

Characterization and Remediation of 91B Radioactive Waste Sites under Performance Based Contracts at Lackland Air Force Base, San Antonio, Texas

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ABSTRACT

This paper describes the challenges behind the implementation of the characterization, remediation, and the Site Closure for three 91b Radioactive Wastes under a Performance Based Contract at Lackland Air Force Base, San Antonio, Texas. The Defense Environmental Restoration Program (DERP) was established by Section 211 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). A part of the DERP provides for the cleanup of hazardous substances associated with past Department of Defense (DoD) activities and is consistent with the provisions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). It is the Air Force Installation Restoration Program (IRP) that has responsibility for the cleanup activities associated with CERCLA. Under contract to the Air Force Center for Environmental Excellence (AFCEE), the ECC Project Team, that included ECC, Cabrera Services, and Malcolm Pirnie, was responsible for the implementation of the actions at three sites. The three IRP (91b) sites included RW015, a 0.02 square kilometer (5.5 acre) site, RW017 a 0.003 square kilometer (0.9 acre) site, and RW033 an 0.356 square kilometer (88 acre) site. Adding to the complexities of the project were issues of archeological areas of interest, jurisdictional wetlands, land open to hunting, issues of security as well as compliance to the myriad of air force base rules, regulations, and Air Force Instructions (AFI). The award of the project task order was July of 2005, the project plan phase started in July of 2005 followed by the remedy implementation that included characterization and remediation as required reached completion in June of 2006. The project closure including the development and approval final status survey reports, proposed plans, and decision documents that parallel the CERCLA process was initiated in June of 2006 and is expected to reach completion in August of 2007.

This paper will focus on the issues of working to achieve radiological and chemical closure under a performance based contract vehicle and the challenges encountered while reaching this goal.

INTRODUCTION

According to the U.S. Department of Defense, more than 700 military installations in the United States and its territories have contaminated sites that require investigation and/or cleanup. These contaminated sites exist owing to past manufacturing, or maintenance operations and these sites are investigated as to the potential environmental threat from contaminated soils, groundwater, or surface water. The Air Force identified over 4,400 sites at various installations that required some level of investigation/cleanup. The Air Force estimates that it has completed approximately 60 percent of the identified sites. This effort is completed by an IRP group for each installation with support from the AFCEE. Lackland Air Force Base (LAFB) sites RW015, RW017, and RW033 are part of this program.

LOCATION

The Lackland Training Annex is situated inside the Lackland Air Force Base, located about 7 miles southwest of the center of San Antonio, Texas and immediately west of and adjacent to Kelly Air Force Base. The main portion of the base encompasses about 11.056 square kilometers (2,752 acres). The Lackland Air Force Base Training Annex is located on the south side of US Highway 90, 0.8 kilometers (one-half mile) west of Interstate Loop 410, 1.2 kilometers (three-fourths of a mile) east of State Highway Loop 1604, approximately 2 miles north of Pearsall Road (State Highway 2536), and about 1.6 kilometers (1 mile) west of the main Lackland Air Force Base.

RW017 is located in the north-central portion of the Lackland Training Annex (LTA), 184 meters (600 feet) by 122 meters (400 feet). RW015 is located in the northeastern portion of the LTA and is now a gravel-paved area, 15 meters (50 feet) by 30 meters (100 feet), enclosed by a chain-link fence. RW033 is located in the western portion of the LTA and encompasses about 0.356 square kilometers (88 acres). As shown in the **Figure 1**, Area Map and Site Locations.

