NVLSP
NATIONAL VETERANS LEGAL SERVICES PROGRAM

Document Appendix:

NVLSP And VLSC White Paper Confirming That Veterans Who Served in Guam from 1962-1975 Were Likely Exposed to Dioxin-Containing Herbicide Agents Including Agent Orange

May 11, 2020

Yale Law School
Veterans Legal Services Clinic

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This appendix provides a selection of sources cited in the National Veterans Legal Services Program (NVLSP) and Veterans Legal Services Clinic at Yale Law School (VLSC) white paper. Additional sources are not reproduced here due to copyright restrictions.

in mortality profiles between men and women, and the information provided by Kang and colleagues may not necessarily apply to the majority of American Vietnam veterans who are male. VA informed the committee that an updated mortality study was underway as of 2017 (Davey, 2017), but no results were available at the time the committee completed its work.

MILITARY USE OF HERBICIDES IN VIETNAM

Military use of herbicides in Vietnam took place from 1962 through 1971. Specific herbicides were selected based on tests conducted in the United States and elsewhere that were designed to evaluate defoliation efficacy (IOM, 1994; Young and Newton, 2004). Four compounds were used in the herbicide formulations in Vietnam: 2,4-dichlorophenoxyacetic acid (2,4-D); 2,4,5-trichlorophenoxyacetic acid (2,4,5-T); 4-amino-3,5,6-trichloropicolinic acid (picloram); and dimethylarsinic acid (DMA, or cacodylic acid). These herbicides were used to defoliate inland hardwood forests, coastal mangrove forests, cultivated lands, and zones around military bases. Whereas the chlorinated phenoxy acids 2,4-D and 2,4,5-T persist in soil for only a few weeks, picloram is much more stable and can persist in soil for years, and cacodylic acid is nonvolatile and stable in sunlight (NRC, 1974). More details on the herbicides used are presented in Chapter 4.

However, other toxic compounds were also present in these herbicide formulations. Specifically, polychlorinated dibenzo-*p*-dioxins (PCDDs), which includes 75 different congeners that vary by the number and placement of the chlorine atoms, can be formed during the manufacture of 2,4,5-T and the half-lives of these in subsurface soil may exceed 100 years (Sinkkonen and Paasivirta, 2000). One contaminant of particular concern is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). This compound is an unintentional byproduct of the production of 2,4,5-trichlorophenol (NRC,1974). The structures of the chemicals of interest (COIs) identified above are shown in Figure 2-1.

Herbicides were identified by the color of a band on 55-gallon shipping containers and were called Agent Pink, Agent Green, Agent Purple, Agent Orange, Agent White, and Agent Blue. Table 2-2 shows the herbicides used in Vietnam by color code name and summarizes the chemical constituents, concentration of active ingredients, years used, and estimated amount sprayed, based on original and revised estimates. Two different formulations of Agent Orange were used in the course of military operations in Vietnam. All agents were liquid except Agent Blue, which was used in powder form in 1962–1964 and as a liquid in 1964–1971. Agent Pink, Agent Green, Agent Purple, Agent Orange, and Agent Orange II all contained 2,4,5-T and were contaminated to some extent with TCDD. Agent White contained 2,4-D and picloram. Agent Blue (powder and liquid) contained cacodylic acid.

Andersen AFB's Legacy: Operation Linebacker II

By Jeffrey N. Meyer, 36th Wing Historian / Published December 18, 2017

ANDERSEN AIR FORCE BASE, Guam -- Thirty-nine years ago, Andersen Air Force Base became involved in Operation Linebacker II, an operation that would arguably be the most significant event in the installations long and distinguished history. Andersen AFB became the site of the most immense buildup of air power in history. More than 12,000 Airmen and 153 B-52s took up five miles of ramp space on the flight line. This article is about the operation that had many names, to include "The Eleven Day War", "11 Days of Christmas", "December Raids or Bombings" and "The Christmas Bombings"- but whatever moniker is used, it boils down to the massive bombing effort of North Vietnam from December 18-29, 1972.

For there to be an Operation Linebacker II there must have been a Linebacker I. The first operation was in response to the "Easter Offensive" when North Vietnamese Army invaded South Vietnam. From May 9 to Oct. 23, 1972, units of the Air Force and Navy bombed targets in throughout North Vietnam. Although the B-52s were minimally used in these northern bombings they continued their traditional Arc Light missions of bombing Vietcong positions south of the Seventeenth Parallel.

As part of the build-up for Linebacker I, Strategic Air Command (SAC) launched Operation Bullet Shot, which sent 124 more B-52s from bases in the U.S. to Guam; bringing the total B-52 strength available for operations in Southeast Asia to 207. One hundred fifty three B-52s were at Andersen AFB (55 B-52Ds and 98 B-52Gs) and another 54 B-52Ds were based at U-Tapao, Thailand. Over 12,000 airmen on Guam were packed into the dorms, with spill-overs residing in temporary steel dorms called Tin City. Canvas Courts, a collection of tent shelters and available off base hotels, and even the base gymnasium were converted to living quarters to house all of the Airmen. The last time there were this many bombers and Airmen on Guam was 1945, for World War II air operations against Japan.

After the Linebacker I bombings halted, Secretary of State Kissinger announced that "peace is at hand." It seems that history has a bad habit of repeating itself. Similarly, after the Munich Conference with Adolf Hitler in 1939, British Prime Minister Neville Chamberlain declared, "peace for our time" right before World War II started. The North Vietnamese rebuilt their military strength during this "peace". On December 13, 1972, the North Vietnamese delegates walked out of the Paris peace talks, and two days later President Nixon (a big football fan, thus the operation's name "Linebacker") ordered the implementation of Linebacker II and the continuation of airstrikes against North Vietnam. However, these new bombing missions would be much different; the big B-52 bombers would have the central role in the operation. The majority of U.S. Air Force personnel stationed on Guam and in Thailand were surprised by the new air offensive, but most air crews agreed that it was about time that B-52s were used in this capacity.

On the first night of the operation 129 bombers launched, 87 from Andersen AFB and another 42 from U-Tapao. There were an additional 39 support aircraft from Seventh Air Force, Navy's Task Force 77 (Six aircraft carriers in the era) and Marine Corps F-4 fighter escorts, F-105 Wild Weasel SAM-suppression missions, Air Force EB-66 and Navy EA-6 radar-jamming aircraft, chaff drops, KC-135 refueling capability, and search and rescue aircraft. The skies over North Vietnam were dominated by U.S. airpower to guarantee the success of the operation and the safety of the aircraft involved.

Even with these precautions, three B-52s were shot down the first night after being hit by SA-2 surface-to-air

missiles (SAMs). Tragically, an Andersen crew aboard a B-52G, call sign Charcoal 01, seconds after dropping bombs on target, would be hit by a SAM. The pilot, Col. Donald L. Rissi (who should have been safely in states), and gunner, Master Sgt. Walt Ferguson, were killed. Three other crew members: Maj. Dick Johnson, radar navigator; Capt. Bob Certain, navigator; and, Capt. Dick Simpson, electronic warfare officer, survived the attack, but were captured. They were later released from captivity in 1973 as part of Operation Homecoming, the return of U.S. service members held as POWs in North Vietnam. The remains of Lt. Robert J. Thomas, copilot, were later identified and returned to his family in 1978.

Another B-52D from U-Tapao, Rose 1, was shot down the first night and crashed into a lake in the Hanoi suburbs. Two of her Airmen are still listed as missing-in-action (MIA) and four became Prisoners of War (POW). The wreckage of the aircraft has been left in the lake, part of its fuselage and the landing gear visible above the water, and it serves as memorial for the Vietnamese people's war effort against the United States. Today, Huu Tiep Lake is also known as B-52 Lake. The list of Airmen killed, MIA, and captured would repeat itself almost daily until the last day of operations.

The third day of operations was the deadliest of the entire operation. The North Vietnamese were learning the repetitive tactics used on the B-52s bombing runs. As waves of B-52s were approaching Hanoi, North Vietnamese MiGs would keep their distance and not attack. This was because the MiGs were reporting the B-52s heading, altitude, and air speed to SAM sites on the ground. Heavy SAM launches followed and they flew directly into the bombers paths resulted in six B-52s shot down. Five of the aircraft lost were from Andersen AFB and of those five, four were G models. Only about half of the B-52Gs models during Linebacker II were modified for Southeast Asian operations as the B-52D. The G models did not have the EW systems and robust jamming capabilities of the veteran D models, which led to dire consequences. This resulted in Andersen's B-52s being returned to their traditional Arc Light missions in South Vietnam and U-Tapao's aircraft taking the bulk of the North Vietnam bombings until the eighth day of operations. Besides the EW issues with the G model, U-Tapao's location was much closer to its targets, meaning quicker turnaround and no mid-air refueling.

After a 36-hour Christmas break, aircraft had completed maintenance checks and air tactics were changed. Day Eight would be the second largest attack of the whole campaign as 120 B-52s from Andersen and U-Tapao attacked military areas around Hanoi and Haiphong. Though the Air Force lost two additional B-52s from U-Tapao, the mission was a huge success because North Vietnam contacted Washington D.C. afterwards to resume peace talks. However, President Nixon would not call off the bombings until talks had actually resumed. The final two days of Linebacker II would see two more B-52s lost. One of those was from the Andersen's 43d Strategic Wing.

Linebacker II ended on December 30 1972 and on January 23, 1973, the cease-fire was signed effectively ending the war for the U.S.

Overall Air Force losses during Operation Linebacker II included fifteen B-52s, two F-4s, two F-111s, and one HH-53 search and rescue helicopter. Navy losses included two A-7s, two A-6s, one RA-5, and one F-4. Seventeen of these losses were attributed to SA-2 missiles, three to daytime MiG attacks, three to antiaircraft artillery, and three to unknown causes. Bombers stationed at Andersen flew729 sorties, each one a long 12 to 18 hour mission over the11 days.

More than 20,000 tons of bombs were dropped on targets in and around Hanoi and Haiphong, with relatively few civilian casualties. The was because the operation was focused on military sites and not on striking

civilians. During Linebacker II, 1,624 people were killed in North Vietnam, 1,318 in Hanoi and 306 in Haiphong. By comparison, during nine days of bombing on Hamburg, Germany in 1944, less than 10,000 tons were dropped and more than 30,000 people died.

Andersen AFB will hold a Linebacker II memorial ceremony at the 36th Wing Headquarters on Wednesday, Dec. 20, 2017 at 2:00 p.m.

Of final note, there are still eight Airmen from Andresen AFB's MIA who flew in Linebacker II missions.

PHOTO DETAILS / DOWNLOAD HI-RES

On to the Next Mission: A B-52 bomber takes off from Andersen Air Force Base in support of Linebacker II. (Photo courtesy of U.S. Air Force)

GUAM
CROSSROADS OF THE PACIFIC

VOL XI NO 36 COMMANDER NAVAL FORCES MARIANAS MARCH 21, 1969

HM1 Michael Bober of the USS Bulloch County (LST 509), HM1 James Cordeiro of USS San Joaquin County, Lieutenant Donald L. Mellman, Medical Officer of Landing Ship Squadron Three, and HM3 Joseph Zambie of the Naval Hospital, receive instructions from Commander M. G. Anderson, Chief of the Neurological Surgery Clinic at the Naval Hospital. The instruction and tour of the hospital was arranged by LT Mellman as part of his continuing education program for corpsmen attached to Landing Ship Squadron Three.

LST Hospital Corpsmen Undergo Training

As a part of the continuing education program for hospital corpsman assigned to ships in Landing Ship Squadron Three, the Squadron Medical Officer, Lieutenant Donald L. Mellman, MC, USNR, recently conducted a group of the corpsmen on an instructional tour of the Naval Hospital Guam. By discussing clinical problems informally at the hospital as well as Naval Station Dispensary from time to time Dr. Mellman enables the corpsmen, who serve on independent duty, to be more fully equipped to meet the medical needs aboard their respective ships.

