to the City of Amarillo, the City of Canyon, and regulatory limits under the Safe Drinking Water Act.

TABLE 7.2 — *Water Quality Comparison*

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo Average 2010 (latest results)	City of Canyon Max. 2006-2010 (latest results)	Pantex Water System Average 2011	*Typical Source or Effect*
Inorganics:						
Antimony	ppm	0.006	NS	NS	< 0.003	Discharge from petroleum refineries, fire retardants, ceramics, electronics and solder
Arsenic	ppm	0.05	NS	NS	0.003	Erosion of natural deposits, discharge from semiconductor manufacturing, petroleum refineries, herbicides and wood preserving
Barium	ppm	2	0.18 4	0.0805	0.120	Erosion of natural deposits, discharge from oil and gas drilling waste and metal refineries
Beryllium	ppm	0.004	NS	NS	< 0.0005	Discharge from metal refineries, coal-burning factories and aerospace and defense industries
Boron	ppm	NA	NS	NS	0.194	Erosion of natural deposits and discharge from detergent factories
Copper[a]	ppm	Action Level = 1.3 (for compliance samples)	90th percentile 0.11	90th percentile 0.11	90th percentile 0.24	Erosion of natural deposits, corrosion of plumbing and leaching from treated wood preservatives

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo Average 2010 (latest results)	City of Canyon Max. 2006-2010 (latest results)	Pantex Water System Average 2011	*Typical Source or Effect*
Chromium	ppm	0.1	0.0039	NS	< 0.004	Erosion of natural deposits, discharge from steel and/or pulp mills and plating operations
Fluoride	ppm	4	0.89	2.97	1.45	Erosion of natural deposits, discharge from aluminum and/or fertilizer factories and water treatment additives
Lead[a]	ppm	Action Level = 0.015 (for compliance samples)	90[th] percentile 0.0000012	90[th] percentile NS	90th percentile 0.005	Erosion of natural deposits and corrosion of plumbing materials
Nitrate	ppm	10	1.16	1.43	1.43	Runoff from feedlots and the use of fertilizer, leaching from septic systems and erosion of natural deposits
Nitrite	ppm	1	< 0.01	0.82	< 0.04	Runoff from feedlots and the use of fertilizer, leaching from septic systems and erosion of natural deposits
Selenium	ppm	0.05	0.0048	NS	0.0035	Discharge from petroleum refineries, erosion of natural deposits and discharge from mining operations
Thallium	ppm	0.002	NS	NS	< 0.0094	Leaching from ore-processing, discharge from electronics production and discharge from glass production industries
Biological:						

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo Average 2010 (latest results)	City of Canyon Max. 2006-2010 (latest results)	Pantex Water System Average 2011	*Typical Source or Effect*
Total Coliform		Action Level = more than 5% of samples show "positive"	5 samples (0.3%) showed “positive”	5 samples (0.3%) showed “positive”	No samples showed “positive”	Indicator organism for potential pathogens
Radionuclides: (avg.)						
Gross Alpha emitters	pCi/L	15	4.05	21.9	5.66	Naturally occurring elements found in the soil and man-made materials
Gross Beta photon emitters[b]	pCi/L	50	6.55	12.1	7.19	Naturally occurring elements found in the soil and man-made materials
Total Radium	pCi/L	5	0.1	1.4	NS	Naturally occurring elements found in the soil and man-made materials
Tritium	pCi/L	20,000	NS	NS	10.35	Naturally occurring elements found in the soil and man-made materials
Herbicides						
2,4-D	ppb	70	NS	NS	< 0.1	Agriculture
2,4,5-TP (Silvex)	ppb	50	NS	NS	< 0.2	Agriculture
Pentachlorophenol	ppb	1	NS	NS	< 0.04	Agriculture
Dalapon	ppb	200	NS	NS	< 1.0	Agriculture
Dinoseb	ppb	7	NS	NS	< 0.2	Agriculture
Pichloram	ppb	500	NS	NS	< 0.1	Agriculture
Secondary Contaminants:						
Aluminum	ppm	0.05 – 0.2	NS	NS	0.05	Naturally occurring elements found in the soil and man-made materials
Chloride	ppm	300	NS	37	14.58	Naturally occurring elements found in the soil

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo Average 2010 (latest results)	City of Canyon Max. 2006-2010 (latest results)	Pantex Water System Average 2011	*Typical Source or Effect*
Color	Color units	15	NS	NS	0.17	Amount of organic material in the water
Corrosivity	mm/year	Noncorrosive	NS	NS	0.15	A secondary parameter (non-health related) indicating the aggressiveness of water to corrode piping
Copper	ppm	1.0	0.11	NS	0.24	Erosion of natural deposits, corrosion of plumbing, leaching from treated wood
Iron	ppm	0.3	NS	0.611	0.084	Naturally occurring elements found in the soil
Manganese	ppm	0.05	NS	NS	< 0.002	Naturally occurring elements found in the soil
pH	S.U.	Greater than 7	NS	NS	7.5	A general measure of the acidity or alkalinity of water
Silver	ppm	0.1	NS	NS	<0.001	Naturally occurring elements found in the soil and man-made materials
Sulfate	ppm	300	NS	NS	21.8	Salty taste
Total Dissolved Solids	ppm	1,000	NS	465	297	Hardness, salty taste
Zinc	ppm	5	NS	NS	0.006	Metallic taste
Total Trihalomethanes: samples taken at DR-115						
Chloroform	ppm	- -	0.0035	0.0042	0.0 0.0032	By-product of chlorination
Bromodichloromethane	ppm	- -	0.0077	0.0055	0.0008	By-product of chlorination
Chlorodibromomethane	ppm	- -	0.0128	NS	0.0065	By-product of chlorination
Bromoform	ppm	- -	0.0066	0.0016	0.0013	By-product of chlorination
Sum of all TTHMs	ppm	**0.08**	**0.03**	**0.04**	**0.03**	By-products of chlorination

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo Average 2010 (latest results)	City of Canyon Max. 2006-2010 (latest results)	Pantex Water System Average 2011	*Typical Source or Effect*
Pesticides:						
Aldicarb	ppb	- -	NS	NS	< 0.5	Pesticide
Aldicarb Sulfone	ppb	- -	NS	NS	< 0.8	Pesticide
Aldicarb Sulfoxide	ppb	- -	NS	NS	< 0.5	Pesticide
Carbofuran	ppb	40	NS	NS	< 0.9	Pesticide
Oxamyl	ppb	200	NS	NS	< 2.0	Pesticide
Baygon	ppb	- -	NS	NS	< 2.0	Pesticide
Carbaryl	ppb	- -	NS	NS	< 2.0	Pesticide
3-Hydroxycarbofuran	ppb	- -	NS	NS	< 2.0	Pesticide
Methiocarb	ppb	- -	NS	NS	< 4.0	Pesticide
Methomyl	ppb	- -	NS	NS	< 2.0	Pesticide
Total Haloacetic Acids: samples taken at DR-115						
Monochloroacetic Acid	ppm	- -	NS	NS	0.0032	By-Product of Chlorination
Monobromoacetic Acid	ppm	- -	NS	NS	0.0009	By-Product of Chlorination
Trichloroacetic Acid	ppm	- -	NS	NS	0.0006	By-Product of Chlorination
Dibromoacetic Acid	ppm	- -	NS	NS	0.0007	By-Product of Chlorination
Dichloroacetic Acid	ppm	- -	NS	NS	0.0015	By-Products of Chlorination
Sum of all HA Acids:	ppm	**0.06**	**0.0083**	**0.0078**	**0.039**	By-Products of Chlorination
Water Quality Constituents:						
Alkalinity	ppm	- -	NS	288	228	Naturally occurring elements found in the soil
Calcium Hardness	ppm	- -	NS	NS	216	Naturally occurring elements found in the soil
Chlorine	ppm	0.2 min. 4.0 max.	0.26 min 2.1 max	0.26 min. 2.1 max.	0.7 min. 2.08 max.	Liquid chlorine used as a disinfectant
Non-Regulated Constituents:						
1,2,3-Trichloropropane	ppb	- -	NS	NS	<0.05	CCL
Acifluorfen	ppb	- -	NS	NS	<1.0	CCL
Bentazon	ppb	- -	NS	NS	<2.0	CCL
Chloramben	ppb	- -	NS	NS	<1.0	CCL
2,4-DB	ppb	- -	NS	NS	<2.0	CCL
Dicamba	ppb	- -	NS	NS	<1.0	CCL

Substance or Contaminant	Unit of Measure	Maximum Contaminant Level	City of Amarillo Average 2010 (latest results)	City of Canyon Max. 2006-2010 (latest results)	Pantex Water System Average 2011	*Typical Source or Effect*
3,5-Dichlorobenzoic acid	ppb	- -	NS	NS	<1.0	CCL
Dichlorprop	ppb	- -	NS	NS	<2.0	CCL
Quinclorac	ppb	- -	Ns	NS	<1.0	CCL
2,4,5-T	ppb	- -	NS	NS	<0.5	CCL
Notes:						
[a] 90th percentile value as defined by the TCEQ.						
[b] Primary MCL for the annual dose equivalent to the total body or to any internal organ. Compliance with this MCL is assumed if gross beta particle activity is less than 50 pCi/L, and if average annual concentration of tritium is less than 20,000 pCi/L and strontium-90 is less than 8 pCi/L.						
Action Level = The concentration of a contaminant that triggers a treatment technique requirement.						
CCL = EPA's Contaminant Candidate List used to determine if regulatory limits are necessary.						
Treatment Technique = If a contaminant exceeds the Action Level, EPA may require the system to use a treatment technique that will reduce the level of a contaminant(s) in drinking water.						
NS = No samples taken						
ND = Not detected						
ppm = Parts per million (milligrams/liter)						
ppb = Parts per billion (micrograms/liter)						
S.U. = Standard Units for powers of hydrogen						

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 compliance monitoring frequency for lead and copper was reduced from annual sampling to triennial sampling in 1997. However, as a best management practice, Pantex conducts annual monitoring for lead and copper in the drinking water system.

Two samples were slightly above the Action Level of 0.015 mg/L for lead. This is likely due to aging plumbing materials such as solder, or insufficient water consumption/usage at the sampling location. The two elevated results were 0.061 and 0.017 mg/L. Corrective measures to replace a waterline are underway.

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.

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). 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 July, the TCEQ Region 1 office conducted a Comprehensive Compliance Inspection of the Pantex Public Drinking Water system. Results of the investigation concluded that Pantex Plant meets or exceeds applicable state and federal requirements related to Public Water Supply Systems.

Wastewater

Pantex operates an onsite 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. Additionally, the plant maintains on-site sewage facilities (OSSF or Septic Systems) to manage domestic-type wastewaters from locations that are not connected to the Plant's wastewater collection system.

8.1 The Scope of the Program

Domestic and industrial wastewaters generated at Pantex Plant are treated in an onsite 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[1] to an underground irrigation system or discharged through a permitted outfall to an onsite 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 (during a wet season 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 that covers an area the same size 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.

[1] 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).

FIGURE 8.4 — *Wastewater Storage Lagoon*

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 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.