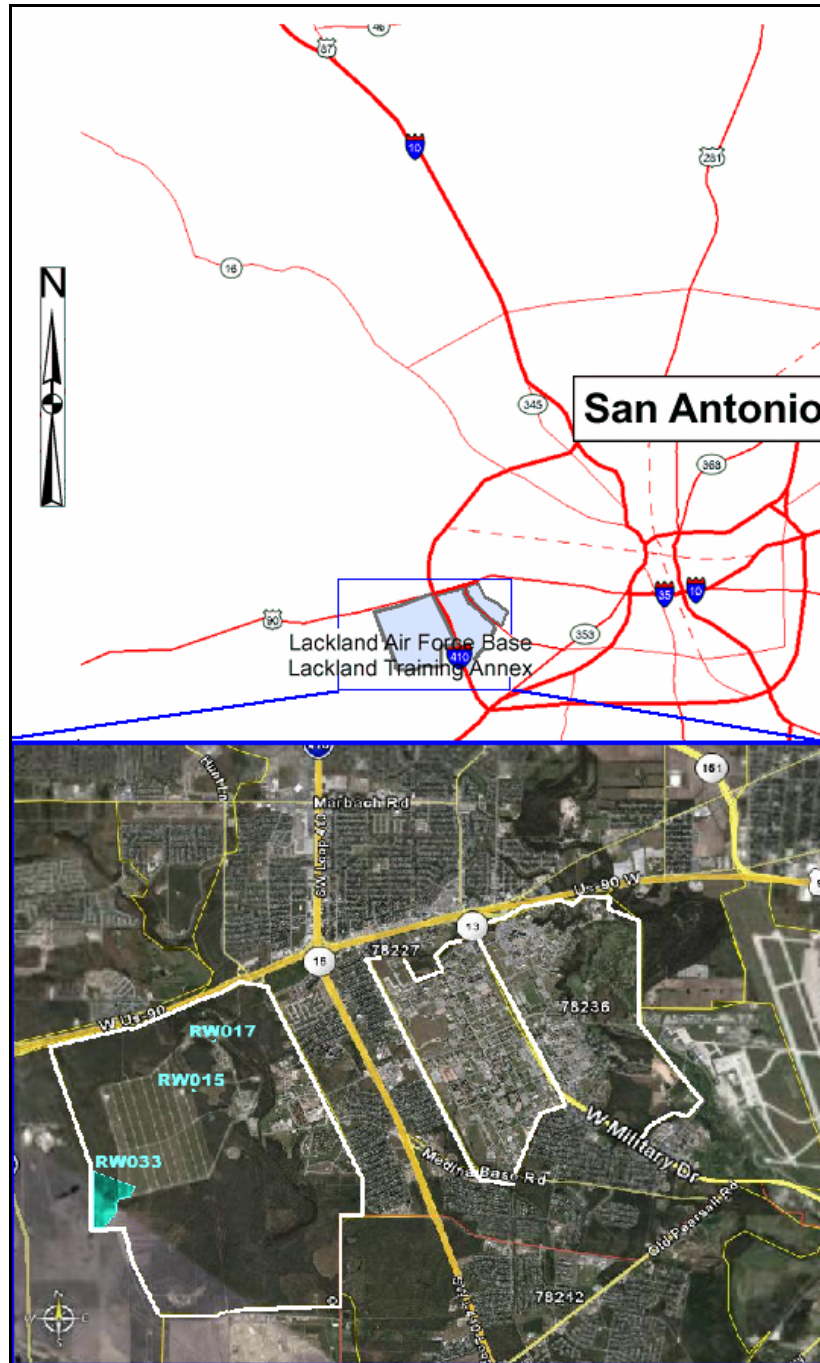


Figure 1. Area map and site locations

INSTALLATION HISTORY & SITE CONTAMINANTS

The Lackland Modification Center, now known as Lackland Training Annex to Lackland AFB, was one of the largest, busiest, and most complex locations involved in the United States Special Weapons Program and was a critical component of the cold war strategy of the United States. This site was known as Site King according to Atomic Energy Commission (AEC) nomenclature (thus making it the eleventh Weapons Storage Area opened by the AEC). Opened in 1955, the site first served as a traditional special Weapons Storage Area (WSA). Weapons of that era required periodic maintenance and inspection of the physical packages. Those activities generated radiological waste. In approximately 1959, the base increased its mission by becoming a modification and demilitarization center. This increased mission resulted in an increase in the amount of radiological waste generated at the base [1].