These corpsmen are primarily responsible for the health of the crews and the sanitation of the fourteen Tank Landing Ships in the Squadron. These men must be able to treat relatively simple problems such as headaches and colds as well as manage serious diseases and injuries until definitive medical attention can be obtained.

Besides dealing with the physical health, corpsmen must also show insight and discretion in areas of interpersonal relationship, since members of the crews often call upon them for assistance in solving personal problems. He teaches the men the value of personal hygeine and the fundamentals of first aid.

Part of the corpsman's responsibility include inspection of his ships for discrepancies in sanitation and for hazards to the health and well being of the crew.

In his administrative duties, the corpsman must account for medical supplies and drugs and insure that his ship is always medically prepared for any emergency. It is his responsibility to maintain up-to-date and accurate medical records on each man in the crew and to prepare medical reports required of the Command.

The Squadron Medical Officer lends assistance and guidance on an individual basis to each of the corpsmen as the need arises.

Take Fire, Add Water, Get Huge Water Shortage

Last week, Crossroads reported that the fire department and volunteers on Guam fought over 40 fires. We also suggested that these fires could affect everyone on Guam. This particular statement was reemphasized last Friday after Crossroads had gone to press. Commander Naval Forces Marianas issued a message to all commands to conserve water and listed the ways this could be accomplished.

Later developments prompted a second message stating that water conservation at the Naval Station and commands south of Agana have had a remarkable effect thus eliminating the need for conservation at those commands. NAS and NRS Barrigada continue to have a serious water shortage according to the message.

There is a serious water shortage on Guam, and residents should cease such things as watering the lawns, washing cars and any other water usage which consumes a large amount of water. Host activities were also directed to reduce water usage by tenant commands.

Fire is not only dangerous as you can see, but can have personal significance. The water consumed during these weekend fires facilitated the water shortage statement.

It is again reiterated that fire is damaging, so watch that burning cigarette, that burning trash. Remember, fire helps no one.

All-Service Ceremony Honors DSC Recipient

The ceremonial brigade was out in full this morning in downtown Agana for the presentation of the Distinguished Service Cross to Army Sergeant Joseph Meno Perez (Ret) of Agat, Guam.

Presenting the award was Major General Charles T. Horner, Commanding General, 2nd Logistical Command, Okinawa. Other distinguished guests were Governor Guerrero, Admiral Philip P. Cole, Air Force Brigadier General Johnson, and other distinguished members of the community.

Sergeant Perez is being awarded the DSC for his extraordinary heroism in action in the Republic of Vietnam.

The following is an account of the action by Sergeant Perez:

"On May 26 my unit was involved in a 'Search and Destroy' mission near Dak To on the Cambodian border. Early in the morning we started down a ridge line. About 9:30 a.m. we started to take a break when sniper fire hit us. Charlie (the Viet Cong) seemed to be in the trees all around us. The first shots wounded one of the men in my squad. (Sgt. Perez' Commanding Officer was also killed in this volley). Charlie opened up in front of us with rifle fire and a 30 caliber machine gun. We were all shooting at Charlie and I was gathering ammo and grenades from the dead. (From the official citation. "Perez directed the troops to seek cover while he remained exposed to the enemy and laid down suppressive fire").

"We were pinned down by machine gun fire when a 'Chicom' grenade landed beside me. I could hear the fuze sizzling and knew I couldn't get away. I grabbed the grenade in my right hand and held my helmet over it with my left. The grenade went off and threw me several feet. (From the official citation. "Without hesitation, he seized the grenade and absorbed its explosion with his body to shield his comrades from the blast").

For this unselfish act of heroism Sergeant Perez was awarded the nation's second highest award for valor, the Distinguished Service Cross.

Foster Homes Needed Now

Foster homes are very badly needed in Guam for children from infancy to the age of 18 years old. The homes are especially needed for the children between 12 and 18 years old.

A foster home is a temporary home for an unrelated child who will live as a member of the foster family until he can return to his own home. Some may need foster care for only a few months, others for longer periods of time. All of these children have a great need for care, understanding and affection if they are to become self-reliant adults.

If you are interested in opening your door to one or more foster children, contact Mr. Gene Hammond of the Division of Social Services, Department of Public Health and Social Services at 42-5149 or 44-6165.

Navy DN Rescues Surfer

A Navy Dental Technician from the Dental Clinic demonstrated what simple training can do in an emergency last weekend. DN Paul Fink of the Prosthetic Department of the Dental Clinic, accompanied by his wife, was enjoying the beach near Talafofo when a heavy set Guamanian surfer lost his balance and was thrown from his board.

The Guamanian was shook up and unable to swim after the occurrence. Without thought, Fink

(Continued on Page

last year, although there are fewer personnel aboard this year. Several other leaks were located and repaired by the team from Public Works Center who have been searching for the cause of the water shortage.

Because of the growth of NCS and its present water usage, it is possible that future plans will include a hook-up with the Government of Guam well across the highway behind the administration building. It is also possible that the present water treatment plant will be expanded, said LTjg Swan.

Fire threat still remains

The dry season is almost over on Guam. Yet the threat of boonie fires still remains. What does the boonie fire mean to NCS personnel?

The NCS fire department has recorded 23 alarms from the first of April, an average of about one per day. Of the 23, grass fires account for 19 alarms. The rest are automobile fires and miscellaneous alarms.

Carelessness is the main cause for the grass fires, said Fire Captain O. Knox. A tossed cigarette butt dropped while boonie stomping can end in a big fire.

One night this past month, a fire started between the executive officer's house and Sat-Comm. Movie-goers watching the show at NCS theater could see the glow of the fire as it burned. The fire proved difficult to reach. Firemen and men from "I" division were called in. Once the site was reached it took an hour and a half to put the fire out.

"Some fires require the assistance of Government of Guam fire departments," Captain Knox said. A recent example of this was the fire near Wettengel Elementary School, at the junction of the NCS road and Marine Drive, in the Harmon Village area this last weekend.

Boonie fires resulted in the prohibition of hunting for a short time in the past two months. They also require water which is short at NCS this month.

Butts and carelessly thrown matches are not the only causes of boonie fires. Last year, it was reported, the heat of an exhaust from a motorcycle was enough to start a fire.

The grass fires usually damage very little except coconut trees, grass and other flora. But, in some cases, the fires burn power poles, destroy livestock and damage houses.

"If we let the fires burn," said Captain Knox, "we risk the chance of burning down a power pole." That could inconvenience a lot of people.

The NCS fire department is a division of the Naval Station fire department.

Mr. Wickersham

Clubs to compete

Two NCS organizations will be among those participating in the annual Table Fashions Tea sponsored by the churchwomen of Saint John's Episcopal Church.

The NCS Officers' Wives Club, under the chairmanship of Mrs. Guy, and the NCS Protestant Women of the Chapel, guided by Mrs. LeFils, are both busy making arangements for their tables.

The Tea is basically a table-setting competition. Joe Murphy, managing editor of the Guam Daily News, will announce the most popular ballot award to the table voted best of the afternoon by the public.

OWC holds outing

Skilled hands formed a shape on the spinning pottery wheel. Women of the NCS Officers' Wives Club looked on in admiration as the shape began to look more like a wide mouth bowl.

This was part of the organization's monthly outing. Ladies of NCS OWC visited the NCS Ceramics Shop, where they saw a display of works done recently by students attending classes in ceramics at the shop. Mrs. C. M. Williams, shop manageress demonstrated methods of ceramic casting to the group. The various steps of wheel-thrown pottery were demonstrated by Lieutenant (junior grade) Leonard Zitnik.

ADMIRING THE EXAMPLES of recent student work in both ceramics and pottery are (l-r) Mrs. James P. Redgate, Mrs. Charles E. Delaney, Mrs. Ronald T. Botsko, Mrs. David M. Chubb, Mrs. Jerry M. VanCleave and Mrs. Jack O. Walker.

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Record of Decision:

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THE UNITED STATES AIR FORCE
INSTALLATION RESTORATION PROGRAM

FINAL
RECORD OF DECISION
FOR
URUNAO DUMPSITES 1 AND 2
URUNAO OPERABLE UNIT

ANDERSEN AIR FORCE BASE, GUAM

December 2003

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13. ABSTRACT (Maximum 200 words)

This Record of Decision presents the rationale for selecting Excavation and Offsite Disposal as the preferred cleanup alternative for Urunao Dumpsites 1 and 2 located west of Northwest Field, Andersen Air Force Base, Guam. This Record of Decision summarizes the history, environmental background, extent of contamination, associated human health and ecological risks, evaluation of remedial alternatives, public involvement, and rationale for selecting the preferred remedy for the Urunao Operable Unit.

14. SUBJECT TERMS

- *Andersen AFB*
- *Remedial Investigation/Feasibility Study*
- *Public Involvement*
- *Human Health Risk Assessment*
- *Ecological Risk Assessment*
- *Excavation and Offsite Disposal*

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1. DECLARATION

1.1 Site Name and Location

Urunao Dumpsites 1 and 2 are located on private property west of the Andersen Air Force Base (AFB) Northwest Field in Guam. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for Andersen AFB is GU6571999519. Prior to 1986, Urunao Dumpsites 1 and 2 were not included in any of the four Andersen AFB Installation Restoration Program (IRP) Operable Units (OUs). A fifth OU (Urunao OU) was established in October 1999 to include Urunao Dumpsites 1 and 2.

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) is a legal technical document prepared for the Urunao OU. The purpose of this ROD is to present the public with a consolidated source of information regarding the history, environmental background, extent of contamination, associated human health and ecological risks, evaluation of remedial alternatives, public involvement, and the proposed *Excavation and Offsite Disposal* as the preferred alternative to clean up Urunao Dumpsites 1 and 2.

The United States Air Force (USAF), the United States Environmental Protection Agency (USEPA) Region IX, the Guam Environmental Protection Agency (GEPA), and affected property owners have all agreed that *Excavation and Offsite Disposal* is the preferred alternative to clean up Urunao Dumpsites 1 and 2. This ROD was prepared in accordance with the Administrative Record for the sites and in compliance with 40 Code of Federal Regulations (CFR), Part 300. The CFR included the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Hazardous and Solid Waste Act of 1982 (HSWA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan of 1990 (NCP).

1.3 Assessment of the Site

Constituents of concern (COCs) that were identified in surface and subsurface soils at Dumpsite 1 include antimony, arsenic, barium, cadmium, lead, manganese, and dioxins. These COCs pose risks to human health and the environment. Additionally, solid waste materials and deteriorated ordnance and explosives (OE) materials were observed at Dumpsite 1 that may pose safety risks to human health and the environment. COCs that were identified in surface and subsurface soils at Dumpsite 2 include benzo(a)pyrene, polychlorinated biphenyl (PCB) Arochlor-1254, antimony, lead, and manganese. These COCs pose potential risks to human health and the environment. Solid waste materials were also observed at Dumpsite 2 that may pose safety risks to human health and the environment.

The preferred *Excavation and Offsite Disposal* cleanup alternative presented in this ROD is a necessary response action to protect human health and the environment, including the underlying groundwater, at Urunao Dumpsites 1 and 2.

1.4 Description of the Selected Remedy

Urunao Dumpsites 1 and 2 are located on steep slopes, over the cliffline and outside the boundary of Andersen AFB. The Dumpsite 1 study area covers approximately 16.5 acres and the Dumpsite 2 study area covers approximately 6.2 acres. Near the end of 2001, an unpaved public access road was constructed within ½ mile of the northwestern portion of Dumpsite 2. Construction of this access road was integral in making the *Excavation and Off-Site Disposal* cleanup alternative feasible. This access road will be improved by the USAF for the purpose of the cleanup at Dumpsites 1 and 2.