8.2 Operational Description and Metrics

The TCEQ is the permitting authority for wastewater discharges. During 2011, 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). 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). In addition, Pantex maintains a Texas Water

Quality Permit that allows it to discharge treated wastewater to an on-site playa (WQ0002296000). Together, through compliance with these three authorizations, the Department of Energy and B&W Pantex manage and discharge treated effluent in a manner that protects 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 three 100-acre tracts of land. Fertilizers and maintenance chemicals are injected into the system through chemical tanks (Figure 8.5). This irrigation system consists of more than 700 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 2011, B&W Pantex beneficially applied approximately 201.9 million gallons of treated wastewater to crops managed by TTU (Figure 8.6). This is a decrease of 19 million gallons compared to operations during 2010. This decrease in volume is a result of construction activities associated with upgrades to the existing 300 acres and addition of a new 100-acre tract. It is anticipated that the new tract will be operational in 2012.

FIGURE 8.6 — Irrigation Tract 101

Since 2004, Pantex has beneficially reused more than 900 million gallons of treated wastewater (i.e., domestic, industrial and treated water from Environmental Restoration activities) for crop production. During 2011, opportunity wheat, winter wheat and sorghum were grown. Table 8.1 shows the volume of water applied for each irrigation tract.

TABLE 8.1— *Annual Irrigation Summary, 2011*

Irrigation Tract	Irrigation Area (acres)	Volume Applied (gallons)	Volume Applied (acre ft./ac)
101	100.86	100,273,272	3.05
201	100.5	76,670,331	2.34
301	98.75	24,969,547	0.78

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. When using the irrigation system, water quality monitoring was conducted after treatment and filtration at Outfall 031 in accordance with the land application permit. During 2011, 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 December 2011. There were no exceedances under either permit. A summary of the results from 2011 is shown in Table 8.2.

TABLE 8.2 — *Water Quality Results from Outfall 031, 2011*

Analyte	TLAP Limits (mg/L) (Max)	Minimum Conc. (mg/L)	Maximum Conc. (mg/L)	Average Conc. (mg/L)	Permit Exceedance/ Violation	Percent Compliance
Antimony	Report	0.001	< 0.003	< 0.003	0/0	100
Arsenic	0.3	0.002	< 0.005	< 0.005	0/0	100
Beryllium	Report	0.0001	< 0.0005	< 0.0005	0/0	100
Cadmium	0.2	ND	ND	ND	0/0	100
Chromium	5.0	0.001	0.003	< 0.005	0/0	100
Cobalt	Report	ND	ND	ND	0/0	100
Copper	2.0	0.008	0.242	0.069	0/0	100
Lead	1.5	0.001	0.004	0.001	0/0	100
Manganese	3.0	0.012	0.035	0.020	0/0	100
Mercury	0.01	ND	ND	ND	0/0	100
Molybdenum	Report	0.004	< 0.010	< 0.010	0/0	100
Nickel	3.0	0.002	0.004	0.003	0/0	100
Selenium	0.2	0.001	0.003	0.002	0/0	100
Silver	0.2	0.002	< 0.005	< 0.005	0/0	100
Thallium	Report	0.0003	0.0005	0.0004	0/0	100
Titanium	Report	0.001	0.005	0.003	0/0	100
Zinc	6.0	0.004	0.013	0.006	0/0	100
HMX	Report	ND	ND	ND	0/0	100
RDX	Report	ND	ND	ND	0/0	100
PETN	Report	ND	ND	ND	0/0	100

Analyte	TLAP Limits (mg/L) (Max)	Minimum Conc. (mg/L)	Maximum Conc. (mg/L)	Average Conc. (mg/L)	Permit Exceedance/ Violation	Percent Compliance
TNT	Report	ND	ND	ND	0/0	100
Ammonia	Report	0.028	1.450	0.622	0/0	100
BOD	Report	8.3	51.0	19.2	0/0	100
COD	Report	12.0	80.0	44.5	0/0	100
NO2/NO3	Report	0.07	0.49	0.17	0/0	100
Oil/Grease	Report	1.71	4.78	2.62	0/0	100
PH	6.0 Min. 10.0 Max.	8.0	8.7	8.4	0/0	100
Total Cyanide	Report	ND	ND	ND	0/0	100
Note: An exceedance is defined as a measured value above or below a permit limit. A violation is defined as a missing permit parameter. For example, failure to obtain a permit-required sample. ND= Not detected.						

Approximately 410 water analyses were accomplished for permit-required samples taken from Outfall 031, with no reported violations. All sample results were below any effluent limitations established in the Land Application Permit. As a best management practice and for process control, an additional 36 samples were collected from the influent weir and another 13 samples were collected for miscellaneous (non-permitted) constituents. These efforts provide information on the treatment capability and efficiency of the wastewater treatment system. Results from 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.

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Surface Water

Data from the surface water program during 2011, while limited, 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 2011.

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 onsite 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 on the outer perimeter of the facility site flows to offsite 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*

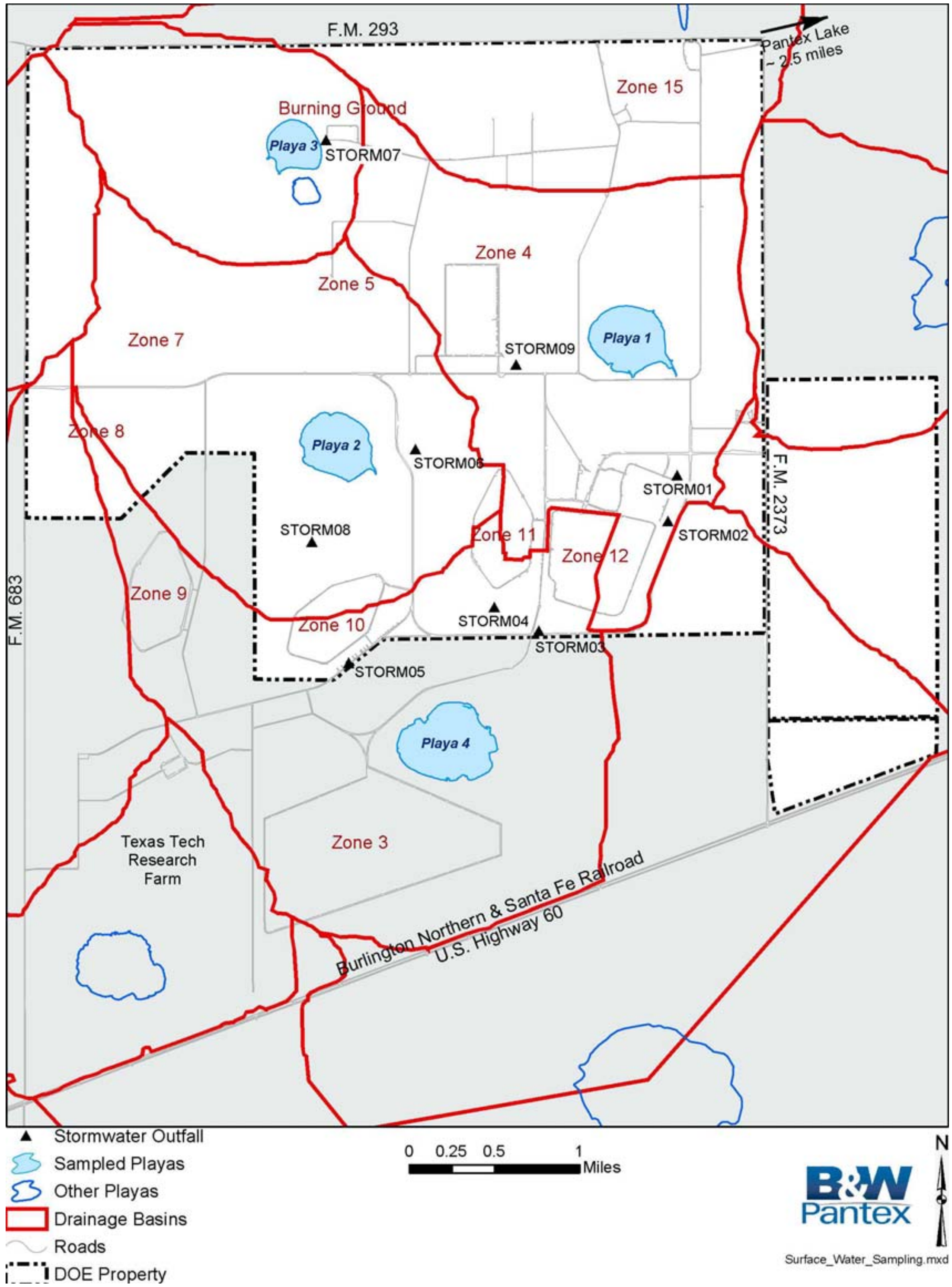

FIGURE 9.2 — ***Drainage Basins, Playas, and Storm Water Outfalls at Pantex Plant***

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 2011, storm water and playa sampling were conducted in accordance with permits issued by the Texas Commission on Environmental Quality (TCEQ) and Data Quality Objectives developed by B&W Pantex media scientists.

Storm water runoff at Pantex Plant is sampled in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Multi-Sector General Permit (MSGP) for storm water. The MSGP was issued in August of 2006 and expired in August 2011. The TCEQ reissued the MSGP in 2011. B&W Pantex filed for coverage under the new MSGP in November of 2011. The new permit expires in August 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 State of Texas was delegated permitting authority for construction storm water discharges from the U.S. Environmental Protection Agency. Therefore, the TCEQ developed a 5-year general permit (TPDES General Permit No TXR 150000, relating to storm water discharges associated with construction activities. The general permit expires in March 2013. Under this permit, three TPDES construction project specific permits were in effect at Pantex at the end of 2011. 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.

B&W Pantex conducted surface water monitoring during 2011 at designated sampling locations in accordance with permit requirements. Environmental surveillance monitoring was also conducted at selected locations as a best management practice. Appendix A lists the 2011 surface water analytes.
In addition to routine sampling at four onsite 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 the subsurface drip irrigation system on the Pantex site.

During 2011, sampling was conducted at four of eight storm water outfalls and at three of six playa lakes found on DOE-owned and -leased land. Based on data from the Amarillo National Weather Service (NWS) located northeast of Amarillo and southwest of Pantex Plant, rainfall during 2011 was dramatically below normal with approximately 17.78 cm for the year (7.0 inches). Rainfall for Amarillo in 2011 was the lowest ever recorded since the NWS began tracking rainfall in 1880. The annual average amount each year is typically 50.1 cm (19.71 inches). The drought during 2011 was not a localized event but included parts of New Mexico, Colorado, Kansas, Oklahoma, and the entire State of Texas.