RW015

RW015 was the primary collection point for all wastes generated by Mason & Hanger, Silas Mason CO. at Lackland Modification Center. This included all waste generated from maintenance, modifications, and demilitarization of weapons. This burial site was so large, that it soon became home to waste collected at various broken arrow accidents around the world. It is known that Plutonium, Uranium, and various metals like Aluminum, Polonium, Beryllium, and Lithium were collected at this site. At the end of the AEC tenure at Lackland, the burial site was exhumed and the waste was transferred to the Pantex Plant in Amarillo, Texas. However, no records or interview subjects could confirm the integrity of all the material removed. Furthermore, some of the material transferred to Pantex, and which ultimately went to Frenchmen Flats at the Nevada Test Site (NTS), was found to be leaking from 7 the storage containers [1]. **Figure 2**, shown below provides an aerial overview of the RW015 site.



Figure 2. RW015 land area aerial

RW017

RW017 was a radioactive burial site used exclusively by the Sandia National Labs personnel at the base, who conducted inspections and modified the weapons as necessary. Records from the AEC departure and interview subjects suggest that the AEC also exhumed this site and relocated the material to Pantex. However, no records exist that would verify this anecdotal evidence. Indeed, due to the discovery of weapons components at this site in 2004, the likelihood that the site was either partially exhumed or not all is high. The components found were reviewed by special weapons experts and were verified as the correct type for weapons of that era. Furthermore, former Sandian Harold Rarrick confirmed that those types of devices were disposed of in similar sites at other AEC weapons storage areas. The typical methodology for Sandia/AEC was to place radiological materials into cardboard boxes and bury the boxes at the site. Materials that may be present at this site include Polonium (not likely due to its 138-day half life), Beryllium, Cesium, and Uranium [highly enriched uranium (HEU), depleted uranium (DU), *natural Uranium* (Unat)], and Trichloroethylene (TCE) [1]. **Figure 3**, shown below provides an aerial overview of the RW017 site.



Figure 3. RW015 land area aerial

RW033

RW033 was the site of Bunker 572. This bunker was used to store weapons undergoing demilitarization. Specifically, the pit portion of the weapon was stored in this location. No enriched materials, either HEU or Weapons Grade Plutonium (WGP), would have been present at the location at the time of the explosion (demilitarization). There was however, a large amount of DU present at the time. While radiological sampling at the time of the explosion did not reveal any contamination, recent sampling indicates the presence of materials consistent with this finding. Furthermore, the extent of the explosion likely encompasses a greater area than previously thought. The fan of explosion ejected material mainly to the Southwest in a fan approximately 90° out of the Southwest-facing doors. Currently, the boundary of the site exists at the fence-line of the base. However, both interview and historical documentation indicates that a great deal of material flew over the base boundary. It is likely material still exists in those fields to the Southwest. There is one last issue that may impact RW033; though anecdotal in nature, must be addressed

here. Approximately $\frac{1}{4}$ to $\frac{1}{2}$ mile to the Southeast of RW033 is OT-012. This site was used to demilitarize high explosive components from the special weapons demilitarized at Lackland. There are reports that during some of the operations, explosions occurred when materials were stacked too high, causing the materials to detonate rather than deflagrate. Some of this material may have been ejected as far as RW033. There are some indications that radiological materials such as plutonium or uranium may have been part of this burn [1]. **Figure 4**, shown below provides an aerial overview of the RW033 site.