Under the *Excavation and Off-Site Disposal* cleanup alternative, all solid waste debris and OE materials will be removed from the Dumpsite 1 prior to excavating and removing any remaining COC-impacted soils. Some deteriorated OE fragments will be burned at Dumpsite 1 using a steel burn pan. Ashes and slag remaining from the burn operation will be removed and disposed of properly, based on laboratory analyses. Other OE materials will be transported to the Andersen AFB Explosive Ordnance Disposal (EOD) facility for proper disposal. A screening of specific procedures and controls for handling OE materials will be included as part of the remedial design, including the handling of OE materials that may be deemed unsafe to remove from the site. All OE material handling will be in accordance with Department of Defense Explosive Safety Manual (DDESM) guidelines and in consultation with the Department of Defense Explosive Safety Board (DDESB). The OE material handling will also be coordinated with GEPA to meet any permit conditions for open burning and to minimize the effects associated with airborne material generated from the burning of OE materials. The remedial design will incorporate procedures that will include, but not be limited to, monitoring ambient atmospheric conditions to ensure that burns are only performed during optimal conditions.

After removing the solid waste debris and OE materials from Dumpsite 1, COC-impacted soils will be excavated and temporarily stockpiled onsite. Composite samples of stockpiled soil will be collected and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) parameters to determine whether the COC-impacted soil is considered hazardous waste for disposal purposes. All COC-impacted soils with concentrations exceeding the cleanup standards, but not characterized as Resource Conservation and Recovery Act (RCRA) hazardous waste, will be transported to the Andersen AFB Landfill for disposal. Any COC-impacted soils with concentrations exceeding the cleanup standards that are also characterized as RCRA hazardous waste will be shipped to a USEPA-certified off-island hazardous waste disposal facility. Once the COC-impacted soils, OE materials, and solid waste materials are removed, the areas disturbed by the cleanup activities will be revegetated with native plants and trees. The cleanup of Dumpsite 2 is similar to Dumpsite 1, except that surface OE materials are not present at Dumpsite 2.

By selecting *Excavation and Off-Site Disposal* as the preferred cleanup alternative, all solid waste debris, OE materials, and COC-impacted soils will be removed from Dumpsites 1 and 2, allowing for unlimited use and unrestricted exposure for the future use of the land.

1.5 Statutory Determination

The preferred *Excavation and Offsite Disposal* cleanup alternative meets the CERCLA statutory requirements, and to extent practicable the NCP, and site-specific experience gained in the Superfund program. The *Excavation and Offsite Disposal* cleanup alternative will also comply with Applicable or Relevant and Appropriate Requirements (ARARs), including the Maximum Contaminant Levels (MCLs) for groundwater, the Coastal Zone Management Act, the Endangered Species Act, RCRA Part 261 Subpart C Characteristics of Hazardous Waste, and CERCLA Removal Action regulations.

Using the preferred *Excavation and Offsite Disposal* cleanup alternative, the source of the solid waste debris, OE materials, and COC-impacted soils will be removed from Dumpsites 1 and 2, thereby eliminating the exposure pathways for human and ecological receptors. The *Excavation and Offsite Disposal* cleanup alternative is a permanent solution that eliminates the potential for offsite migration of contaminants or migration of contaminants from the subsurface to groundwater. Due to the steep slopes at Dumpsites 1 and 2, the implementation of the *Excavation and Offsite Disposal* cleanup alternative will be difficult. However, as compared with other remedial alternative capital and operation and maintenance (O&M) costs, the *Excavation and Offsite Disposal* cleanup alternative will be more cost effective in the long-term because the O&M costs will be eliminated.

A 5-year review of this ROD will be unnecessary because no residual COCs will remain at Dumpsites 1 and 2 at concentrations exceeding cleanup levels after implementation of the *Excavation and Offsite Disposal* cleanup alternative. In addition, this cleanup alternative will allow for unrestricted use of the land.

1.6 ROD Data Certification Checklist

The following information is included in the Decision Summary, Part 2 of this ROD, along with reference tables, figures, and section numbers.

- COCs and their respective concentrations for Dumpsites 1 and 2 are presented in Tables 2-6, 2-7, 2-8, and 2-9 and Figures 2-12 and 2-13.

- The baseline human health risks represented by each COC are presented in Tables 2-10 through 2-37; and the baseline ecological risks are presented in Tables 2-38 through 2-58 and Figures 2-5 and 2-11. The summary of site risks is presented in Section 2.7.

- The established cleanup levels for each COC are presented in Tables 2-59 and 2-60 and Figures 2-12 and 2-13.

- The principal threats from COC sources are discussed in Section 2.11.

- The current and reasonably anticipated future land use and current and potential future uses of groundwater in are presented in Section 2.6.

- The potential future land and groundwater uses that will be available at the dumpsites following implementation of the preferred remedial action are presented in Section 2.12.

- The estimated present-worth remedial costs, including the projected number of years over which the remedial cost was estimated, are presented in Tables 2-62 and 2-63 and in Sections 2.10 and 2.12.

- Key factors that led to selection of *Excavation and Offsite Disposal* as a preferred cleanup alternative are presented in Section 2.13.

Additional background information regarding the environmental investigation for Dumpsites 1 and 2 can be found in the Administrative Record files.

1.7 Authorizing Signatures and Supported Agency Acceptance of the Remedy

The following signature pages document that the USAF, USEPA Region IX, and GEPA supported acceptance of the *Excavation and Offsite Disposal* cleanup alternative for Urunao Dumpsites 1 and 2 (Urunao OU).

INSTALLATION RESTORATION PROGRAM

PHASE I: RECORDS SEARCH

ANDERSEN AIR FORCE BASE, GUAM

PREPARED FOR:

UNITED STATES AIR FORCE
HQ SAC / DEPV
OFFUTT AFB, NEBRASKA

WITH THE
ASSISTANCE OF:

HQ AFESC / DEVP
TYNDALL AFB, FLORIDA

SUBMITTED BY:

REYNOLDS, SMITH AND HILLS, INC.
JACKSONVILLE, FLORIDA

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
GAINESVILLE, FLORIDA

MARCH 1985

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06	06		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

11. Title: Installation Restoration Program, Phase I Records Search for Andersen AFB, GU

19. A search of USAF, state and federal agency records and interviews with past and present base personnel and agency representatives were conducted to identify past hazardous waste generation and disposal practices at Andersen AFB, Guam. Andersen AFB is located on the northeastern end of the island of Guam, Mariana Islands, in the southwest region of the Pacific Island (3,318 miles west of Hawaii, 1,499 miles east of the Phillipines, and 1,563 miles southwest of Japan). Twenty locations and/or facilities were identified as potential hazardous waste sites. Follow-on recommendations included alternate techniques for handling hazardous wastes, confirmation studies and in some cases, closure of existing hazardous waste disposal sites.

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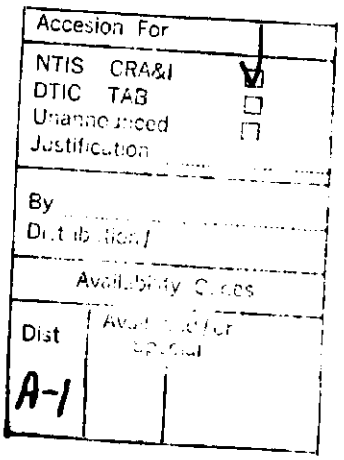

INSTALLATION RESTORATION PROGRAM

PHASE I: RECORDS SEARCH

ANDERSEN AIR FORCE BASE, GUAM

Prepared for:

UNITED STATES AIR FORCE
HQ SAC/DEPV
Offutt AFB, Nebraska

With the Assistance of:

HQ AFESC/DEVP
Tyndall AFB, Florida

Submitted by:

REYNOLDS, SMITH AND HILLS, INC.
Jacksonville, Florida

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Gainesville, Florida

March 1985

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dichloromethane). The waste rags containing small amounts of these solvents are usually disposed of in the landfill.

43rd AMS Photographic Laboratory

This operation produces only small quantities of rags saturated with methyl alcohol that are used to clean the photographic equipment, including lenses, mounted on aircraft. These rags are disposed of in the sanitary trash. No problems are anticipated from this disposal technique.

Arts and Crafts Photographic Laboratory

This operation, located in Bldg. 25005, generates small quantities of waste fixer and developer, which are disposed of in the sanitary sewer.

4.1.3 PESTICIDE HANDLING, STORAGE, AND DISPOSAL

Pesticides and herbicides are currently being used by the 43rd CES Entomology Section to maintain grounds and structures and to prevent pest-related health problems. Before 1984, the 43rd CES Roads and Grounds Shop was responsible for herbicide applications. Pest-control measures include health-related and structural insect and rodent-control rodent-control programs; weed-control at security fences, parking areas, and utility and antenna sites; and landscape maintenance programs.

Pesticides have been stored and handled in Bldg. 20010 since 1978. During the same period, herbicides have been stored and handled in Bldg. 20021. Prior to 1978, pesticide handling and storage had been conducted in a building which was located where the present MAC terminal stands. For an undetermined length of time up to approximately 1967, pesticides had been stored in an igloo (No. 8479) in the northwestern portion of AAFB.

Records of types and quantities of pesticides used are available from 1982 to present. No record or recollection of disposal of excess or outdated pesticides is available.

Until about 1977, pesticide wastewaters, generated by rinsing spray equipment, were disposed of on the ground at various rinse water sources. Since no designated area was used for repeated disposal of rinse water and due to the dilute concentration of pesticides in these wastes, no significant pesticide residuals are anticipated from these disposal practices. Since 1977, rinse waters have been used as diluent for subsequent formulations of the same pesticides. Empty pesticide containers have always been landfilled. Prior to the mid-1970s, the containers were landfilled without rinsing; subsequent to that time, all containers have been triple-rinsed and punctured or crushed prior to landfilling.

Two incidences of accidental pesticide and herbicide spills have occurred. The most recent spill occurred at the Harmon Annex tank farm on Feb. 8, 1984, when 1,500 gal of a Diuron/water mixture were released from a herbicide sprayer. The spill resulted from a broken hose and created a stream of herbicide which covered approximately 1/3 acre before seeping into the ground. The residual herbicide left on the ground surface was placed in metal drums and removed from the site for subsequent disposal. The spill posed no significant threat to humans or wildlife. There was no water in proximity to the spill. The herbicide spreader was taken for repairs and modifications of the valve system to avoid another incident. The Guam Environmental Protection Agency (EPA) was notified after the spill occurred and offered guidance and inspected the site upon completion of the cleanup. It was found that the cleanup was complete, and no further action was needed (43rd CES, 1984).

Another incident occurred in 1972 at the intersection of Tarague Beach Rd. and Pati Point Rd. At this location, approximately 100 gal of

3-percent malathion were drained from a tank trailer. No report of this incident or related action is available.

4.1.4 PCB HANDLING, STORAGE, AND DISPOSAL

The 43rd CES Electrical Shop performs electrical inspection, maintenance, and installation procedures on AAFB. However, the Public Works Center on the Naval Station (NS) has performed maintenance of transformers on AAFB, including those containing PCB fluids. Reworking has taken place on NS facilities since initial operation of AAFB. In 1976, a program to replace equipment containing PCB dielectric fluid with mineral-oil-filled equipment was initiated by the Navy Public Works Center. A list of transformers containing PCB fluids, transformer locations, and volume of fluid in each transformer is maintained by AAFB. An open storage area (Pad No. 20013, adjacent to Bldg. 20011) is currently used for storage of out-of-service electrical components. An inspection of this area revealed that all transformers had been removed. No evidence of dielectric fluid residues was observed at the site. Several minor leaks have occurred, as noted on the inspection sheet. Any fluids which have leaked are cleaned up by Navy personnel and taken to the Navy Public Works Center for disposal. No past PCB spill sites were identified.