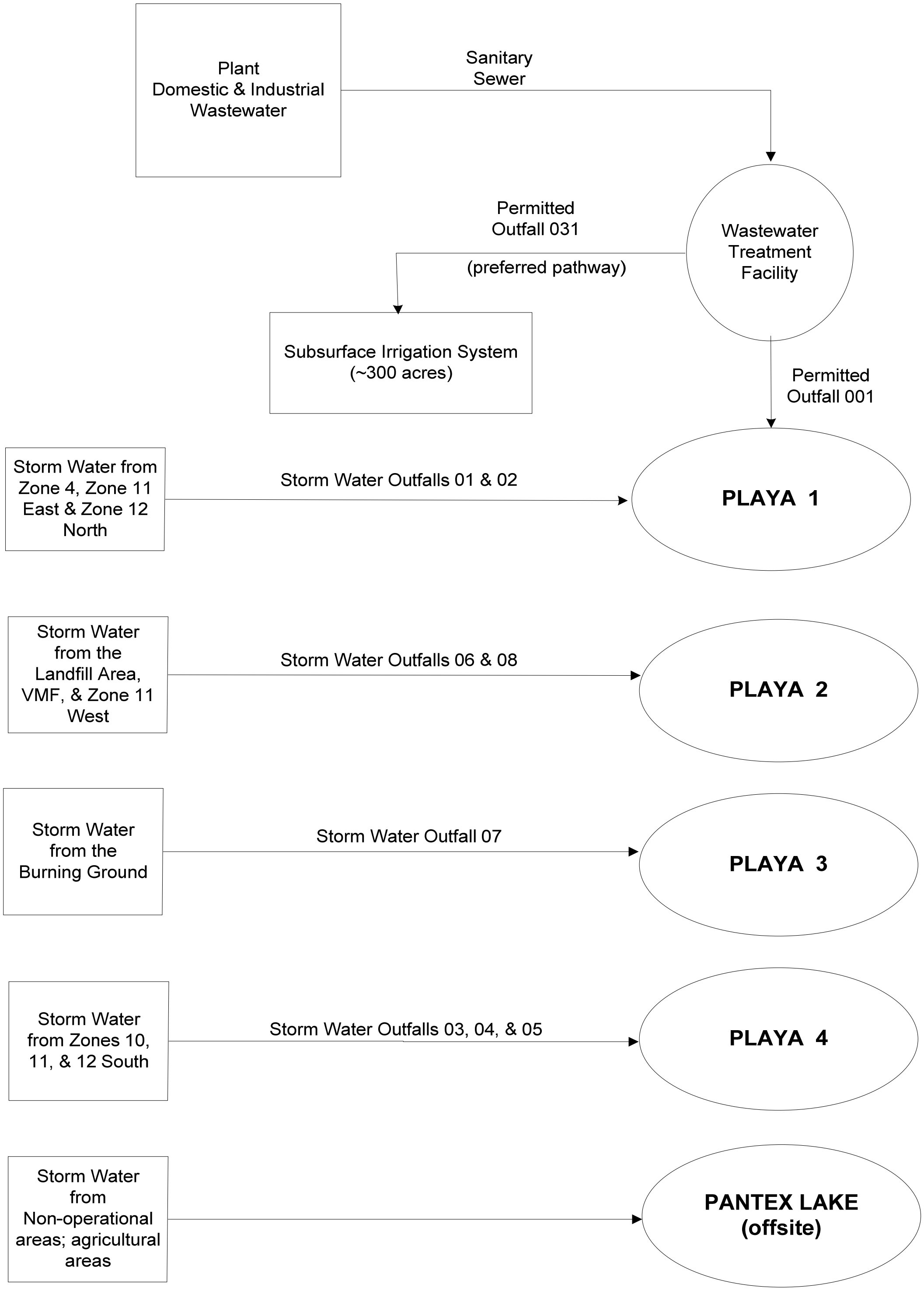

FIGURE 9.3 — *Pantex Surface Water Schematic, 2011*

Storm water monitoring required by the TPDES MSGP in 2011 consisted of both visual monitoring and analytical monitoring. Both are required each year of 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 2011 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 2011 and compares them with the IWQPs.

TABLE 9.1 — *Annual Storm Water Results (metals), 2011 (mg/L)*

	Outfall STORM01	Outfall STORM02	Outfall STORM03	Outfall STORM04	Outfall STORM05	Outfall STORM06	Outfall STORM07	Outfall STORM08	IWQP
Arsenic	<0.005	NS	0.003	NS	<0.005	<0.005	NS	NS	**0.3**
Barium	0.035	NS	0.183	NS	0.034	0.163	NS	NS	**4.0**
Cadmium	<0.001	NS	0.0001	NS	<0.001	0.0002	NS	NS	**0.2**
Chromium	<0.010	NS	0.006	NS	<0.010	<0.010	NS	NS	**5.0**
Copper	0.003	NS	0.005	NS	0.002	0.008	NS	NS	**2.0**
Lead	<0.002	NS	0.001	NS	<0.002	0.001	NS	NS	**1.5**
Manganese	0.015	NS	0.033	NS	0.004	0.066	NS	NS	**3.0**
Mercury	<0.0002	NS	<0.0002	NS	<0.0002	<0.0002	NS	NS	**0.01**
Nickel	0.002	NS	0.003	NS	0.0008	0.005	NS	NS	**3.0**
Selenium	<0.005	NS	0.003	NS	<0.005	<0.005	NS	NS	**0.2**
Silver	<0.001	NS	<0.001	NS	<0.001	<0.001	NS	NS	**0.2**
Zinc	0.008	NS	0.016	NS	<0.010	0.026	NS	NS	**6.0**

IWQP= Inland Water Quality Parameter limits, 30 TAC §319.22
NS = No Sample Taken

Environmental surveillance sampling was conducted at three onsite playas for both radiological and non-radiological constituents. In addition to Pantex's playa sampling program, radiological co-sampling is performed at select playas in coordination with the Texas Department of State Health Services (TDSHS). Pantex performs confirmation co-samples at the playas with the TDSHS during each of their visits throughout the year.

Radiological sampling at the playas included isotopic uranium ($^{233/234}U$, $^{235/236}U$, ^{238}U) and plutonium (^{238}Pu, $^{239/240}Pu$), as well as tritium (^{3}H). Isotopic radiological analyses were compared to Derived Concentration Guides (DCGs) for water. Tritium analyses were compared to the Maximum Contaminant Levels (MCLs) for drinking water. Specific analytes detected are described in subsequent sections of this chapter.

Non-radiological sampling at the playas during 2011 included a dozen different metals, approximately 60 different volatile organic compounds (VOCs), 60 semi-volatile organic compounds (SVOCs), and a suite of 15 different explosives. Results of metal analyses were compared to IWQPs and with historical values. VOCs, SVOCs, and explosives were measured against their respective Practical Quantitation Limits (PQLs) and were also compared to historic results.

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 (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 2011, storm water monitoring within the Playa 1 basin was conducted in the playa and at Storm Water Outfall 01. Playa 1 was sampled in the first quarter during 2011 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. Explosives, VOCs, and SVOCs were below their respective PQLs. Radiological sampling conducted at Playa 1 during 2011 involved co-sampling with the TDSHS during the month of January. Tritium was below the MCL for drinking water. Isotopic radiological analyses for uranium and plutonium were below the DCGs for ingested water.

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 third and fourth quarters of 2011. Activities 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 2011.

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. No monitoring was performed at Storm Water Outfall 02 during 2011 due to extremely dry conditions that persisted for the entire year.

9.2.2 Playa 2 Basin

Playa 2 is approximately 30 hectares (74 acres) in size and receives only storm water runoff. Playa 2 receives runoff from the west side of Zone 11, the north side of Zone 10, and an area of agricultural fields that includes both pasture and cultivated fields. Because of the drought in 2011, storm water monitoring within the Playa 2 basin was conducted only at Storm Water Outfall 06.

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 recently re-paved lot used for parking and staging vehicles on the south side of the VMF.

Monitoring at Storm Water Outfall 06 was conducted during the first, third, and fourth quarters of 2011. 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 2011.

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 over closed cells. Storm water from this area eventually flows on northward to Playa 2. Because of drought conditions in 2011, no sampling was performed at Storm Water Outfall 08.

FIGURE 9.5 — *Storm Water Outfall 08*

9.2.3 Playa 3 Basin

Playa 3, the smallest playa at the Pantex site, is approximately 22 hectares (54 acres) in size and receives only storm water runoff. Playa 3 receives 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 northeast of Playa 3 between the playa and the Pantex Burning Ground.

Playa 3 was co-sampled with TDSHS in the first quarter of 2011 for radionuclides only. Tritium was below the MCL for drinking water. Isotopic radiological analyses for uranium and plutonium were below the DCGs for ingested water.

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. Because of drought conditions during 2011, no sampling was performed at Storm Water Outfall 07.

9.2.4 Playa 4 Basin

Playa 4 is approximately 46 hectares (112.5 acres) in size 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 operational areas on the Pantex site. The playa receives discharges 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 potable water when flushing the Fire Department's storage tanks or testing fire hydrants. In 2011, storm water monitoring was conducted in the playa and within the basin at Storm Water Outfalls 03 and 05.

Playa 4 was sampled in the first quarter during 2011 for metals, VOCs, SVOCs, explosives, and radionuclides. Metals analyses at Playa 4 were all consistent with historic levels found at the playa and all metals were below the IWQPs. VOCs, SVOCs, and explosives were below their respective PQLs. Radiological sampling conducted at Playa 4 during 2011 included co-sampling with the TDSHS during the month of January. Tritium was below the MCL for drinking water. Isotopic radiological analyses for uranium and plutonium were below the DCGs for ingested water.

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 that flows to Playa 4 (Figure 9.6). Three drainages along the Plant boundary with TTU, draining the southern portions of Zones 11 and 12, convey most of the water from Zones 11 and 12 to Playa 4. Periodically, potable water from the Plant's fire protection system is discharged through this outfall. There are no industrial effluents discharged through this outfall.

FIGURE 9.6 — *Storm Water Outfall 03*

Permit-required monitoring at Storm Water Outfall 03 was conducted during the first and fourth quarters of 2011. 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 2011.

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 to Playa 4 (Figure 9.7). There are no industrial effluents discharged through this outfall. Because of drought conditions in 2011, no monitoring at Storm Water Outfall 04 was conducted.

FIGURE 9.7 — *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 third and fourth quarter of 2011. Activities 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 2011.

9.2.5 Pantex Lake

Pantex Lake is the largest playa controlled by the DOE and B&W Pantex 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. 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 historical wastewater discharges. There are no monitored storm water outfalls in the Pantex Lake basin. Since there are no Plant operations within the Pantex Lake watershed and a significant amount of historical data has been collected, monitoring at Pantex Lake was discontinued in 2004.

9.3 Historical Comparisons

Limited storm water sampling data was available because of extremely dry conditions during the year. Sampling results from storm water outfalls that were available during 2011 showed no significant changes during the year and were consistent with historical data from past years. All monitoring results for metals are within the IWQP established by the State of Texas. Total suspended solids and total petroleum hydrocarbons reflect similar results to 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.

Playa sampling results that were obtained during 2011 were very similar with past monitoring results. Metals, explosives, VOCs, SVOCs, and radionuclides remain relatively unchanged at the playas. This information continues to support the conclusion that operations at Pantex Plant do not have a negative impact on the water quality of the playas.

9.4 Conclusions

Monitoring storm water runoff and the playa lakes at Pantex Plant is performed as required by State environmental permits and as a best management practice. The surface water monitoring program at Pantex Plant continues to provide data that reinforces the premise that continuing Plant operations is having no detrimental impact to the quality of the surface waters at the Plant.

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Soils

Results of permit required soil monitoring are reported in this chapter. Results of soil monitoring conducted at the Burning Ground in 2011 were, with one exception, within established background comparison values. Results of soil monitoring conducted at the subsurface irrigation site were consistent with previous year's results and indicate operations are having no negative impact to the environment.