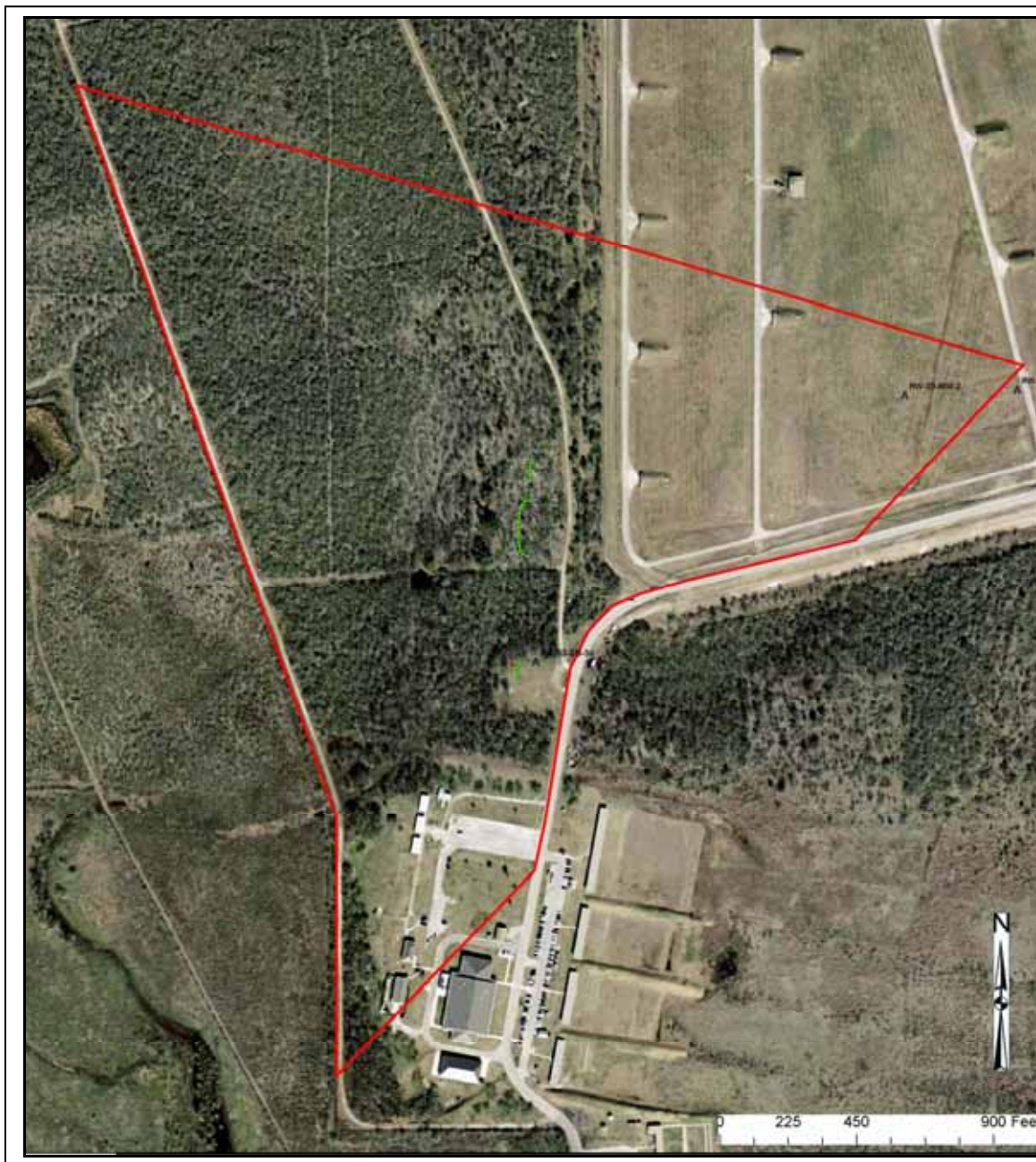


Figure 4. RW033 land area aerial

HISTORICAL AND REGULATORY STATUS

The United States Air Force Installation Restoration Program as well as the regulatory status of each site is detailed in the following.

Installation Restoration Program

The Defense Environmental Restoration Program (DERP) was established under Section 211 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations, Part 300 and Executive Order (EO) 12580, Superfund Implementation. Section 211 of SARA, 10 USC 2701, authorizes the Secretary of Defense to carry out the DERP. The Army, Navy, Air Force, and Defense Agencies program, budget and manage individual transfer accounts with the Office of the Deputy Under Secretary of Defense for Environmental Security (ODUSD (ES)). Three program categories have been established under DERP: Installation Restoration Program (IRP), Other Hazardous Waste (OHW), and Building Demolition/Debris Removal (BD/DR). The OHW category includes the cleanup of ordnance and explosives wastes (OEW) at a FUDS property that poses an imminent danger to the public or the environment. The BD/DR category includes demolition and removal of unsafe buildings at FUDS transferred to governmental units. The IRP category includes cleanup activities associated primarily with CERCLA-defined hazardous substances, pollutants, and contaminants; DoD-unique materials; petroleum, oil, and lubricant (POL) contamination, and provides for the cleanup of hazardous substances associated with past DoD activities. In cases where the hazardous substance is associated with a radioactive waste disposal site; the Air Force Safety Center, Division of Weapons, Space, and Nuclear Safety (AFSC/SEW) is tasked with providing regulatory oversight for the remediation involving 91b Materials[2].