4.1.5 POL HANDLING, STORAGE, AND DISPOSAL

The types of POL used and stored at AAFB include MOGAS, diesel fuel No. 2 (DF-2), fuel oil, kerosene, JP-4, liquified petroleum gas (LPG), petroleum-based solvents, hydraulic fluid, and lube oil.

In addition to fixed storage tanks, drums and smaller containers are used for aboveground storage of incoming and waste materials, mainly solvents, hydraulic fluid, and lube oil.

POL spill management is addressed in the Spill Prevention Control and Countermeasure (SPCC) Plan. This plan is revised regularly to ensure

United States General Accounting Office 133387

GAO

Report to the Chairman, Subcommittee on Environment, Energy and Natural Resources, Committee on Government Operations, House of Representatives

April 1987

HAZARDOUS WASTE

DOD Installations in Guam Having Difficulty Complying With Regulations

GAO/NSIAD-87-87

538655

Executive Summary

Purpose

Hazardous waste can seep into water supplies, contaminate soil, and be released into the air, thereby posing potential threats to the environment or public health. The Department of Defense (DOD) generates large quantities of hazardous wastes.

The Chairman of the Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations, as part of the Subcommittee's oversight responsibilities, asked GAO to review DOD's efforts to dispose of hazardous waste generated at DOD installations in Guam.

Background

The Resource Conservation and Recovery Act of 1976 (RCRA), as amended, regulates management of hazardous waste including the generation, transportation, treatment, storage, and disposal of such waste. The Environmental Protection Agency (EPA) has issued implementing regulations and has authorized Guam's EPA to carry out inspection and enforcement activities in Guam. Under DOD policy, installation commanders are responsible for ensuring that their operations comply with RCRA. The Defense Logistics Agency, through its Defense Reutilization and Marketing Service and its local offices, has responsibility for assisting the commanders by disposing of hazardous waste and constructing required storage facilities.

Results in Brief

DOD installations in Guam were not in compliance with RCRA because inadequate emphasis has been placed on (1) the importance of complying with the procedures for handling, storing, and disposing of hazardous waste, (2) education and training programs for personnel on the dangers of mishandling these wastes, and (3) the need for sufficient inspection and enforcement activities at base level.

DOD has begun actions to address the causes of noncompliance. In addition, the installations are trying to improve hazardous waste management.

GAO's Analysis

Compliance With RCRA

Andersen Air Force Base, a hazardous waste generator, and five of six generators located on the Guam Naval Complex were inspected by

Guam's EPA and found to be out of compliance with RCRA. Installation officials attributed noncompliance to factors similar to those GAO and DOD's Inspector General identified in earlier reports, including lack of (1) cooperative tenants, (2) attention to administrative matters, (3) storage facilities, and (4) sufficient staff to regularly inspect generators.

Of 79 violations identified by Guam's EPA during 1985 and 1986, 39 were considered to be serious. These constituted a threat of releasing hazardous waste to the environment or involved the failure to (1) protect groundwater, (2) store the waste in proper containers, or (3) ensure that the hazardous waste was delivered to approved facilities. The two most common types of violations involved pretransport and container use and management. Pretransport violations involve the failure to meet packaging, labeling, marking, and placarding requirements. These violations could lead to improper handling or disposal because it would be difficult to later identify the contents. Container use and management violations involved storage of waste in damaged or leaking containers.

Improper Dumping

Although Air Force and Navy installations in Guam have established procedures and provided training programs on how to manage and dispose of hazardous waste, GAO observed instances where maintenance activities improperly dumped or spilled hazardous waste. Improper dumping or spilling of hazardous waste at the Naval Complex damages the environment on base and contaminates the ocean near the shore. Groundwater contamination is of less concern at the Naval Complex because the Complex's groundwater is not used for drinking water.

Dumping or spilling hazardous waste is a greater concern at Andersen because Andersen is located over a major portion of Guam's aquifer. The storm water drainage system at Andersen consists of more than 100 storm drains, which rapidly remove surface runoff water into the aquifer. Of the nine base maintenance shops and facilities GAO toured, it found that eight were still discharging pollutants into storm drains or directly on the ground.

No Disposal Contract

The Defense Reutilization and Marketing Service has had difficulties providing timely disposal of hazardous waste because it has been unable to find a capable contractor willing to bid on the disposal contract. As a result, wastes have been stored improperly. To deal with the accumulated hazardous waste, the Defense Reutilization and Marketing Service arranged for shipments of the waste to a disposal site in the United

States using Military Traffic Management Command contract ships and continued its attempts to finalize a contract with a commercial disposal contractor.

Manifest Problems

GAO's analysis of the last shipment of hazardous waste from Guam showed significant discrepancies in what was recorded on the various disposal documents, including the manifests. The Defense Reutilization and Marketing Office had not reconciled any of the discrepancies GAO found in these documents.

Recommendations

GAO recommends that the Secretary of Defense direct

- Air Force and Navy officials in Guam to take actions to ensure that all personnel handling hazardous waste know the proper procedures for disposing of the waste so as to eliminate the dumping of wastes in ways that could contaminate the environment and
- the Defense Reutilization and Marketing Office in Guam to place more emphasis on its procedures for reconciling discrepancies on disposal documents for hazardous waste, including delivery orders, pickup orders, manifests, and the Integrated Disposal Management System.

Agency Comments

As requested, GAO did not obtain official comments, but it did discuss its findings with agency program officials during the course of its review.

Contents

Abbreviations

AFB	Air Force Base
DOD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
DRMS	Defense Reutilization and Marketing Service
EPA	Environmental Protection Agency
GAO	General Accounting Office
MTMC	Military Traffic Management Command
RCRA	Resource Conservation and Recovery Act of 1976

Introduction

Hazardous wastes can seep into water supplies, contaminate soil, and escape into the air, thereby posing potential threats to the environment or public health. The Resource Conservation and Recovery Act of 1976 (RCRA), as amended, provides for regulatory controls over the generation, transportation, treatment, storage, and disposal of hazardous wastes. The Department of Defense (DOD), being a generator[1] of large quantities of hazardous waste and an operator of treatment, storage, and disposal facilities, must comply with RCRA requirements.

The Environmental Protection Agency (EPA) has primary responsibility for implementing RCRA. EPA regulations, initially published in May 1980, govern hazardous waste generators, as well as transporters, and owners and operators of hazardous waste treatment, storage, and disposal facilities.

RCRA allows EPA to authorize state and territorial regulatory agencies to administer and enforce hazardous waste programs in lieu of a federal program provided they are at least as stringent and comprehensive. In January 1986, EPA authorized Guam's EPA to carry out the responsibility for issuing permits and inspecting and regulating hazardous waste generators, transporters, and storage, treatment, and disposal facilities in Guam. As a result, Guam's EPA carries out inspection and enforcement activities at DOD installations there.

On October 21, 1980, DOD issued its overall policy guidance for implementing RCRA regulations. DOD designated each installation commander as responsible for ensuring that all operations, including those of tenants, comply with RCRA requirements. The Defense Logistics Agency, through its Defense Reutilization and Marketing Service (DRMS), was assigned responsibility for providing hazardous waste storage and disposal services to installation commanders. By 1984 the local DRMS offices, including the Defense Reutilization and Marketing Office (DRMO) in Guam, were accepting and disposing of DOD's hazardous waste.

According to Guam's EPA records, Andersen Air Force Base (AFB) and the Guam Naval Complex are the major hazardous waste generators in Guam. Andersen AFB is considered one generator by EPA, while the Guam Naval Complex has six EPA-designated generators, including the DRMO as a tenant. During 1985, the seven generators produced 161 tons of hazardous waste. Records at the Defense Reutilization and Marketing Region, Honolulu, Hawaii, show that waste paint comprises the largest

[1] A generator is an individual or organization whose act or process produces hazardous waste.

quantity of waste. Other wastes generated in large quantities are (1) non-polychlorinated biphenyl oil, (2) hydraulic fluid, and (3) trichlorofluorethane.

Objectives, Scope, and Methodology

On July 1, 1986, the Chairman of the Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations, requested that we review DOD's efforts to dispose of the hazardous waste generated at DOD installations in Guam. Our objectives were to determine (1) the extent to which DOD installations were meeting RCRA requirements and (2) the effectiveness of DRMS's disposal and storage functions, including the tracking of hazardous waste from receipt to disposal.

To accomplish our objectives, we

- reviewed EPA, DOD, Air Force, and Navy regulations governing the handling and disposal of hazardous waste;
- interviewed officials in Guam at Andersen AFB, the Navy's Public Works Center and Ship Repair Facility, the DRMO, and Guam's EPA;
- reviewed manifest files at Andersen AFB, the Navy Public Works Center and Ship Repair Facility, and the DRMO in Guam to determine amounts and types of wastes being disposed of and disposal sites being used;
- reviewed Guam's EPA inspection files and reports on the hazardous waste manifest system for DOD generators in Guam;
- accompanied Guam's EPA inspectors on inspections of Andersen AFB, the Navy's Public Works Center and Ship Repair Facility, and the DRMO;
- interviewed EPA regional officials in San Francisco concerning their role in the overall management of hazardous waste in Guam;
- interviewed command headquarters officials from the Naval Facilities Engineering Command, Pacific Division, and from the Defense Reutilization and Marketing Region in Honolulu, Hawaii, which services the Pacific area, concerning their role in the overall management of hazardous waste in Guam; and
- interviewed DRMS operations and contracting officials in Battle Creek, Michigan, and Ogden, Utah, concerning their role in contracting for disposal contractors.

The comments of officials responsible for managing the disposal of hazardous waste were sought during the course of our review, and their comments are included where appropriate.

Our review was conducted between August 1986 and January 1987 in accordance with generally accepted government auditing standards.

Chapter 2

DOD Installations Are Not in Compliance With RCRA Requirements

Andersen AFB, a hazardous waste generator, and 5 of 6 generators located on the Guam Naval Complex in Guam were not in compliance with RCRA requirements, according to Guam's EPA inspectors. Most of the violations[1] causing noncompliance were of a serious nature, and many were repetitive. Our review also disclosed other problems that either violated RCRA or could lead to violations. These included (1) maintenance activities at both installations improperly dumping waste, (2) discrepancies in disposal documentation, (3) inability of DRMO to provide adequate disposal service, and (4) storage facilities that did not meet RCRA requirements.

Air Force and Navy installation officials attributed noncompliance to a number of factors, including (1) uncooperative tenants, (2) inattention to administrative matters, (3) lack of capable disposal contractors, (4) inadequate storage facilities, and (5) insufficient staff to regularly inspect generators.

Most Generators Were Not in Compliance With RCRA Requirements

Andersen AFB is one generator, and the Guam Naval Complex has six generators, including DRMO, a tenant organization. Inspection reports by Guam's EPA for the seven DOD hazardous waste generators showed that one, the Naval Station, was in compliance with RCRA requirements during 1985 and 1986. The remaining six generators were not in compliance, as each had been cited for one or more violations.

To determine the installations' compliance status, we asked Guam's EPA to inspect the DOD activities that generate the most hazardous waste in Guam—Andersen AFB, the Ship Repair Facility, the Public Works Center, and the DRMO. The inspections showed that all four generators were not in compliance with RCRA. Table 2.1 shows the number of violations by installation identified by Guam's EPA inspections made during calendar years 1985 and 1986 including the inspections we requested.

[1] A violation is one or more deficiencies as prescribed by EPA regulations.