10.1 The Scope of the Program

This chapter presents the results of permit required soil sampling at Pantex Plant during 2011. 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 at three subsurface irrigation tracts and analyzed for various parameters in accordance with Provision V.I of the Pantex Plant Texas Land Application Permit (Permit WQ0004397000). All samples were analyzed by offsite 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 2011, 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 2011, soil was sampled at five onsite 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 composited to form individual 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 ten metals (See the "BG Soil" column in Appendix A). With the exception of mercury at sampling location BG-SS-C1, all sampling results for metals in 2011 were below the established background concentrations (Tables 10-1 through 10-5). The initial Burning Ground soil sampling results indicated a potential statistically significant increase (SSI) for mercury (0.36 mg/kg). The established background concentration is 0.29 mg/kg for mercury at this location (BG-SS-C1). The result from confirmation sampling, as provided for in Permit HW-50284, was 0.29 mg/kg for mercury, which is the established background value at location BG-SS-C1.

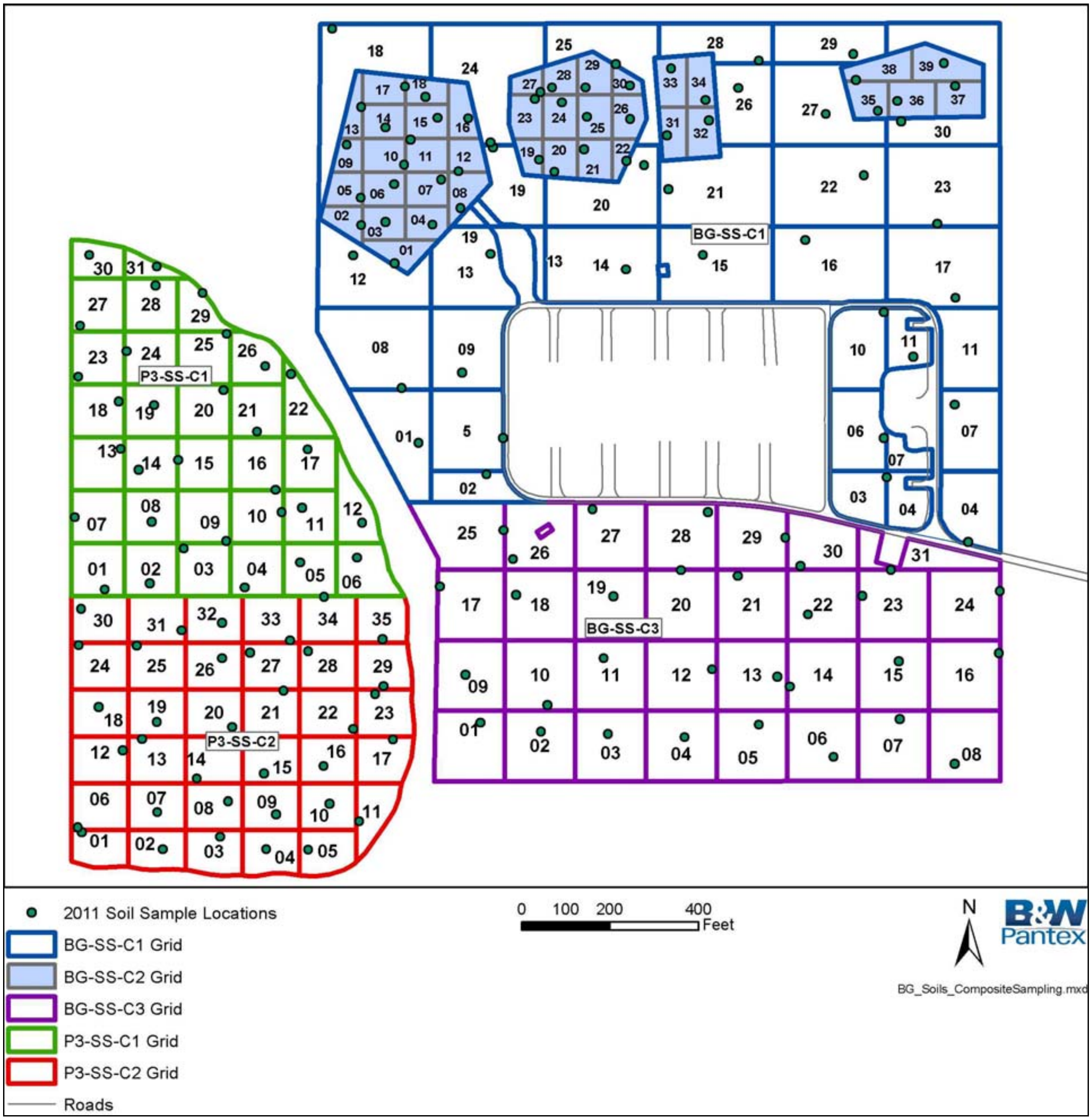

FIGURE 10.1 — ***Burning Ground Multi-Incremental Soil Sampling Locations for 2011***

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 2011 were below the established permit background concentrations.

TABLE 10.1 — *Calendar Year 2011 Monitoring Results at Location BG-SS-C1 (in mg/kg)*

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Silver (Ag)	3.20	8.42	No
Boron (B)	< 15.00	50.00	No
Cadmium (Cd)	0.84	1.00	No
Cobalt (Co)	7.10	17.55	No
Chromium (Cr)	16.30	19.93	No
Copper (Cu)	18.80	67.34	No
2,4-dinitrotoluene (DNT24)	< 0.22	0.50	No
2,6-dinitrotoluene (DNT26)	< 0.12	0.50	No
Mercury (Hg) [1]	0.29	0.29	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	170.00	858.24	No
Nickel (Ni)	15.80	29.76	No
Lead (Pb)	20.90	54.76	No
Pentaerythritol tetranitrate (PETN)	< 0.48	5.00	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	2.30	2.60	No
Triaminonitrobenzene (TATB)	11.00	23.25	No
1,3,5-trinitrobenzene (TNB135)	< 0.12	10.00	No
Trinitrotoluene (TNT)	< 0.12	10.00	No
Zinc (Zn)	77.10	160.58	No

[1] Results from confirmation sample. Initial sample results were 0.36 mg/kg.

TABLE 10.2 — *Calendar Year 2011 Monitoring Results at Location BG-SS-C2 (in mg/kg)*

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Silver (Ag)	0.18	1.00	No
Boron (B)	< 15.00	50.00	No
Cadmium (Cd)	0.24	1.00	No
Cobalt (Co)	6.80	8.77	No
Chromium (Cr)	16.10	16.23	No
Copper (Cu)	21.20	75.38	No
2,4-dinitrotoluene (DNT24)	< 0.22	0.50	No
2,6-dinitrotoluene (DNT26)	< 0.12	0.50	No
Mercury (Hg)	0.018	0.20	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	< 0.12	1.00	No
Nickel (Ni)	13.70	24.53	No

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Lead (Pb)	14.50	77.82	No
Pentaerythritol tetranitrate (PETN)	< 0.48	5.00	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	< 0.12	1.00	No
Triaminonitrobenzene (TATB)	0.081	3.00	No
1,3,5-trinitrobenzene (TNB135)	< 0.12	10.00	No
Trinitrotoluene (TNT)	< 0.12	10.00	No
Zinc (Zn)	86.50	317.32	No

TABLE 10.3 — ***Calendar Year 2011 Monitoring Results at Location BG-SS-C3 (in mg/kg)***

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Silver (Ag)	0.39	1.00	No
Boron (B)	< 15.00	50.00	No
Cadmium (Cd)	0.60	1.00	No
Cobalt (Co)	7.20	18.68	No
Chromium (Cr)	16.40	28.96	No
Copper (Cu)	17.60	53.84	No
2,4-dinitrotoluene (DNT24)	< 0.22	0.50	No
2,6-dinitrotoluene (DNT26)	< 0.12	0.50	No
Mercury (Hg)	0.054	0.20	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	60.00	367.10	No
Nickel (Ni)	14.20	30.88	No
Lead (Pb)	20.50	54.88	No
Pentaerythritol tetranitrate (PETN)	< 0.48	5.00	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	1.40	1.80	No
Triaminonitrobenzene (TATB)	7.40	26.86	No
1,3,5-trinitrobenzene (TNB135)	< 0.12	10.00	No
Trinitrotoluene (TNT)	< 0.12	10.00	No
Zinc (Zn)	66.20	168.00	No

TABLE 10.4 — *Calendar Year 2011 Monitoring Results at Location P3-SS-C1 (in mg/kg)*

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Silver (Ag)	0.14	1.00	No
Boron (B)	< 15.00	50.00	No
Cadmium (Cd)	0.50	1.00	No
Cobalt (Co)	7.00	35.78	No
Chromium (Cr)	19.20	36.35	No
Copper (Cu)	18.70	44.21	No
2,4-dinitrotoluene (DNT24)	< 0.22	0.50	No
2,6-dinitrotoluene (DNT26)	< 0.12	0.50	No
Mercury (Hg)	0.038	0.20	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	< 0.12	1.00	No
Nickel (Ni)	16.00	43.38	No
Lead (Pb)	19.70	54.13	No
Pentaerythritol tetranitrate (PETN)	< 0.48	5.00	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	< 0.12	1.00	No
Triaminonitrobenzene (TATB)	< 0.12	3.00	No
1,3,5-trinitrobenzene (TNB135)	< 0.12	10.00	No
Trinitrotoluene (TNT)	< 0.12	10.00	No
Zinc (Zn)	72.80	129.75	No

TABLE 10.5 — *Calendar Year 2011 Monitoring Results at Location P3-SS-C2 (in mg/kg)*

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Silver (Ag)	0.12	1.00	No
Boron (B)	< 15.00	50.00	No
Cadmium (Cd)	0.42	1.00	No
Cobalt (Co)	7.60	37.21	No
Chromium (Cr)	19.20	49.34	No
Copper (Cu)	17.50	43.93	No
2,4-dinitrotoluene (DNT24)	< 0.22	0.50	No
2,6-dinitrotoluene (DNT26)	< 0.12	0.50	No
Mercury (Hg)	0.028	0.20	No
Octahyro-1,3,5,7-tetranitro-1,3,5,7-tetraazozine (HMX)	0.071	1.00	No
Nickel (Ni)	16.40	53.18	No
Lead (Pb)	18.80	24.41	No

Constituent (IRPIMS Code)	2011 Monitoring Result	Background Comparison Level	2011 Monitoring Result Exceeds Background?
Pentaerythritol tetranitrate (PETN)	<0.48	5.00	No
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	<0.12	1.00	No
Triaminonitrobenzene (TATB)	<0.12	3.00	No
1,3,5-trinitrobenzene (TNB135)	<0.12	10.00	No
Trinitrotoluene (TNT)	<0.12	10.00	No
Zinc (Zn)	67.60	139.91	No

10.3 Subsurface Drip Irrigation System Soil Sampling and Analysis

In 2011, the annual TLAP subsurface drip irrigation system soil samples were collected from three locations, Tract 101, Tract 201, and Tract 301, with each tract representing no more than 100 acres. Samples were collected individually at zones of 0-6, 6-18, and 18-30 inches, with each composite sample consisting of 18 subsamples. These composite samples were analyzed for agricultural parameters, high explosives, metals, reactivity, herbicides, pesticides, semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs). See the TLAP Soil column in Appendix A for specific analytes.