RW015

As part of the IRP, the Air Education and Training Command and Lackland AFB conducted the Phase I records search and a remedial investigation. The investigations were initiated to evaluate the presence or absence of contamination and the risk to public health and the environment, if any, associated with past operations at this site.

Previous remedial investigations (RIs) conducted in the late 1980s and early 1990s have shown radiation concentrations at RW015 to be less than the maximum permissible concentrations established for radionuclides in water (10 CFR Part 20, Appendix A, 1987) and less than the 15 picocuries per gram (pCi/g) criterion for soil referenced in Title 25 of the Texas Administrative Code (TAC), §289.202(eee)(4)(B) and Title 40 of the Code of Federal Regulations (CFR), Part 192 for ²²⁶ Radium. Gross beta and gross gamma measurements were performed inside the fence at RW015 and in the area just west of the fence. Soil samples were collected and analyzed for gross alpha and gross beta activity. No readings significantly different from background concentrations were reported for these soil samples. No non-radiological constituents of potential concern (chemicals) have been identified at RW015 from previous investigations.

Based on the previous RI results, the United States Air Force (USAF) Radioisotope Committee (RIC) determined the site could be released for unrestricted use; however, the AFSC is the regulatory authority for releasing the RW015 site and required that an additional characterization survey be completed [3]. The following figure provides a site conceptual model of the RW015 site.

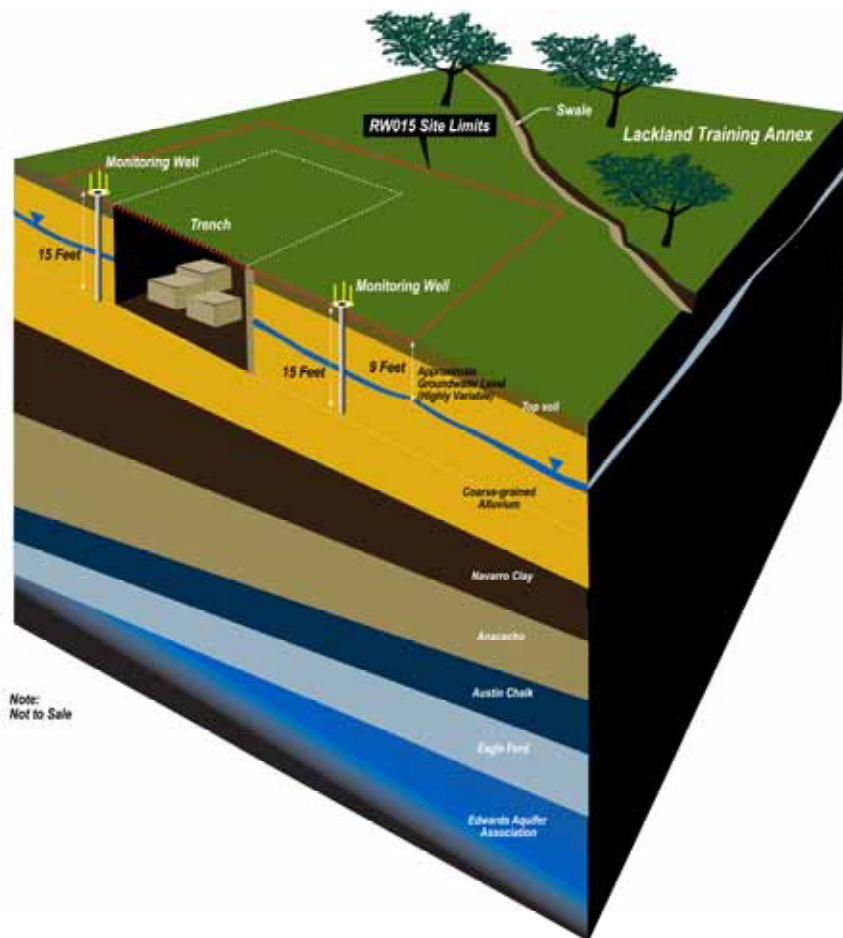


Figure 5. RW015 site conceptual model

RW017

Under the onus of the IRP, Lackland AFB conducted the Phase I records search and a remedial investigation. The investigations were initiated to evaluate the presence or absence of contamination and the risk to public health and the environment, if any, associated with past operations at this site.