Table 2.1: RCRA Violations Found in Four Inspections, by Installation

	Number of violations				
	1985		1986		
Installation	First	Second	First	GAO requested	Total
Anderson Air Force Base	4	11	1	7	23
Guam Naval Complex Generators: Ship Repair Facility	5	0	2	6	13
Public Works Center	5	2	3	6	16
Naval Air Station, Agana	8	5	1		14
Naval Magazine	0	0	1		1
Naval Station	0	0	0		0
DRMO	6	0	0	6	12
Total	**28**	**18**	**8**	**25**	**79**

Many Violations Were Serious

EPA defines a Class I violation as one that results in a release or serious threat of release of hazardous waste to the environment or involves the failure to ensure that (1) groundwater will be protected, (2) proper containerization and identification activities will be undertaken, or (3) hazardous wastes will be destined for and delivered to approved facilities. These violations include such things as leaking containers; improper storage; incorrect manifests; and improper labeling, placarding, and marking of containers. About half of the 79 violations were Class I violations.

Class II violations are those that do not meet Class I criteria and are less serious. An example of a Class II violation is a bloated or excessively rusted drum.

As shown in table 2.2, the two most common Class I violations involved inadequate pretransport measures and improper container use and management. Pretransport violations involve the failure to meet the packaging, labeling, marking, and placarding requirements. These violations could lead to improper handling or disposal because the contents would be unknown. Container use and management violations involved storage in damaged or leaking containers.

Table 2.2: Types of Violations in 1985 and 1986

	Class I violations					
	1985		1986			
Requirements	First	Second	First	GAO requested	Total	All violations
Use/management of containers	4	2	0	8	14	23
Pretransport	5	3	0	3	11	31
Manifest	3	0	2	0	5	9
Contingency plan	2	0	0	2	4	9
General facility standards	0	0	2	0	2	4
Disposal	1	0	0	0	1	1
Preparedness/prevention	0	0	0	1	1	1
Recordkeeping/reporting	0	0	1	0	1	1
Total	**15**	**5**	**5**	**14**	**39**	**79**

Figure 2.1 illustrates a Class I violation of both the use and management of containers and general facilities requirements—an improperly stored drum containing a hazardous waste solvent. Adequate steps had not been taken to keep the waste from entering the ground in the event of a leak: the waste had not been stored on an impermeable floor, there were no raised edges or dikes to contain a spill, and there was no protection from the weather, as required by RCRA. Figure 2.2 shows a punctured container of hazardous waste, which is a violation of the requirements associated with the use and management of containers.

Figure 2.1: Hazardous Waste (in Foreground) **Improperly Stored at Navy Ship Repair Facility in Guam**

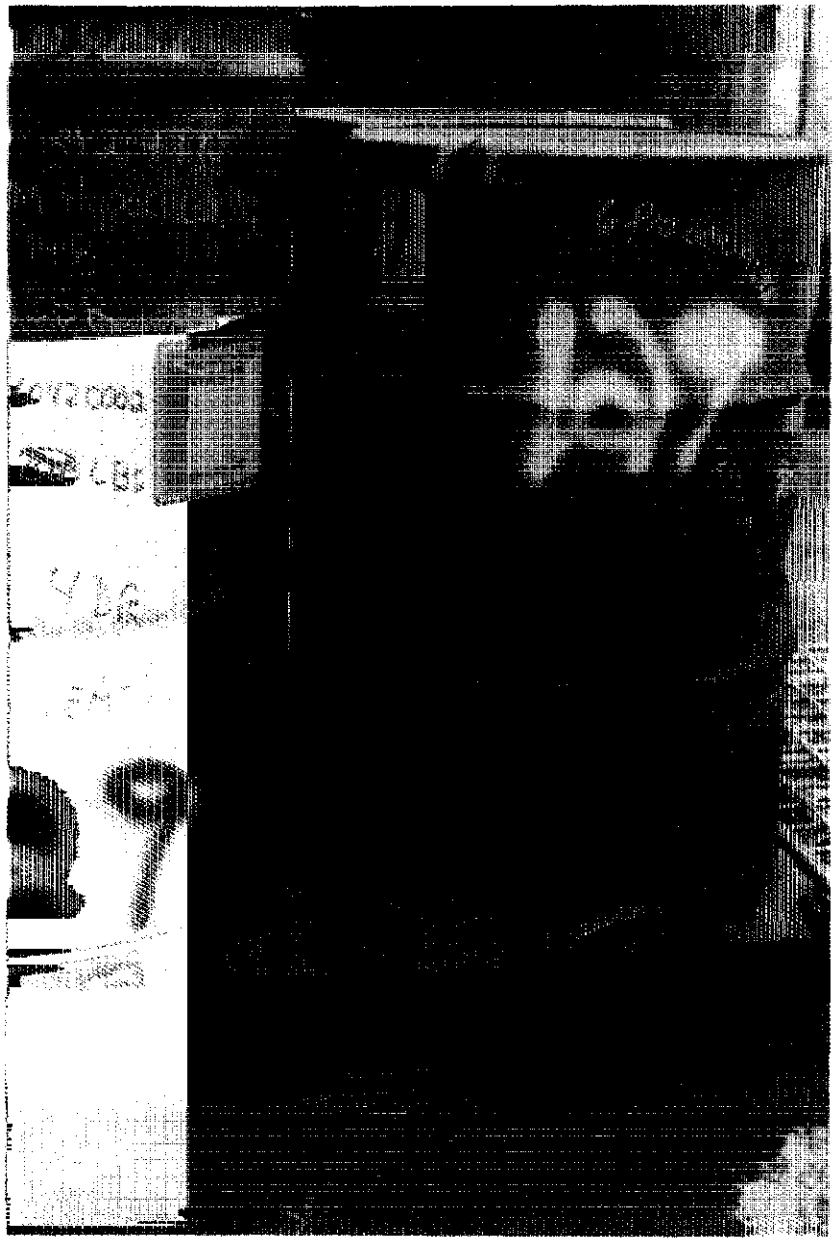


Figure 2.2: Drum of Calcium Hypochlorite Bleach in a Punctured Container Awaiting Shipment From the DRMO in Guam

Pollutants Discharged Into Storm Drains or Directly on the Ground

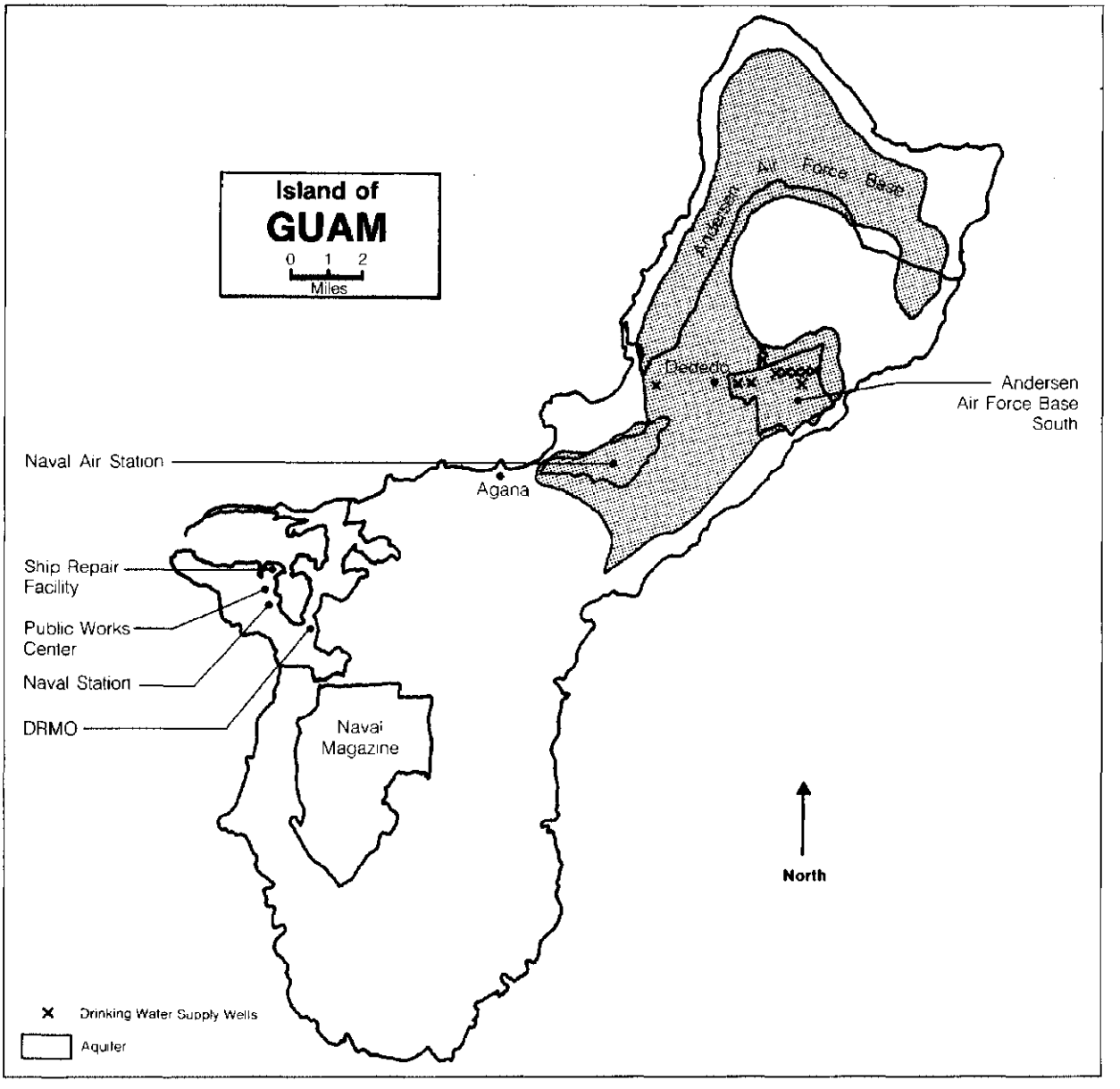
Although the Air Force and Navy installations in Guam have established procedures and provided training programs on how to handle, store, and dispose of hazardous waste, we observed instances where maintenance activities had improperly dumped or spilled hazardous waste. The improper dumping or spilling of hazardous waste at the Guam Naval Complex damages the environment on base and contaminates the ocean near the shore. With the exception of the Naval Air Station, contamination of the groundwater on base is of less concern because the groundwater at the Guam Naval Complex is not used as drinking water.

Since the Naval Air Station and Andersen AFB are located over Guam's aquifer,[2] the dumping or spilling of hazardous waste is of more concern at Andersen AFB because there are a large number of dry wells located on base. (See figure 2.3.) The storm water drainage system at Andersen AFB consists of more than 100 storm drains, which rapidly remove surface runoff water into the aquifer through dry wells.[3] As a result, these storm drains and dry wells can act as direct conduits for contaminants to enter the aquifer. Of the nine base maintenance shops and facilities we toured, we found that eight were still discharging pollutants, such as ethylene glycol (antifreeze) and cleaning solution (detergent), into storm drains or directly on the ground.

[2]In 1978, the groundwater resources of northern Guam were designated a "principal source aquifer" in recognition of their extraordinary importance as the primary source of drinking water for about three fourths of the island's population. The designation noted that aquifers are vulnerable to contamination and consequently require constant attention to protect against degradation.