10.3.1 Subsurface Drip Irrigation System Soil Sampling Results

The 2011 subsurface soil sampling results for high explosives, SVOCs, VOCs, reactivity, herbicides, and pesticides, were all non-detects. The results of the agricultural parameters (nutrient parameters analyzed on a plant available or extractable basis) and metals are presented in Tables 10.6 through 10.8. 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

With the exception noted for the initial mercury results, onsite Burning Ground surface soil monitoring results for 2011 were within the concentration ranges of the established background levels. Results of soil monitoring conducted at the subsurface irrigation site were consistent with previous year’s results and indicate operations are having no negative impact to the environment.

TABLE 10.6 — *TLAP Soil Results from Tract 101*

Analyte	6-Inch Depth Measured Value	18-Inch Depth Measured Value	30-Inch Depth Measured Value	Unit of Measurement
Agricultural Parameters				
pH (1:1 ratio soil pH)	7.4	7.7	8.0	pH Units
Conductivity (S Salts 1:1)	0.53	0.63	0.67	MMHOS/CM
Nitrate (as Nitrogen)	4.9	4.5	15.4	MG/L
Ortho Phosphate	15.0	9.0	3.0	MG/L
Potassium	600.0	414.0	335.0	MG/L
Sulfur	15.0	8.0	10.0	MG/L
Calcium	3,670.0	5,498.0	5,276.0	MG/L
Magnesium	575.0	901.0	852.0	MG/L
Sodium	77.0	162.0	177.0	MG/L
Boron	1.74	1.01	1.08	MG/L
Total Nitrogen	995.0	749.0	439.0	MG/L
Sodium Absorption Ratio (SAR)	1.2	1.8	2.2	
Metals				
Arsenic	3.73	4.03	3.7	MG/KG
Barium	145.0	152.0	153.0	MG/KG
Cadmium	0.51	0.45	0.41	MG/KG
Chromium	18.7	20.8	20.1	MG/KG
Lead	14.7	14.1	13.2	MG/KG
Mercury	0.02	0.02	0.02	MG/KG
Silver	0.12	<0.518	<0.515	MG/KG
Selenium	<1.21	<1.14	<1.14	MG/KG

TABLE 10.7 — *TLAP Soil Results from Tract 201*

Analyte	6-Inch Depth Measured Value	18-Inch Depth Measured Value	30-Inch Depth Measured Value	Unit of Measurement
Agricultural Parameters				
pH (1:1 ratio soil pH)	7.2	7.8	8.0	pH Units
Conductivity (S Salts 1:1)	0.55	0.62	0.51	MMHOS/CM
Nitrate (as Nitrogen)	0.8	1.5	0.8	MG/L
Ortho Phosphate	16.0	4.0	2.0	MG/L
Potassium	625.0	397.0	359.0	MG/L
Sulfur	11.0	7.0	5.0	MG/L
Calcium	3,207.0	5,233.0	5,437.0	MG/L
Magnesium	549.0	788.0	879.0	MG/L
Sodium	81.0	132.0	176.0	MG/L
Boron	1.16	0.91	0.74	MG/L
Total Nitrogen	1,085.0	782.0	495.0	MG/L
Sodium Absorption Ratio (SAR)	1.3	1.5	2.2	
Metals				
Arsenic	3.43	4.08	3.83	MG/KG
Barium	127.0	155.00	159.0	MG/KG
Cadmium	0.48	0.42	0.41	MG/KG
Chromium	13.5	20.70	15.1	MG/KG
Lead	14.0	14.20	12.8	MG/KG
Mercury	0.02	0.02	0.02	MG/KG
Silver	<0.591	<0.594	<0.563	MG/KG
Selenium	<1.18	<1.12	<1.11	MG/KG

TABLE 10.8 – *TLAP Soil Results from Tract 301*

Analyte	6-Inch Depth Measured Value	18-Inch Depth Measured Value	30-Inch Depth Measured Value	Unit of Measurement
Agricultural Parameters				
pH (1:1 ratio soil pH)	6.9	7.8	7.9	pH Units
Conductivity (S Salts 1:1)	0.44	0.69	0.66	MMHOS/CM
Nitrate (as Nitrogen)	2.8	2.4	2.5	MG/L
Ortho Phosphate	14.0	6.0	4.0	MG/L
Potassium	578.0	398.0	323.0	MG/L
Sulfur	14.0	19.0	22.0	MG/L
Calcium	2,978.0	5,436.0	5,592.0	MG/L
Magnesium	571.0	763.0	811.0	MG/L
Sodium	69.0	124.0	147.0	MG/L
Boron	0.58	0.21	0.35	MG/L
Total Nitrogen	996.0	801.0	560.0	MG/L
Sodium Absorption Ratio (SAR)	1.0	1.3	1.7	
Metals				
Arsenic	3.75	3.89	3.45	MG/KG
Barium	126.0	167.0	143.0	MG/KG
Cadmium	0.52	0.41	0.43	MG/KG
Chromium	18.5	18.0	18.3	MG/KG
Lead	14.6	13.8	11.8	MG/KG
Mercury	0.02	0.02	0.02	MG/KG
Silver	<0.605	0.18	<0.57	MG/KG
Selenium	<1.15	<1.16	<1.08	MG/KG

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Fauna

No changes in the faunal monitoring program were made for 2011. 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 2011.

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 onsite locations and one control location. Areas where samples were collected 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, and Zone 8. No prairie dogs were available for sampling at FS-4, 12-36, and Zone 4 (West) sites in 2011. Control samples for prairie dogs were collected at Buffalo Lake National Wildlife Refuge near Umbarger, Texas (Randall County); however, no cottontails were captured there. Buffalo Lake 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.

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

Analytical results of the 2011 faunal sampling are presented in Table 11.1 (prairie dogs) and 11.2 (cottontails), as are the historical means (1997-2000) for prairie dogs. For the first time, historical means were calculated and examined for cottontails using the first four years of data (2007-2010; Table 11.2). Fifteen prairie dogs and four cottontails were sampled. All 2011 results (maximum values or means) for cottontail and prairie dog samples were below minimum detection activity (MDA) levels or 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 at Buffalo Lake National Wildlife Refuge, the control site. 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, $^{233/234}$U, and ^{238}U in Prairie Dogs in 2011, 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)	--	--	--	--	--	--
Zone 8	4 (4)	0.690 ± 0.568	-0.113[c] ± 0.285	0.331 ± 0.387	14	0.017 ± 0.065
Playa 2	4 (4)	0.441 ± 0.558	0.156 ± 0.322	0.253 ± 0.134	14	0.055 ± 0.136
Burning Ground	1 (1)	0.264 ± 0.567	--	--	11	0.152 ± 0.300
Playa 3	2 (2)	0.183 ± 0.320	-0.060 ± 0.288	0.062 ± 0.172	14	0.019 ± 0.070
FS-4[d]	--	--	--	--	--	--
12-36[d]	--	--	--	--	--	--
Buffalo Lake[e]	4 (4)	0.271 ± 0.554	-0.278 ± 0.564	0.078 ± 0.243	14	0.015 ± 0.055
$^{233/234}$Uranium						
Zone 4 (W)	--	--	--	--	--	--
Zone 8	4 (4)	0.029 ± 0.017	0.000 ± 0.130	0.011 ± 0.013	11	0.012 ± 0.019
Playa 2	4 (4)	0.027 ± 0.012	0.005 ± 0.014	0.015 ± 0.011	11	0.013 ± 0.022
Burning Ground	1 (1)	0.015 ± 0.018	--	--	9	0.018 ± 0.040
Playa 3	2 (2)	0.008 ± 0.006	0.007 ± 0.006	0.008 ± 0.000	11	0.020 ± 0.022
FS-4	--	--	--	--	--	--
12-36	--	--	--	--	--	--
Buffalo Lake	4 (4)	0.035 ± 0.013	-0.001 ± 0.015	0.018 ± 0.015	11	0.017 ± 0.025
^{238}Uranium						
Zone 4 (W)	--	--	--	--	--	--
Zone 8	4 (2)	0.053 ± 0.020	0.004 ± 0.005	0.021 ± 0.022	11	0.010 ± 0.021
Playa 2	4 (2)	0.030 ± 0.012	0.011 ± 0.009	0.018 ± 0.008	11	0.009 ± 0.009
Burning Ground	1 (1)	0.026 ± 0.015	--	--	9	0.013 ± 0.026
Playa 3	2 (1)	0.012 ± 0.007	0.006 ± 0.007	0.009 ± 0.004	11	0.011 ± 0.015
FS-4	--	--	--	--	--	--
12-36	--	--	--	--	--	--
Buffalo Lake	4 (2)	0.030 ± 0.013	0.013 ± 0.011	0.018 ± 0.008	11	0.015 ± 0.029

[a] Counting error at 95% 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] No prairie dogs available.
[e] Control location.

TABLE 11.2 — *Tritium, $^{233/234}$U, and ^{238}U in Cottontail Rabbits in 2011, 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)	0.077 ± 0.311	0.015 ± 0.296	0.046 ± 0.044	12	0.087 ± 0.274
Zone 12 South	2 (2)	0.076 ± 0.306	0.064 ± 0.319	0.070 ± 0.009	13	0.346 ± 0.397
Buffalo Lake[d,e]	--	--	--	--	--	--
$^{233/234}$Uranium						
Zone 4	2 (2)	0.005 ± 0.006	0.004 ± 0.006	0.004 ± 0.001	12	0.014 ± 0.013
Zone 12 South	2 (2)	0.009 ± 0.006	0.001 ± 0.005	0.004 ± 0.007	13	0.012 ± 0.008
Buffalo Lake	--	--	--	--	--	--
^{238}Uranium						
Zone 4	2 (2)	0.003 ± 0.004	0.003 ± 0.003	0.003 ± 0.000	12	0.009 ± 0.011
Zone 12 South	2 (2)	0.006 ± 0.005	0.000 ± 0.127	0.003 ± 0.004	13	0.005 ± 0.005
Buffalo Lake	--	--	--	--	--	--

a Counting error at 95% 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 Control location.
e No cottontails obtained.

Twenty-two prairie dogs (from Pantex and Buffalo Lake) were collected in 2011 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 onsite 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 concerns that include disease issues.

Herpesvirus 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 herpesvirus, 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 herpesvirus since sampling began in 1996. Evidence of the virus was detected at both Pantex and the control site. All 22 (100%) individuals analyzed in 2011 tested positive for herpesvirus or titers of herpesvirus, up from 13 of 24 (54 percent) in 2010. No other antibodies or diseases were detected.

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 indicated no detrimental impacts from Plant operations in 2011. Sampling results indicated that prairie dogs on-site are not harboring any diseases of concern to Plant workers or neighboring landowners.

Flora

Radionuclide concentrations in vegetation samples, which included both native vegetation and crops from onsite and offsite locations, were compared to historical values and values observed in samples from control locations. These comparisons indicated no adverse impacts from Plant operations in 2011. Additionally, there were no significant changes in analytical results between 2010 and 2011.

12.1 The Scope of the Program

Flora surveillance is complementary to air, fauna, and 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 at onsite and offsite locations monitors potential impacts from current Plant operations at the Burning Ground, the Firing Sites, Zone 12 (Figure 12.1), and offsite 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). 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 and ^{238}Uranium. Analytical data were corrected for moisture content and reported in pCi/g dry weight. The onsite and offsite 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 stem and leaves from grasses and forbs were collected from one control, 10 onsite, and 10 offsite locations. Samples were collected during the growing season, no more frequently than once per month at any location, in 2011. The presence of adequate vegetation for sampling varied in 2011 due to very dry conditions during the growing season.