A number of non-intrusive investigations of this site were conducted in the 1990s. None of the investigations resulted in any findings of radiological contamination. A follow-on investigation conducted by Earth Tech from December 2001 through July 2003 was reported in March 2004. This investigation included radiological and geophysical surveys and soil and groundwater sampling. The radiological survey identified 10 areas with radiological levels significantly higher than background. Seven of these areas were inside the fence and three were outside the fence. Radiological levels at these 10 areas ranged from 5 to 27 times background. Surface soil was sampled at six of these areas. At these specific locations, small sources were found within 6 to 8 inches of the ground surface. The sources included electrical connectors and ceramic cylinders. These sources were collected and properly disposed.

The geophysical survey was conducted with an electromagnetometer. Conductivity measurements significantly less than background indicate previous soil disturbance or excavation around the site. Sixteen soil samples were collected near and below the sources discussed previously and 12 samples were taken from six additional borehole locations at various depths to 5.5 meters (18 feet) below ground surface (bgs).

These samples were analyzed for radioactivity, metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). The borehole samples yielded no elevated levels of chemical or radiological contaminants of concern. The surface soil samples did show elevated levels of ^{137}Cs , ^{234}U , ^{235}U , and ^{238}U . The investigation resulted in the collection of five groundwater samples. These samples were analyzed for radioactivity, metals, VOCs and SVOCs. The samples yielded no chemical or radiological contaminants of concern [4].

The AFSC is the regulatory authority for releasing the RW017 site and required that an additional characterization survey be completed.]. The following figure provides a site conceptual model of the RW017 site.

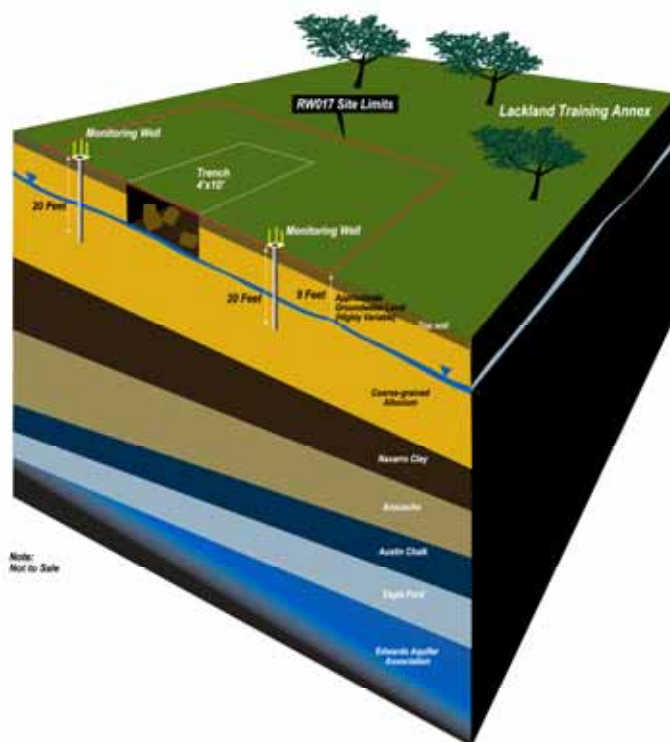


Figure 6. RW017 site conceptual model

RW033

IRP Site RW033 is located in the western portion of the LTA. The site includes the location of former storage Igloo 572 and extends westward toward the base boundary. At approximately 10:24 a.m. (CST) Wednesday, November 13, 1963, 50,500 kilograms of chemical high-explosive TNT detonated and destroyed Igloo 572. The igloo doors, which opened to a west-by-southwest direction, were blown from the facility in the initial stages of the blast. The final result of the blast was a complete vaporization of the igloo contents, a sizeable crater, and removal of some rock strata below the igloo. Off site, windows in buildings several miles from the igloo were broken. Three handling-crew personnel, moving high-explosive materials to the interior of the igloo from an outside location, were believed to have initiated the accident. The cause of the accident was never identified, but was speculated to be the result of an accidental mechanical contact

between two high-explosive components. Site personnel received no serious personal injuries. The contents of adjacent igloos were not impacted [5].