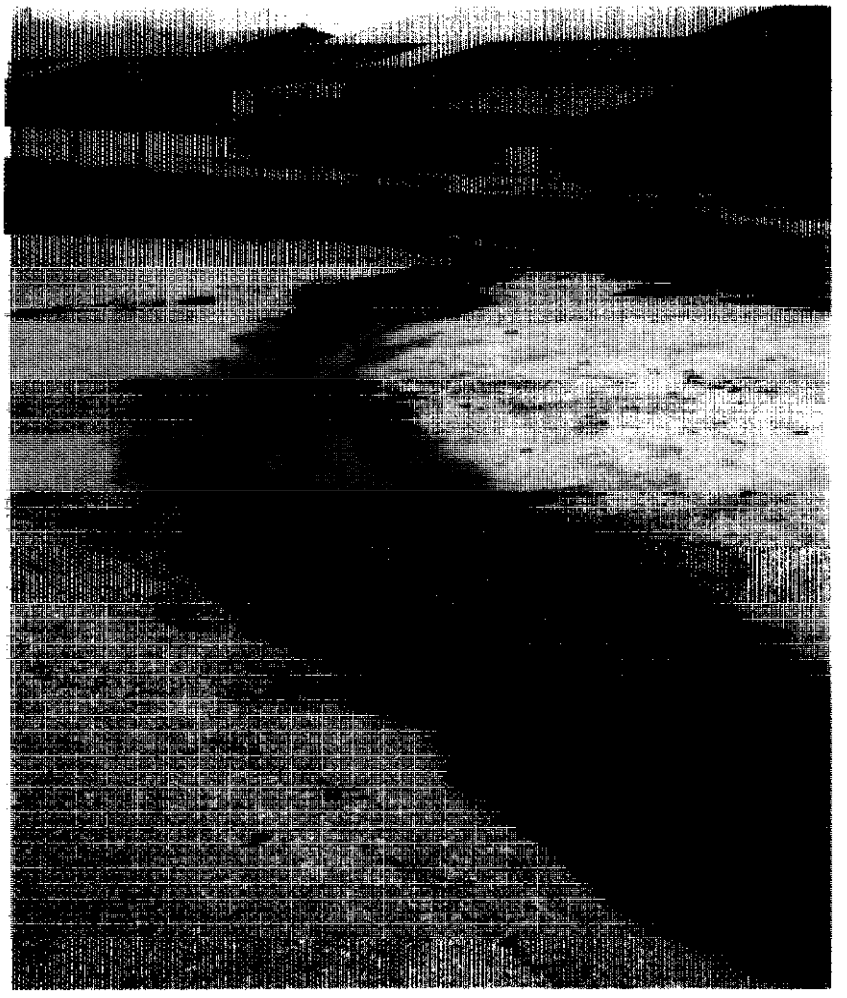
[3]Dry wells are holes drilled into the ground to facilitate the recharge of the aquifer by rainwater runoff.

Figure 2.3: Map of Guam Showing DOD Installations and the Aquifer



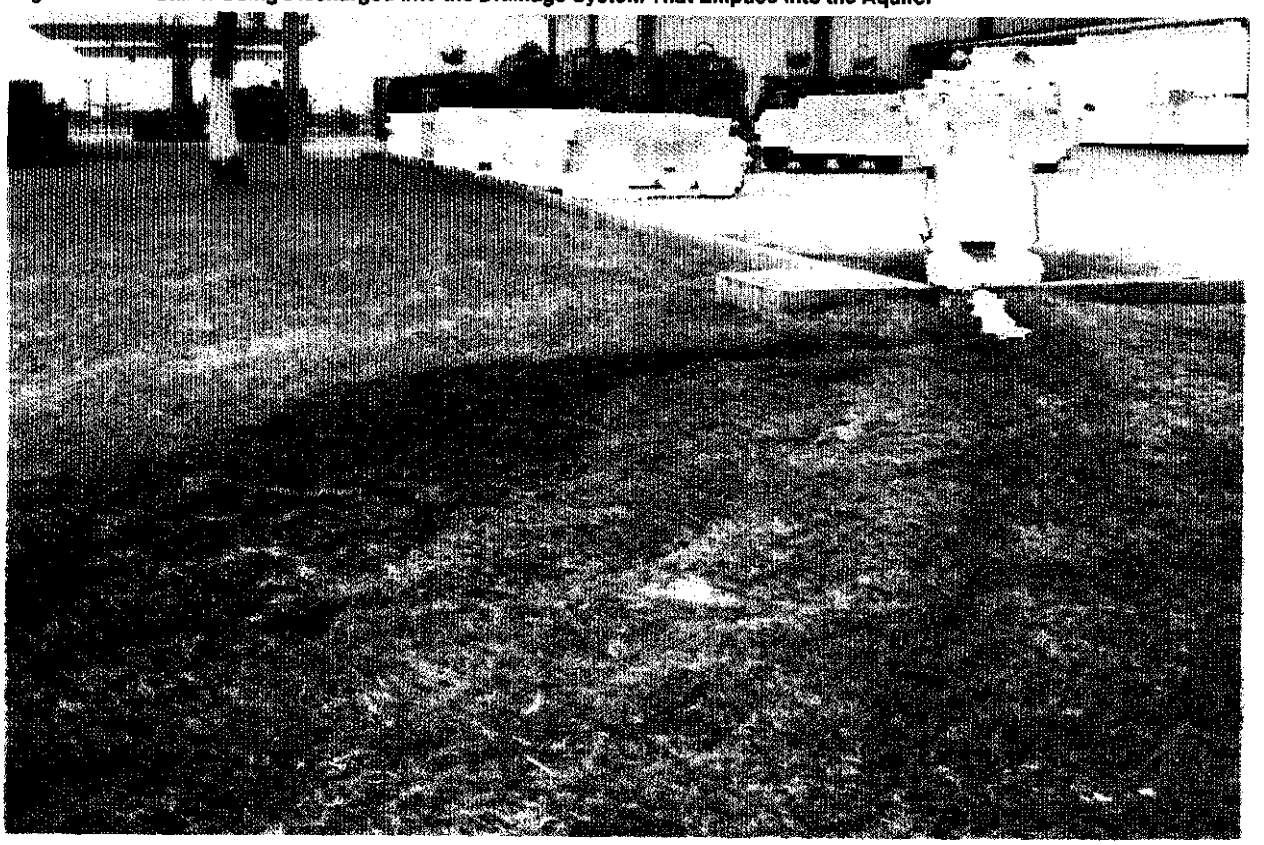
During our tour of the vehicle maintenance shop, we observed antifreeze and other contaminant spills, which drained either into the storm drain system or directly on the ground. We followed the storm drain from the vehicle maintenance shop and found that it empties into an area located over the aquifer. Figure 2.4 shows that contaminant spills at Andersen AFB's vehicle maintenance shop drain directly into the ground.

Figure 2.4: Pollutants Discharged Directly on the Ground



Figures 2.5 and 2.6 show pollutants from the aircraft ground maintenance shop being discharged directly into the storm drain system that empties into the aquifer. Andersen AFB had built a retaining wall around the maintenance area to trap any spilled hazardous waste. This retaining wall permitted the collection and proper disposal of the hazardous waste before it reached the environment. However, as shown, a hole had been made in the retaining wall, thus permitting the waste to run out on the ground and into the drainage system that empties into the aquifer.

Figure 2.5: Pollutants Being Discharged Into the Drainage System That Empties Into the Aquifer



While the vehicle maintenance shop obtained a work order to correct the drainage problem, other maintenance shops and facilities continued to discharge pollutants on the ground or into the storm drains. Officials at Andersen AFB stated that efforts had been made to educate maintenance personnel on the possible adverse effects of improperly discharging pollutants. They also stated that the constant turnover of maintenance personnel and the lack of staff to adequately inspect the hazardous waste generators were major causes of the improper handling of hazardous

Figure 2.6: GAO and Air Force Officials Inspect a Dry Well Where Pollutants From the Ground Maintenance Shop Could Enter the Aquifer

waste. They agreed that more should be done to prevent these improper practices, such as (1) making training in hazardous waste handling procedures part of the indoctrination procedures for incoming personnel who will be working in areas that could generate hazardous waste, (2) providing adequate collection containers and storage space in the maintenance shops, and (3) revising inspection procedures and job descriptions to ensure that someone is designated as the hazardous waste inspector and conducts inspections on a regular basis.

Manifest Problems

Regulations implementing RCRA require that the transfer of hazardous waste to a disposal facility be documented using the EPA's manifest system. The manifest document is the EPA-required form used for recording the shipment of hazardous wastes from the generator to the disposal site. Hazardous waste generators are responsible for preparing the manifests and confirming that the waste is delivered to the designated disposal site. A copy of the manifest accompanies the shipment, is used by the disposal site to record wastes received, and is returned to the generator to allow confirmation that the wastes reached the disposal site.

DRMO has primary responsibility for disposing of hazardous waste generated by DOD in Guam. As such, DRMO is responsible for preparing manifests and confirming that the quantities of wastes recorded on the manifests are delivered to the designated disposal sites. To determine if DRMO adequately tracks the transfer of waste to disposal sites, we examined the seven manifests and other disposal documentation for its last contract shipment, which left Guam in January 1986.

Disposal Documentation

The first step in shipping hazardous waste off the island is for the DRMO to develop a detailed list of waste on hand to be shipped. This list is converted into a delivery order and forwarded to the DRMO contracting officer at the Defense Reutilization and Marketing Region in Ogden, Utah. The contracting officer then sends the delivery order to the contractor, who has a specified period of time to pick up the wastes. From the delivery order the contractor prepares pickup orders, which list the material by type of waste he intends to pick up for each shipment.

When the disposal contractor arrives at the DRMO, he works with the DRMO staff to prepare the required EPA manifests.

Quantity Manifested Was Not Equal to Quantity Received at the Treatment, Storage, or Disposal Facility

According to the seven manifests for the last commercial disposal contract shipment from Guam, the DRMO shipped 13,588 pounds of bulk hazardous waste and 14,216 gallons of hazardous waste in 460 drums. Our review of the manifests and other disposal documentation showed that the disposal site had received the bulk waste with little variation from what was listed on the manifests. However, on two of the seven manifests, we found significant discrepancies[4] in that the net number of containers noted as having been received at the disposal site was less than what was listed by DRMO as having been shipped. As an example of a significant discrepancy, one line item on one of the seven manifests listed five drums of waste battery acid as having been shipped, while only one drum was shown as having been received at the disposal facility.

According to EPA regulations, when significant discrepancies are discovered, the owner or operator of the disposal facility is required to attempt to reconcile the discrepancies with the waste generator or transporter. Discrepancies that cannot be resolved within 15 days must be reported by the disposal facility to EPA. As of October 1986, 9 months after receipt of the shipment, the discrepancies noted on the manifests had not been reported by the disposal site officials to EPA.

As of September 1986, the DRMO had not reconciled the discrepancies between the amount listed on the manifests as having been shipped and the amount recorded on the manifests as having been received by the disposal site operator. DRMO officials stated that they do not attempt to reconcile the differences because they use the Integrated Disposal Management System in addition to EPA's manifest system to track the waste. They believe that their management system is more accurate than EPA's system.

DRMO officials told us that the Integrated Disposal Management System, a computerized system for tracking DRMS materials, including hazardous waste, permits DRMS to track each container of hazardous waste from the time the DRMO receives the waste until it is disposed of. The delivery orders and pickup orders, which list each container, are used to record the movement of the waste in the system.

[4]EPA regulations state that significant discrepancies in quantity are (1) for bulk waste, variations greater than 10 percent in weight and (2) for batch waste, any variation in piece count, such as a discrepancy of one drum in a truckload.

As part of the Integrated Disposal Management System, DRMO maintains an inventory of all hazardous waste on hand, ready for shipment, and shipped for disposal. During our examination of the hazardous waste stored at the DRMO, we tried to trace some of the items in the storage area to the Integrated Disposal Management System inventory. In addition, we tried to trace items from the inventory to the actual containers in the storage area.

We could not find listings in the inventory of several items located in the storage area. Also, we could not locate in the storage area some of the items listed in the inventory. These problems indicate that the Integrated Disposal Management System may not adequately track the waste as was suggested by DRMO officials. DRMO officials stated that they had procedures for accounting for all hazardous waste, but they were aware that the lack of adherence to procedures on the part of some of their staff has in the past caused some problems in accounting for all of the hazardous waste.