Tritium results from 81 percent of onsite and offsite sample locations were at or below minimum detectable activity (MDA) levels. The mean results of tritium analyses at onsite and offsite locations were similar to the results at the control location OV-VS-20 and the historical mean (calendar years 1997-2002).

Sampling events during the year starting in May at MA-VS-02, P1-VS-01, and OV-VS-05and again in September at P4-VS-01 resulted in a higher measured value for tritium than any of the results from the

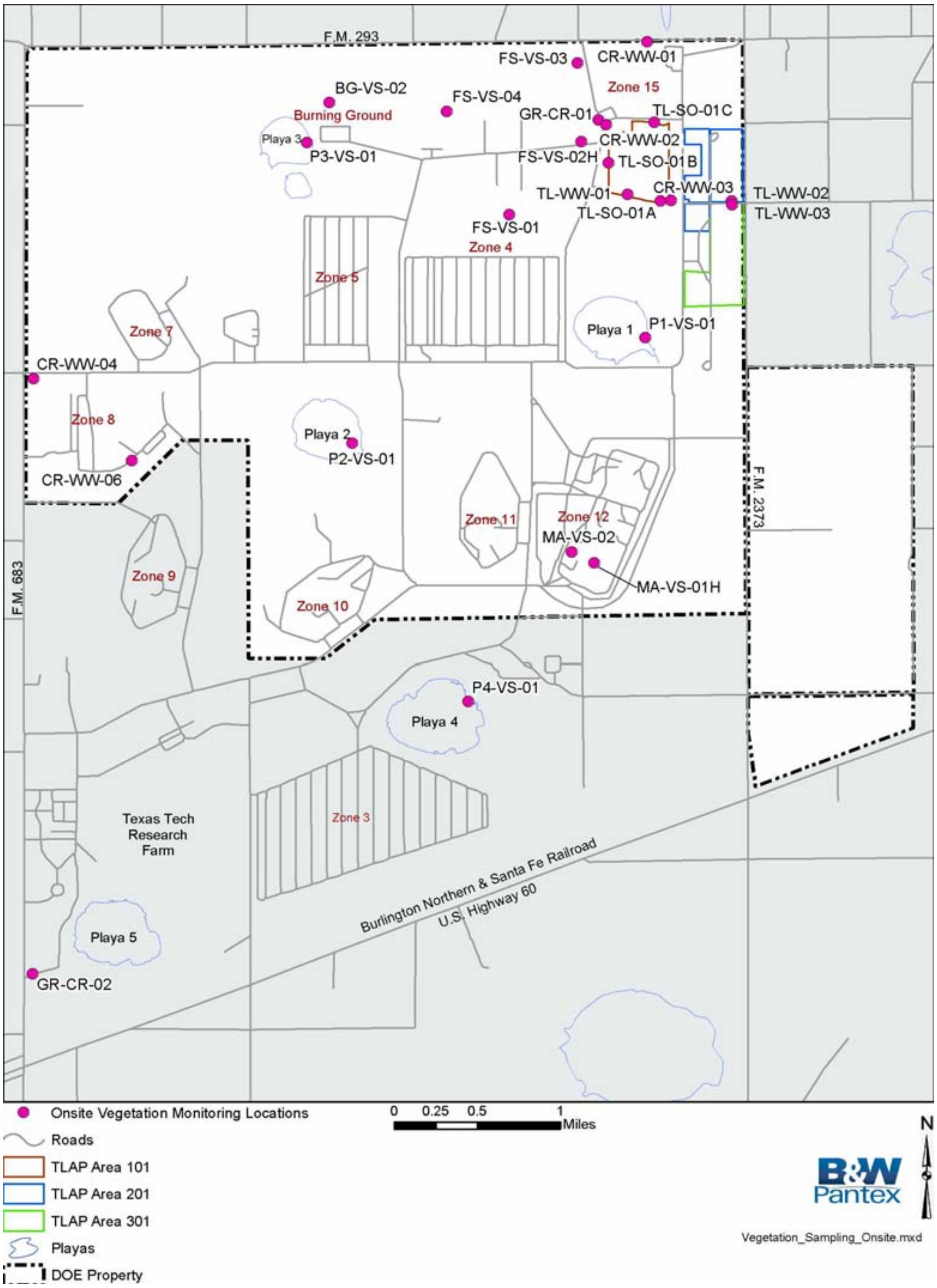

FIGURE 12.1 — ***Onsite Vegetation Monitoring Locations***

NOTE: On Figures 12.1 and 12.2, note the following designations: B- Bushland, BG- Burning Ground, CR-crops, FS- Firing Sites, GR- garden produce, MA- Material Access Area, O- offsite, 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.

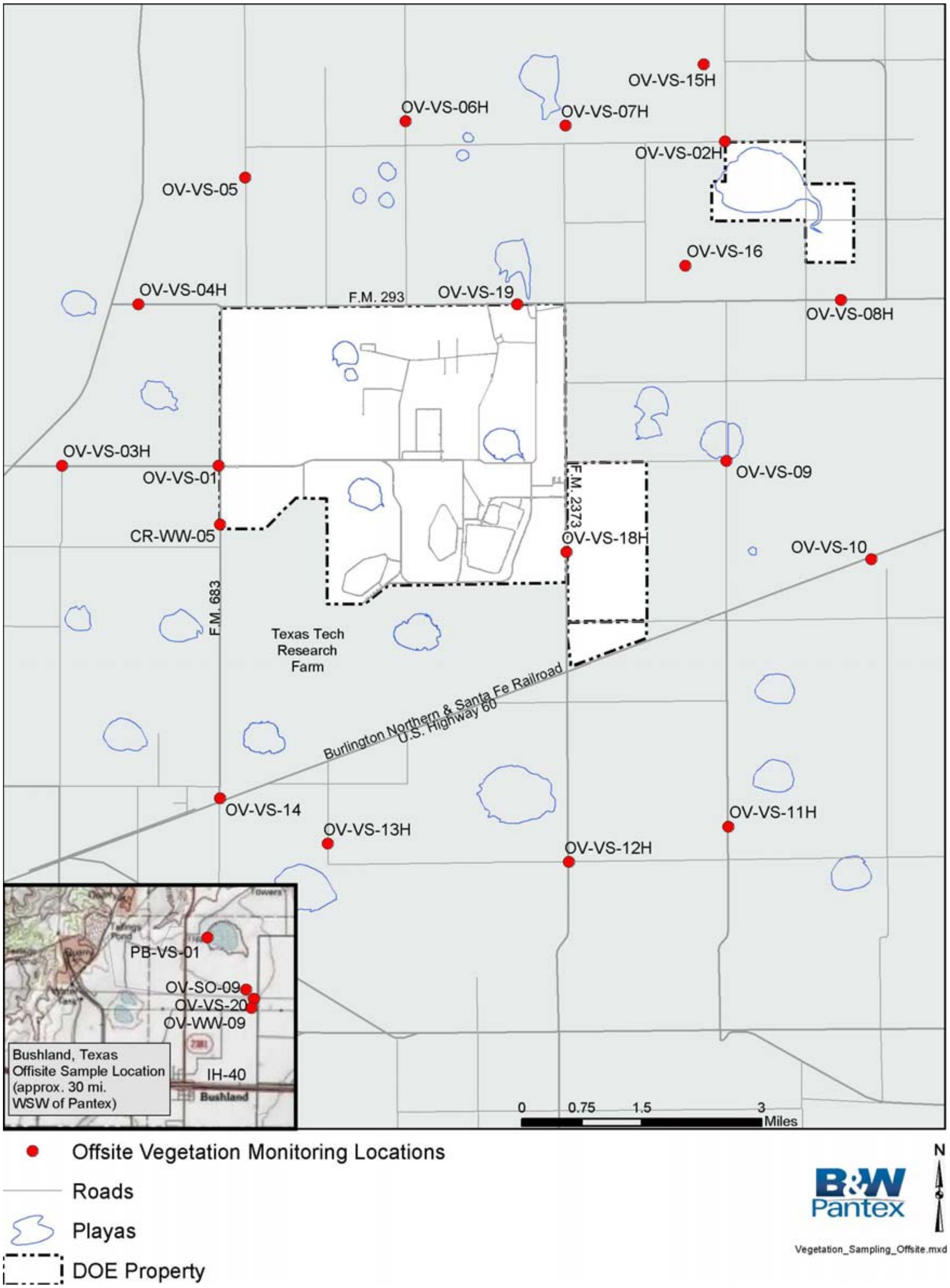

FIGURE 12.2 — ***Offsite Vegetation Monitoring Locations***

control location during the year and were also greater than the historical mean of results from the control location. The P1-VS-01 and OV-VS-05 results were 0.67 ± 0.0.9 and 0.47 ± 0.07 pCi/g, respectively, and were all-time highs for these locations. Sampling results for MA-VS-02, P1-VS-01 and OV-VS-05 later in the year were not elevated and were comparable to the control location. The September sampling result for P4-VS-01 was not an all-time high but was greater than the control location results. Sample results for P4-VS-01 earlier in the year were not elevated and were comparable to the control location. Results for all other onsite and offsite locations were consistent with those found in previous years. Concentrations of tritium in native vegetation indicate that no uptake of tritium into vascular plants has occurred.

The percentage of vegetation samples at or below the MDA level for $^{233/234}$Uranium and ^{238}Uranium in all vegetation were 81 and 79 percent, respectively. These percentages are higher than most years. Usually the percentage of vegetation samples at or below the MDA level is near 50%. Area soils have naturally occurring uranium and the vegetation samples are not washed and may contain some dirt and dust. Measured values for $^{233/234}$Uranium and ^{238}Uranium at all onsite and offsite locations during 2011 were similar to the values obtained at the control location.

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 onsite 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 near the Killgore Building 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 onsite, were collected in April 2011, and one control sample was collected from Bushland, Texas. The majority of onsite winter wheat sampling locations were near the Firing Sites, Burning Ground, and on the Texas Land Application Permit area, with the remainder evenly distributed across the Plant. Three onsite samples, a duplicate sample of irrigated grain sorghum, and one control sample from Bushland, Texas were collected in July 2011. No dryland grain sorghum was available for sampling due to severe drought conditions. Fruits and leaves from garden plants were sampled in July 2011.

All crop and garden samples were analyzed for tritium, $^{233/234}$Uranium and ^{238}Uranium. Tritium results for garden produce were comparable to the offsite control location. The $^{233/234}$Uranium and ^{238}Uranium at the garden locations during 2011 had a few samples that were elevated above the vegetation control location values, and two were an all-time high reading for $^{233/234}$Uranium. Squash sampled from GR-CR-01 was one of the high readings at 1.05 ± 0.14 pCi/g and radish from CR-CR-02 was the second at 0.45 ± 0.08 pCi/g.

Tritium results in dryland and irrigated winter wheat had several elevated sample results. Two results were high enough to be considered outliers. These samples, with four others, were re-analyzed by the analytical laboratory. Results were mixed and very difficult to interpret. Table 12.1 shows the high initial sample result and the subsequent reanalysis result for each location experiencing an abnormally high tritium level. All higher detections were all time highs for the respective designated locations with the exception of TL-WW-01. Tritium in the irrigated grain sorghum was similar to the onsite and offsite vegetation samples.