The only known radioactive material dispersed as a result of the explosion was uranium metal (Davis, 1963). Two types of uranium metal were involved in the accident: tuballoy (manufactured through separation of uranium from ore) and depleted uranium (depleted in its content of ^{234}U and ^{235}U isotopes) [6].

Medina Facility personnel and an Air Force/Sandia Corporation helicopter team conducted radiation surveys on site and downwind from the site immediately after the accident. Using portable alpha- and gamma-radiation survey instruments, no alpha-radiation count rates or radiation exposure rates were measured at levels above that typical of naturally occurring background sources. Metallic fragments and unexploded high explosives were not identified as part of the debris (AEC, undated). Wind direction and velocity data were obtained from the U.S. Weather Bureau, focusing downwind survey teams in a west-by-southwest direction to the town of La Coste. La Coste, 32.2 kilometers (20 miles) downrange from the igloo, was specifically targeted for survey as the dust-and-debris cloud was observed to be quite heavy near the ground [7].

The AFSC is the regulatory authority for releasing the RW033 site and required that an additional characterization survey be completed. The following figure provides a site conceptual model of the RW033 site.

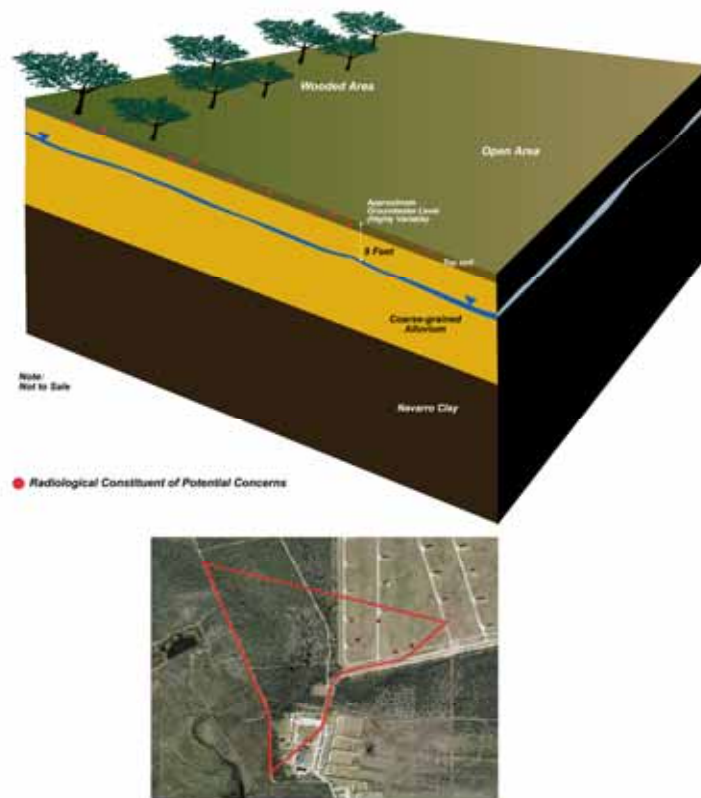


Figure 7. RW033 site conceptual model

ECC Project Team Scope of Work

ECC is completing the remedial investigation through site closure of low-level radioactive disposal (RAD) at 91b sites RW015, RW033, and RW017. The effort was initiated by development Derived Concentration Guideline Limits (DCGLs) and a series of work plans consistent with Federal, State, and local laws and regulations as well as complying with the Air Forces and base specific rules, and instructions.

All activities are coordinated with US Air Force and Texas State Agencies including: AFCEE, Lackland AFB, Civil Engineering Squadron (CES)/Environmental Flight, Air Force Institute Operational Health, Air Force Safety Center, Texas Commission on Environmental Quality (TCEQ), and Texas State Historic Preservation Organization. This ensures appropriate remedy selection and documentation in support of site closure.