Our review of the disposal documentation showed that no reconciliation had been made between what was listed on pickup orders, what was manifested, what was actually loaded on the disposal contractor's ship, and what was recorded in the Integrated Disposal Management System.

Because the hazardous waste disposal documentation had been inadequately maintained and discrepancies in documentation had not been reconciled, we could not determine if drums shown on the manifests as shipped by DRMO but not recorded as received by the disposal site had been disposed of properly.

Inadequate Disposal Service

In order to comply with the RCRA regulation limiting temporary storage to 90 days and to limit the need for storage facilities, DOD requires timely disposal of hazardous waste. In 1980, this responsibility was transferred from DOD installations to DRMS. DRMS has encountered difficulties in providing timely service for the disposal of hazardous waste from the Guam installations because of a lack of capable contractors in the Pacific area willing to bid on the disposal contracts. A DRMO report showed that, as of July 31, 1986, 97 percent of the containers of hazardous waste awaiting disposal had been in storage for over 90 days.

The DRMO has been cited for various RCRA violations involving improper storage. Our inspection of the DRMO storage area showed that hazardous

waste was being stored in facilities that did not conform to EPA requirements, such as protection from the weather and spill containment.

DRMS has taken steps to improve contracting for commercial disposal services. It has worked with the contractors who submitted bids in response to the latest solicitation to try and solve the technical deficiencies of their proposals.

While DRMS has been working with the bidders, the Guam DRMO has contracted with the Military Traffic Management Command (MTMC) to ship hazardous waste to the continental United States for disposal.

Most Violations Were Repetitive

In commenting on our observations, unit commanders stated that violations we had noted were of a transitory nature. We agree that some violations may have lasted briefly or violations may have been corrected shortly after Guam's EPA inspections. However, as noted previously, the Air Force and Navy installations have often been cited for the same category of violations in succeeding semiannual inspections. Our analysis of Guam's EPA inspection reports showed that 21 of the 33 violations, or 64 percent, cited in calendar year 1986 were in the same categories as the 1985 violations.

Unit commanders at the two DOD installations gave us their opinions of why their particular installations were in violation of RCRA. Though not necessarily applicable to each installation, the causes cited by the commanders were (1) lack of cooperation by tenants who report to commands other than the one to which the installation commander reports, (2) inattention to administrative matters by base personnel handling hazardous waste, (3) insufficient staff to make regularly scheduled inspections, (4) high staff turnover, (5) lack of storage facilities that meet RCRA requirements, and (6) climatic conditions (high humidity and rain) on Guam which cause rusting.

Prior GAO and DOD Reports

The RCRA violations documented during our review of the two DOD installations in Guam were similar to the violations cited in our May 1986 report and a July 1986 DOD Inspector General's report.[5] Our report, Hazardous Waste: DOD's Efforts to Improve Management of Generation, Storage, and Disposal (GAO/NSIAD-86-60, May 19, 1986), noted that many

[5]Review of Hazardous Material/Hazardous Waste Management Within the Department of Defense, July 17, 1986.

DOD installations in the United States have yet to achieve full compliance with RCRA requirements and that DOD could do more to reduce the volume of waste requiring disposal. Reasons cited for noncompliance included the lack of command level emphasis on management of hazardous waste, the lack of storage facilities conforming to RCRA requirements, and the installation commanders' lack of authority over tenants. Officials at DOD installations located in the United States stated that, in addition to the above reasons, noncompliance was caused by (1) inattention to administrative matters by installation personnel handling hazardous waste and (2) insufficient staff to inspect generators regularly.

DOD, at the time we issued our 1986 report, issued a policy directive for hazardous waste management, and the services were implementing it worldwide. The policy incorporated the proposals we had made in a draft of the report sent to DOD for its comment. DOD's efforts to improve the hazardous waste management program are still in progress.

The July 1986 DOD Inspector General's report summarized the results of a worldwide review of DOD's hazardous waste management, including installations in Guam. It found that DOD was not in compliance with RCRA and that DOD's management of hazardous materials and hazardous waste was unsatisfactory. Specifically, the Inspector General cited

- limited DOD hazardous waste technical guidance (it is a broad policy statement only, and the major command and installation guidance implementing this policy is fragmented and at times inconsistent with RCRA requirements);
- lack of effective structured management (at various levels management is by committee, often without adequate guidance);
- lack of command awareness/emphasis and limited technical expertise of people handling the waste; and
- lack of communication at all levels.

Efforts to Improve

Air Force, Navy, and DRMO officials stated that, during the last year, they have initiated several actions to improve hazardous waste management. These include

- instituting new inspection and accountability procedures for waste transferred to the DRMO;
- using alternatives to disposal such as selling, reusing, and recycling the waste;
- building new storage facilities that conform to RCRA requirements; and

- using nonhazardous materials instead of hazardous materials, thereby reducing the amount of hazardous waste generated.

Conclusions

Despite instructions on the proper procedures for managing and disposing of hazardous waste, most DOD activities in Guam which generate hazardous waste are repeatedly cited for RCRA violations. We believe that inadequate emphasis has been placed on (1) the importance of complying with the procedures for handling, storing, and disposing of hazardous waste, (2) education and training programs for personnel on the dangers of mishandling these wastes, and (3) the need for sufficient inspection and enforcement activities at the base level.

Although RCRA requires that the transportation and disposal of hazardous waste be tracked using the EPA manifest system, the Guam DRMO relies on its Integrated Disposal Management System to track hazardous waste shipments rather than using the required EPA manifest system. Our analysis showed that the Integrated Disposal Management System contained some inaccurate information and variances in disposal documentation and Integrated Disposal Management System data were not reconciled. As a result, we believe the DRMO is not assured that the quantities of hazardous waste shipped are being disposed of properly.

Recommendations

We recommend that the Secretary of Defense direct

- Air Force and Navy officials in Guam to take actions to ensure that all personnel handling hazardous waste know the proper procedures for disposing of the waste so as to eliminate the dumping of wastes in ways that could contaminate the environment and
- DRMO officials in Guam to place more emphasis on their procedures for reconciling discrepancies between what is listed on each disposal document for hazardous waste including delivery orders, pickup orders, manifests, and the Integrated Disposal Management System.

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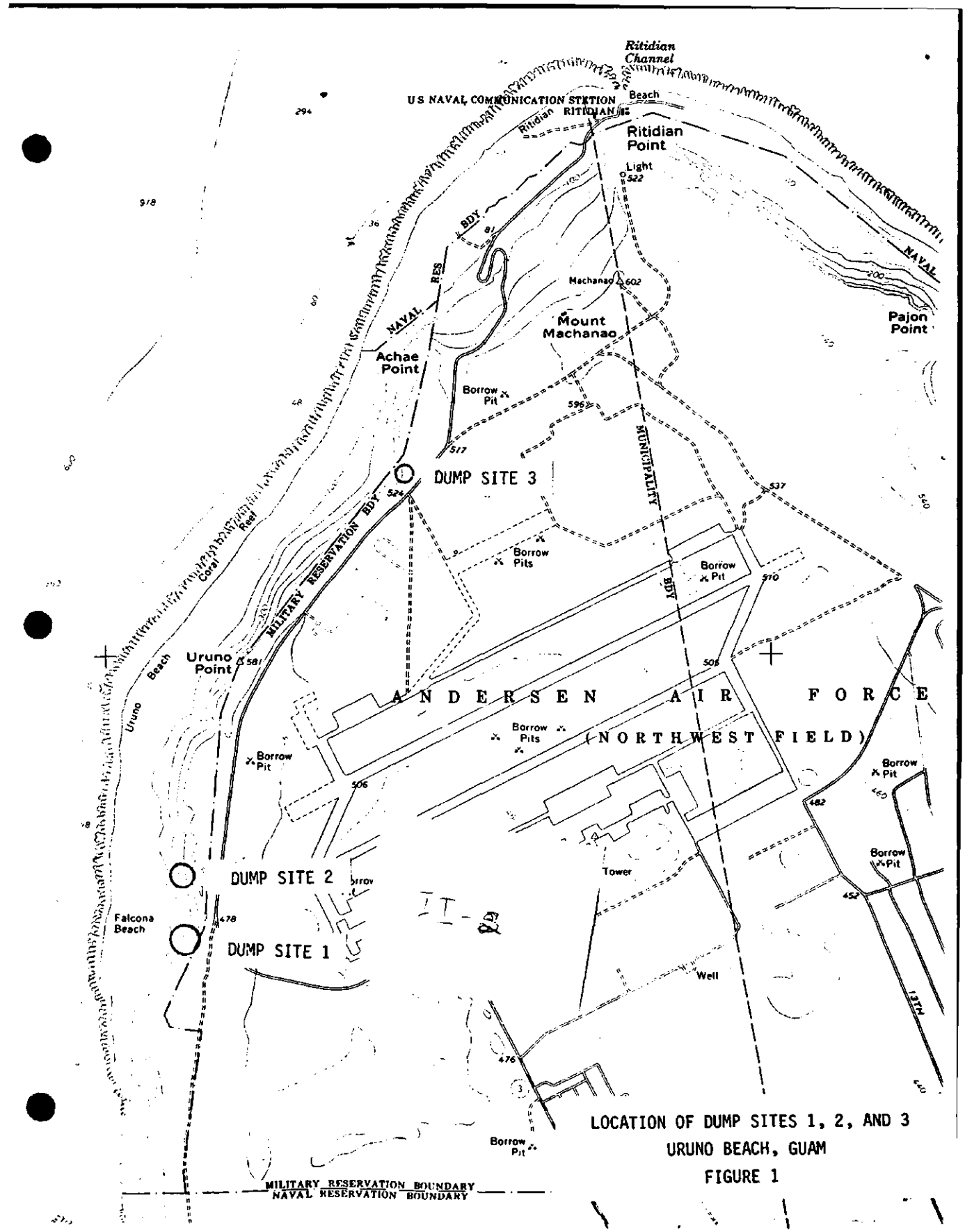

LOCATION OF DUMP SITES 1, 2, AND 3
URUNO BEACH, GUAM
FIGURE 1

Recharge is intermittent and fluctuates with rainfall. The discharge at or near the shore fluctuates less because of storage in the aquifer.

Pollutant migration along hydrologic route is possible due to high annual rainfall which may exceed 100 inches per year. The majority of the rainfall on the northern portion of Guam percolates rapidly downward to the water table which is slightly above sea level. The rainfall penetrates 150 to 500 feet of overlying limestone and moves laterally to a point of discharge usually to the ocean, spring or pumped well. Any soluable or miscible pollutant may be transported with the ground water to any of these discharge points. While the travel time of the rainfall from the ground surface to the water table has not been documented, minimum travel time may be a few days and maximum travel time is on the order of a few months. For the more porous, cavitated section of the island, the estimated velocity within the limestone aquifer was on the order of ten feet per day (Navy, 1983). Thus, is can be assume that no area in northern Guam is more than two miles from a discharge point and that pollutant transport by ground water can be rapid.

About 70 percent of the drinking water on Guam comes from groundwater and is pumped from the northern lens. The lens is estimated to have a total average daily recharge of 111.9 million gallons. Because of the high permeability of the limestone plateau, no perennial streams exist on the northern portion of Guam. Drainage occurs generally downward through numerous cracks, crevices, fissures, joints and sinkholes to the water table. The water then moves laterally through the aquifer to points of discharge along the sea shore. In time of heavy rains or prolonged rains, standing water occur in the coastal lowlands.