TABLE 12.1 — *Comparison of Initial and Reanalysis Sampling Results for Winter Wheat Locations Experiencing Abnormally High Tritium Results*

Sampling Location	Initial Analysis (pCi/g)	Reanalysis (pCi/g)
CR-WW-01	52.5 ± 3.30	0.26 ± 0.05
TL-WW-03	7.05 ± 0.60	0.87 ± 0.10
CR-WW-04	0.36 ± 0.12	1.76 ± 0.16
CR-WW-05	0.17 ± 0.10	1.06 ± 0.11
TL-WW-01	0.08 ± 0.07	0.70 ± 0.09
TL-WW-02	0.10 ± 0.08	1.54 ± 0.15

The ^{238}Uranium results for all onsite wheat and grain sorghum locations in 2011 were comparable to the offsite vegetation control location and historical figures. Results for ^{238}Uranium in garden produce were comparable to results from offsite control locations and historical values with the exception of GR-CR-01 at 0.10 ± 0.03 pCi/g. This sample was a duplicate with a sample reading of 0.06 ± 0.03 pCi/g. The control location was 0.04 ± 0.02 pCi/g.

12.3 Conclusions

Radionuclide concentrations in flora samples were comparable to values observed in samples from control locations or historical data with the exception of winter wheat samples and garden produce. Since the U.S. Department of Energy currently has no limiting concentrations for tritium or uranium in vegetation and all sample results are measured in picocuries per gram of vegetative material, even the higher sample result for tritium of 52.5 pCi/g at CR-WW-01 is minute. Therefore, sample results indicate there were no adverse impacts to vegetation resulting from Pantex operations in 2011.

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Quality Assurance

Pantex, because of our unique mission and service to our country, must strive to become a High Reliability Organization (HRO). High reliability also 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 29,973 individual analytical results obtained during 2011, 99.5 percent were useable for making environmental decisions —the highest percentage of useable data achieved in the last 15 years.

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-14001 *Environmental Management Systems Specification* (ISO, 2004). During 2011, 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 2011, 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, and 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. They are scheduled based on risk assessment models provided by the B&W Pantex Quality and Performance Assurance Division.

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.

Co-verifications

Data verification is performed on 100 percent of the laboratory data. Five percent of all data packages undergo co-verification on an annual basis. Historically, the co-verification of data packages has helped to identify areas that can be interpreted in different ways and has helped data validators come to an agreement on how data should be reviewed. The majority of data verification for 2011 was performed by a specialized technical subcontractor.

Quarterly, a random selection of at least 10 percent of manual entries into the Integrated Environmental Database (IEDB) is verified and documented by a second party. Transcription errors can occur when hand entering data into the IEDB, and a second party check of the manual entries provides assurance that the data are correct.

Also quarterly, a random selection of at least 5 percent of all reported data from hardcopy Certificates of Analyses is compared by a second party to the data uploaded from subcontract laboratory Electronic Data Deliverables (EDDs) into the IEDB. EDDs provide an easy way for analytical laboratories to deliver their data to the customers, and they allow different laboratories to provide consistent reporting parameters. Errors can be caused by miscommunication of the desired format or data elements. A second party check of the data uploaded into the IEDB from EDDs provides assurance that all data are correct.

<u>Data Management Systems Audit</u>

An audit of the data management systems, primarily the 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.

<u>Annual Review of all Operations</u>

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.

<u>Recordkeeping</u>

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 2011, 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 2011, 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 and DPAs 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). Sample results are qualified as useable by means of various data qualifier flags, based on industry standard conventions, 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 B&W Pantex media scientist was alerted to any limitations in the use of the data, based on the DQO requirements. Of the 29,973 individual results obtained in 2011 from all laboratory analyses, 99.5 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 0.5 percent of data rejected.

13.4.2 Laboratory Technical Performance

All subcontract laboratories were required to participate in inter-laboratory comparison studies administered by DOE and EPA. In 2011, Pantex offsite 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 24 and 25, for all participating subcontract laboratories used by Pantex in 2011 (GEL and TestAmerica) are presented in Figure 13.2. Both subcontract laboratories had acceptable MAPEP results in 2011.

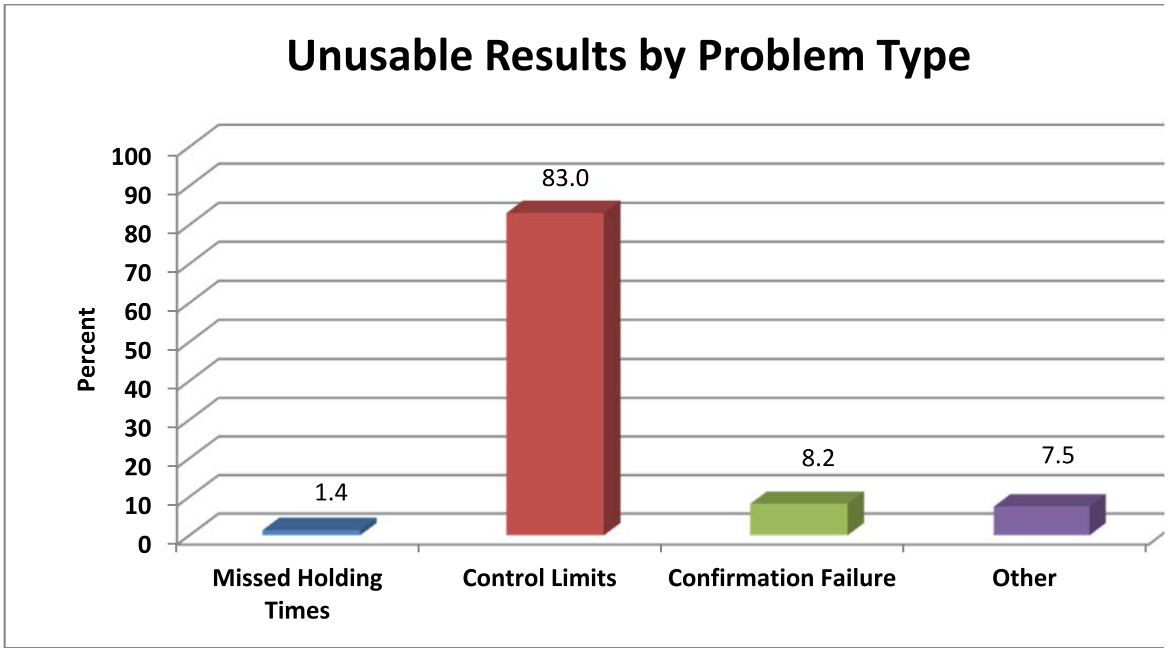

FIGURE 13.1 — *2011 Data Rejection Summary*

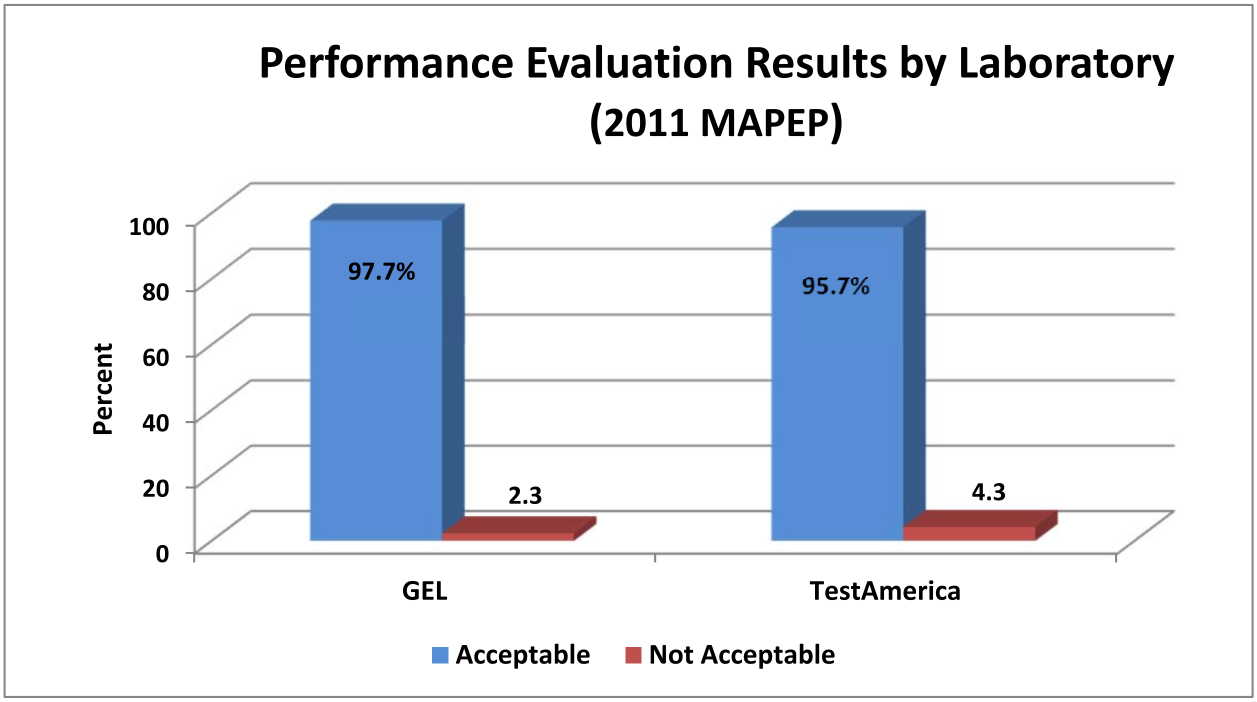

FIGURE 13.2 — *2011 MAPEP Results*

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.

13.5.1 Duplicate and Replicate Analyses

During 2011, 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
$\sigma 95S$ = sample uncertainty (95%)
$\sigma 95R$ = replicate uncertainty (95%)

An RER of less than or equal to one indicates that the replicates are comparable within the 95 percent confidence interval. For 2011, the average RER value for vegetation data was 0.34, with an associated standard deviation of 0.675. The 2011 vegetation sample RER anaylsis 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 2011, 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).