CHALLENGES

To execute this scope of work AFCEE chose to implement this effort through one of its major contracting initiatives that began in federal fiscal year of 2001 the performance-based cleanup (PBC). In PBC, the contractor in essence owns the site cleanup until complete, and is paid for achieving well-defined milestones. Since the driving mechanism is profit, the process encourages innovative solutions to accelerate cleanup. The regulator must approve any selected cleanup remedy; thereby ensuring human health and the environment are protected.

The challenges associated with execution of scope of work such as one associated with these three 91b sites and relate to scope creep, and behavioral inertia, and in many cases the issues are interrelated.

Scope Creep

This common phenomenon is where additional requirements are added after a project has started without reconsidering the resourcing or timescale of the project. Scope creep arises from the misapprehension that such small additions will not affect the project schedule.

Behavioral Inertia

There are three basic descriptors in the physical sciences associated with the properties of inertia (1) indisposition to motion, excitation or action, (2) resistance to change lack of activity; (3) sluggishness. In the case of the psychological-behavioral analog the applicable aspect takes the form of resistance to change. It should be noted that the resistance to change is more not so much a resistance to change however is more accurately associated with an understanding of new techniques and approaches relative to the more well known tried and true approaches.

An aspect of the project that speaks to these challenges is provided in the following

Example

ECC was contracted by AFCEE to achieve site closure addressing the potential chemical contamination present in soil and or groundwater at concentrations above the action levels set by the Texas Risk Reduction Program (TRRP) in one of the radioactive wastes sites, specifically RW017. The typical process for addressing these issues under the TRRP is the completion of an Affected Property Assessment (APAR). The APAR elements include but are not limited to:

- Completion of a written narrative that is a review of historical data and or
- The collection of additional data, as required
- Identification of the appropriate remedial action, as required

Upon acceptance of the APAR and after completion of the remedial process the TRRP requires the completion of a Response Action Completion Report (RACR) i.e. demonstration that the remediation, if

required, has been successfully executed and or documented. Finally, this process is followed by the completion of Decision document that documents appropriate closure of the site.

The typical process for executing this effort takes a period of approximately one and one half years to complete and includes multiple review cycles by all project stakeholders including Texas Commission of Environmental Quality (TCEQ), Lackland Air Force Base (LAFB), and AFCEE.

ECC was able to abbreviate this process by generating a Tier 1 ecological exclusion criteria checklist and narrative report that successfully demonstrated the Contaminants of Concern (COC) concentrations are less than Method Quantitation Limits (MQLs) or background and therefore the process detailed in the TRRP was not applicable. Therefore the site could be closed with no further action. The TCEQ completed its review and issued a letter of confirmation that no exceedances had occurred and resultantly the Tier 1 ecological exclusion checklist criteria had been met.

However, since this methodology fell outside the standard TRRP process it took some extra time for review evaluation by the project stakeholders to confirm that the this methodology fully satisfied not only the air force bases commitments to the state but also successfully satisfied the bases and air forces rules, regulations and instructions. Further, implementing this approach required some additional changes to the final reporting requirements for site closure.

PROJECT CURRENT STATUS

The Project Team's unique planned project approach that included:

- Development and regulatory approval of DCGLs and in parallel with the production other project specific work plans (Quality Assurance Plan, Health and Safety Plan, Final Status Survey Plan, Remedy Work Plan, Storm Water Pollution Prevention Plan, Waste Management Plan)
- Parallel execution of characterization of the three RW sites, followed by parallel remedial efforts
- State approval of a Tier 1 ecological exclusion criteria checklist and narrative report that demonstrated the COC concentrations are less than MQLs and therefore the process detailed in the TRRP was not applicable

The approach process summarized above moved the project from contract award in July, 2005 to plan conceptualization and DCGL development, to project closure within a one year period. All three of the sites have been characterized, remediated, and restored. Approximately 198 cubic meters (7000 cubic feet) of radioactive waste containing cesium, depleted, natural, and enriched uranium has been removed from the total of 0.382 square kilometers (94.4 acre) land area. Multi Agency Radiation Site Survey and Investigation Manual (MARSSIM) based Final Status Survey Reports have been approved by the AFSC. The decision documents for each site are currently generated and are under varying stages of review. The development and approval process for the decision documents is expected to be complete by August of 2007.

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