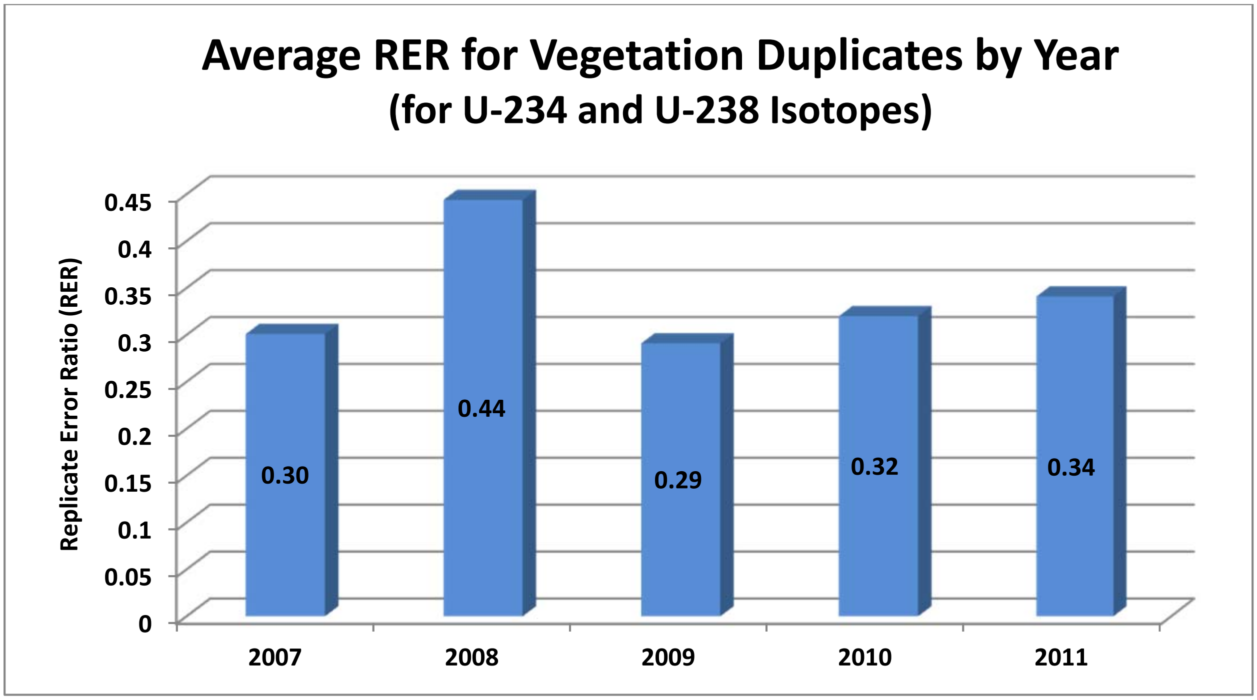

FIGURE 13.3 — Five Year Replicate Error Ratio for Vegetation Duplicates

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 toluene and acetone were detected in trip blanks in 2011. These compounds are indicative of common laboratory solvents. The frequency of detection was 0.7 percent.

13.6 Onsite Analytical Laboratories

A limited number of samples were analyzed onsite during 2011, using approved EPA or standard industry methods. Onsite analyses included the following:

- Pantex Industrial Hygiene Laboratory performed analysis of samples for chemical oxygen demand, biochemical oxygen demand, and ferrous iron in the first six months of the year; and
- Pantex Materials and Analytical Services Laboratory performed analysis of samples for alkalinity, color, hardness, nitrates, nitrites, and hexavalent chromium.

These onsite laboratories followed an internal quality control program similar to the program outlined in the SOW. The onsite 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 2011, 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 16 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.

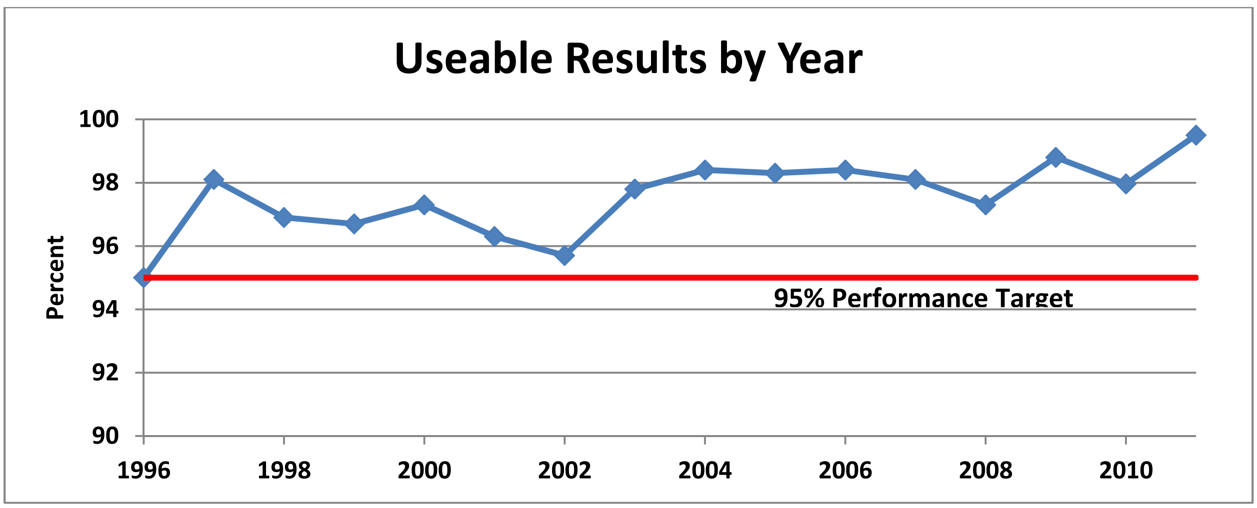

FIGURE 13.4 — *History of Useable Results Data*

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.

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Appendix A Analytes Monitored in 2011

Analyte	CAS Number	Air	GW[1]	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]	-	-
Chromium	7440-47-3	-	■	■	■	■	■	■	-	-
Chromium (hexavalent)	18540-29-9	-	■	-	-	-	-	-	-	-
Cobalt	7440-48-4	-	■	-	■	■	■	-	-	-
Copper	7440-50-8	-	■	■	■	■	■	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Iron	7439-89-6	-	■	■	■	-	-	-	-	-
Ferrous Iron	1345-25-1	-	■	-	-	-	-	-	-	-
Lead	7439-92-1	-	■	■	■	■	■	■	-	-
Magnesium	7439-95-4	-	■	-	-	-	-	■[9]	-	-
Manganese	7439-96-5	-	■	■	■	■	-	-	-	-
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	-	-	-	-	-	-	-	-	-
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	-	■	■	■	■	■	-	-	-
Explosives										
1,3-dinitrobenzene	99-65-0	-	■		■	-	-	-	-	-
1,3,5-trinitrobenzene	99-35-4	-	■	-	■	-	■	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	-	■	-	~	■	-	-
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	-	-	■	-	-	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Aroclor 1248	12672-29-6	-	-	■	-	-	-	-	-	-
Aroclor 1254	11091-69-1	-	-	■	-	-	-	-	-	-
Aroclor 1260	11096-82-5	-	-	■	-	-	-	-	-	-
Pesticides										
Alachlor	15972-60-8	-	-	■	-	-	-	-	-	-
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	-	-	■	-	-	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Herbicides										
2,4-D	94-75-7	-	-	-	-	-	-	■	-	-
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	-	-	-	-	-	-	■	-	-
Fluoride	7782-41-4	-	■	■	-	-	-	-	-	-
Foaming agents (surfactants)	NA	-	-	■	-	-	-	-	-	-
Ignitability	NA	-	-	-	-	-	-	■	-	-
Nitrate (as N)	14797-55-8	-	■	■	-	-	-	■	-	-
Nitrate/nitrite (as N)	1-005	-	■	-	-	■	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	-	-	-	-	■	-	-
Phosphorus, Total (As P)	7723-14-0	-	■	-	-	-	-	-	-	-
Reactivity	NA	-	-	-	-	-	-	■	-	-
Sodium Adsorption Ratio	NA	-	-	-	-	-	-	■	-	-
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	-	■	■	-	-	-	-	-	-
Total Kjeldahl Nitrogen	NA	-	-	-	-	-	-	■	-	-
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	-	■	■	■	-	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	■	■	-	-	-	-	-
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	-	■	■	■	-	-	■	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	■	-	-	-	-	-	-
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	-	■	■	■	-	-	■	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Chloroethane	75-00-3	-	■	■	■	-	-	-	-	-
Chloroform	67-66-3	-	■	■	■	-	-	■	-	-
Chloromethane	74-87-3	-	■	■	■	-	-	-	-	-
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	-	-	■	-	-	-	-	-	-
Tetrachloroethylene	127-18-4	-	■	■	■	-	-	■	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	-	■	-	-	■	-	-
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	-	-	-	■	-	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	■	■	-	-	-	-	-
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	-	-	■	■	-	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	■	■	-	-	-	-	-
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	-	-	■	-	-	-	-	-	-

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
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	-	-	■	-	-	-	-	-	-
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	-	-	-	-	-	-	-	-	■

Analyte	CAS Number	Air	GW[1]	DW[2]	SW[3]	IW[4]	BG[5] Soil	TLAP Soil[6]	Veg.[7]	Fauna
Western encephalitis	NA	-	-	-	-	-	-	-	-	■
Hanta virus	NA	-	-	-	-	-	-	-	-	■
Plague bacteria	NA	-	-	-	-	-	-	-	-	■
Pseudorabies	NA	-	-	-	-	-	-	-	-	■
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	GW[1]	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.

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Appendix B Birds Identified at Pantex in 2011

COMMON NAME	SCIENTIFIC NAME
Pied-billed grebe	*Podilymbus podiceps*
Black-crowned night-heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*
Sandhill crane	*Grus canadensis*
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Green-winged teal	*Anas crecca*
Northern shoveler	*Anas clypeata*
Blue-winged teal	*Anas discors*
Ruddy duck	*Oxyura jamaicensis*
Redhead	*Aythya americana*
Lesser scaup	*Aythya affinis*
Common goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
American coot	*Fulica americana*
Black-necked stilt	*Himantopus mexicanus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Killdeer	*Charadrius vociferus*
Greater yellowlegs	*Tringa melanoleuca*
Wilson's phalarope	*Phalaropus tricolor*
Upland sandpiper	*Bartramia longicauda*
American kestrel	*Falco sparverius*
Prairie falcon	*Falco mexicanus*
Red-tailed hawk	*Buteo jamaicensis*
Swainson's hawk	*Buteo swainsoni*

Common Name	Scientific Name
Ferruginous hawk	*Buteo regalis*
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Turkey vulture	*Cathartes aura*
Bald eagle	*Haliaeetus leucocephalus*
Northern bobwhite	*Colinus virginianus*
Ring-necked pheasant	*Phasianus colchicus*
Rock dove (feral pigeon)	*Columba livia*
Mourning dove	*Zenaida macroura*
Eurasian collared dove	*Streptopelia decaocto*
Greater roadrunner	*Geococcyx californianus*
Long-eared owl	*Asio otus*
Burrowing owl	*Athene cunicularia hypugea*
Great horned owl	*Bubo virginianus*
Northern flicker	*Colaptes auratus collaris*
Western kingbird	*Tyrannus verticalis*
Horned lark	*Eremophila alpestris*
Cliff swallow	*Hirundo pyrrhonota*
Chihuahuan raven	*Corvus cryptoleucus*
American robin	*Turdus migratorius*
Loggerhead shrike	*Lanius ludovicianus*
Gray catbird	*Dumetella carolinsis*
Northern mockingbird	*Mimus polyglottos*
Brown thrasher	*Toxostoma rofum*
European starling	*Sturnus vulgaris*
Brown towhee	*Pipilo fuscus*
Grasshopper sparrow	*Ammodramus savannarum*

COMMON NAME	*SCIENTIFIC NAME*
Lark sparrow	*Chondestes grammacus*
Lark bunting	*Calamospiza melanocorys*
Western meadowlark	*Sturnella neglecta*
Red-winged blackbird	*Agelaius phoeniceus*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Brown-headed cowbird	*Molothrus ater*
Great-tailed grackle	*Quiscalus mexicanus*
House sparrow	*Passer domesticus*
House finch	*Carpodacus mexicanus*

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Helpful Information

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°.					

Pantex Plant, Amarillo, Texas