The NAVCAMS Finegayan area lies directly to project site and can be used to describe the hydrology of the project area. Drainage is generally downward percolation of rainfall into the porous limestone substrata. portions of the project area flows over the cliffs to the coastal terraces below. Approximately 30 inches of rainfall infiltrates to the water table and the has the potential for mixing with or dissolving surface or near surface pollutants and introducing them to the ground water. These pollutants would be generally moved seaward to discharge points. The groundwater gradient of NAVCAMS Finegayaan is saline and therefore unusuable for domestic supply (Navy, 1983). Therefore, the project area is not within a recharge area.

11. Aesthetics. The project site is bordered by a white coral sand beach with several points by rocky limestone outcroppings extending nearly to the sea. Spectacular view planes atop the ridge with virtually unspoiled appearance of steep cliffs, sand beach, varied coastline and shallow water reefs. Trail access down the cliff face is obscured by dense vegetation. No road for vehicular access to the property exists.

12. Air Quality. Overall, the air quality at the project site is generally good except when heavy use of Andersen Air Force Base by military aircraft particularly in the morning hours when smoke and exhaust fumes hover close to the ground by temperature differentials, abnormal conditions may occur.

13. Noise Quality. Man-made noise of the site is virtually nonexistent due to the fact that the project area in uninhabited. The only human activities with a significant impact on ambient noise levels are the aircraft operations at Andersen Air Force Base. Usually aircraft noise is of short duration and infrequent, since the restricted use of the Northwest Field. The site is also outside the Air Installation Compatible Use Zones established by AAFB (see Figure 9).

14. Electronic Emissions. A complex of military communication installations surround the project area. The Air Force satellite tracking station facility on the Northwest Field of AAFB and the Naval Communication Station Finegayan operate highly sensitive radiowave and microwave communications equipment. The highly sensitive nature of the equipment and the close proximity to the proposed project requires that no device can be used on the site which causes interference for frequency bands 225-260 MHz, 399.5-401.5 MHz, 1227-1575 MHz, 2.2-2.3 GHz and 8-16 GHz. Interference is defined as:

a. For MHz frequency bands. The man-made noise shall not exceed atmospheric noise measured at the receiving antenna during low noise periods.

b. For GHz frequency bands. The maximum permissible power flux densities (calculated according to International Telecommunications Union Radio Regulations) are:

(1). 2.2-2.3 GHZ = -154 dbW/m^2
(2). 8.025-11.7 GHz = -150 dbW/m^2
(3). 12.50-12.75 GHz = -148 dbW/m^2
(4). antenna sensitivity = -172 dbm for all bands

These frequency bands are utilized 24 hours per day, 365 days per year. The only use of the project area is when explosives are being transported near the facility. Coordination will be required for the transport of unexploded ordnance or for explosives to be used in order to detonate the unexploded ordnance.

15. Solid Waste. The sanitary landfill at Andersen Air Force Base receives about 16 tons of solid waste per day. The site is located about one mile northeast of the main gate at approximately 13 degrees 34 minutes and 45 seconds north latitude and 144 degrees 53 minutes and 30 seconds east longitude. The landfill occupies about 41 acres and has a projected lifespan of 8 years (Figure 10). Bulky waste, construction debris, etc. are disposed in a hardfill which is in the same vicinity but separate from the landfill. Since the landfill is located on limestone, there is concern for potential leachate contamination of the groundwater. A monitoring well provides data for quarterly reports to indicate whether contamination has occurred. Table 2 gives the groundwater monitoring data for AAFB sanitary landfill.

16. Hazardous/Toxic Wastes. In March 1986, the U.S. Environmental Protection Agency conducted a preliminary assessment of suspected hazards

present with member of the Pacific Strike Team and Technical Assistance Team. EPA reported that 50-80 55-gallon drums were observed of which all were empty and most were rusted out. EPA indicated that empty deteriorated drums or gas cylinders do not constitute an imminent or substantial threat to public health or the environmental. EPA took no further action on this project.

The 55-gallon drums are in such deteriorated condition that the contents no longer remain and have evaporated or leached into the ground. Any contaminants from the drums would quickly migrate to the groundwater table. Since much of the debris has been dumped over the cliff 30 years ago and more, the chances of detecting any contamination would be minimal. The length of time in which the leachate reaches the groundwater table and moved to the ocean is weeks. No monitoring well exists at the site.

17. Missions Requirements. The U.S. Navy is proposing the construction and operation of electronic installations on Tinian, Commonwealth of the Northern Mariana Islands and the Guam. The action in Guam consists of the construction and operation of receiver antenna arrays, ground screens and support facilities at the Naval Communications Area Master Station of the Western Pacific and in Northwest Field, Andersen AFB in northern Guam. The electronic installations are integral parts of the US surveillance network commonly referred to as the Relocatable Over The Horizon Radar. The project area would encompasses approximately 200 acres for each sites. The Navy's project is located directly adjacent to this proposed action. The cleanup action may have direct and indirect impacts to the mission of the Navy's project and consideration on the mission effect will need to be evaluated.

C. BIOLOGICAL ENVIRONMENT

1. Terrestrial Environment.

a. Flora. In March of 1975, Phillip H. Moore conducted a botanical survey of the project for the environmental impact statement for Seibu Leisure (Guam) Inc. Moore divided the native vegetation into four zones and indicated that the zones are fairly uniform within each zone except the forest area which is in a stage of development and can be called a "typhoon forest." Of the many species encountered in the four zones, Moore considered six species which could be considered rare or quite rare on the island. No endangered species were found. A list of the species found in indicated in Appendix C.

On July 15-18, 1986, a walk-through reconnaissance survey was made by Dr. Derral Herbst of the U.S. Fish and Wildlife Service. The project site was divided into three geographical units. The first unit consisted the area between the cliff edge to the vegetation line back to the beach. It is comprised of limestone forest, coconut forest and coastal or strand

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Decision Date: 11/14/13 Archive Date: 11/26/13

DOCKET NO. 10-21 420) DATE
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On appeal from the
Department of Veterans Affairs Regional Office in Waco, Texas

THE ISSUE

Entitlement to service connection for Hodgkin's disease, claimed as due to in-service herbicide exposure.

REPRESENTATION

Appellant represented by: Katrina J. Eagle, Attorney

WITNESS AT HEARING ON APPEAL

Appellant

ATTORNEY FOR THE BOARD

M. Zawadzki, Counsel

INTRODUCTION

The Veteran served on active duty from July 1970 to July 1992.

This matter comes before the Board of Veterans' Appeals (Board) on appeal from a June 2008 rating decision issued by the Department of Veterans Affairs (VA) Regional Office (RO) in Waco, Texas in which the RO, in pertinent part, denied service connection for Hodgkin's disease.

In March 2013, the Veteran testified before the undersigned Veterans Law Judge at the RO; a transcript of the hearing has been associated with the Virtual VA e-folder. The e-folder does not include any additional relevant documents.

Subsequent to issuance of the most recent supplemental statement of the case (SSOC), the Veteran submitted additional evidence in support of his claim. This evidence was accompanied by a waiver of RO consideration. See 38 C.F.R. § 20.1304 (2013).

FINDINGS OF FACT

1. Resolving all reasonable doubt in his favor, the Veteran was exposed to herbicides during service.

2. The Veteran was diagnosed with Hodgkin's disease in May 2007.

CONCLUSION OF LAW

The Veteran's Hodgkin's disease is presumed to have been incurred in active military service. 38 U.S.C.A. §§ 1110, 1131, 1116, 5107A, 5107 (West 2002 & Supp. 2013); 38 C.F.R. §§ 3.303, 3.307, 3.309 (2013).

REASONS AND BASES FOR FINDINGS AND CONCLUSION

Duty to Notify and Assist

The Veterans Claims Assistance Act of 2000 (VCAA) describes VA's duty to notify and assist claimants in substantiating a claim for VA benefits. 38 U.S.C.A. §§ 5100, 5102, 5103, 5103A, 5107, 5126 (West 2002 & Supp. 2013); 38 C.F.R. §§ 3.102, 3.156(a), 3.159, 3.326(a) (2013). The United States Court of Appeals for Veterans Claims (Court), in Dingess/Hartman v. Nicholson, 19 Vet. App. 473 (2006), has held that the VCAA notice requirements apply to all elements of a claim.

Given the favorable disposition of the claim on appeal, the Board finds that all notification and development actions needed to fairly adjudicate this claim have been accomplished.

Analysis

The Veteran asserts that his Hodgkin's disease is related to herbicide exposure during service, specifically, his service at Andersen Air Force Base in Guam from December 1972 to May 1973.

If a veteran was exposed to an herbicide agent (to include Agent Orange) during active military, naval, or air service, certain diseases shall be service-connected if the requirements of 38 C.F.R. § 3.307(a)(6) are met, even if there is no record of such disease during service, provided further that the rebuttable presumption provisions of 38 C.F.R. § 3.307(d) are also satisfied. 38 C.F.R. § 3.309(e). These diseases include Hodgkin's disease. 38 C.F.R. § 3.309(e). Thus, a presumption of service connection arises for a veteran with in-service herbicide exposure who develops Hodgkin's disease.

Veterans who served in the Republic of Vietnam during the period beginning on January 9, 1962, and ending on May 7, 1975 shall be presumed to have been exposed to an herbicide agent, unless there is affirmative evidence to establish that the Veteran was not exposed to any such agent during that service. 38 U.S.C.A. § 1116(f); 38 C.F.R. § 3.307(a)(6)(iii). The Veteran in this case has not asserted, nor does the record indicate, that he served on land in the Republic of Vietnam. Accordingly, the presumption of herbicide exposure does not apply and actual, direct exposure to herbicides must be shown. See Combee v. Brown, 34 F. 3d 1039, 1042 (Fed. Cir. 1994).

The Veteran has repeatedly described exposure to Agent Orange on Andersen Air Force Base in Guam between December 1972 and May 1973. He has reported loading and unloading drums of Agent Orange from his truck, with leaking fluids sometimes getting on his person. He testified during the March 2013 hearing that the drums were generally black with an orange (or in some cases blue or silver) band around them. He stated that his superiors instructed him to pick up "drums of Agent Orange" from the Navy Base. He reported driving drums to the Uranao dumpsites where there was a small cliff over which he and fellow service members would push the drums off the back of the truck. The Veteran added that some drums were deteriorating; so the contents would splash on them. He reported dumping at these sites on approximately five occasions during his time in Guam, with about another five or ten trips to the Naval base to retrieve or deliver drums. During the hearing, the Veteran's attorney submitted a Board decision regarding another veteran, documenting that the veteran in that case reported transporting 55-gallon drums to Andersen Air Force Base, with several barrels of Agent Orange falling onto the road.

The RO attempted to verify the Veteran's reported in-service herbicide exposure, and made a request to the National Personnel Records Center (NPRC) for documents showing exposure to herbicides. In February 2008, the NPRC responded that there were no records of exposure to herbicides.

However, the Veteran has submitted a number of pieces of evidence in support of his assertion that he was exposed to herbicides during his service in Guam. The Veteran provided an Environmental Protection Agency (EPA) December 2003 Superfund Record of Decision regarding Andersen Air Force Base. The Record of Decision states that, based on accounts by former Air Force personnel, wastes were dumped at the Uranao dumpsites; by being pushed over a cliff. The Record of Decision states that there were no documented accounts of waste disposal practices, duration, volume, or the types of disposed materials. Another EPA document regarding Andersen Air Force Base provided by the Veteran discusses numerous hazardous

substances associated with the base and states that most soil contamination problems were either the result of nearby industrial activity or the result of material being placed into scattered dump sites. The report also discusses the Uranao dumpsite, located over a cliff line in the northwest portion of the base. According to the report, crashed aircraft were pushed off the runways over this cliff throughout the Vietnam War.

The Veteran submitted a Public Health Assessment from the Department of Health and Human Services Agency for Toxic Substances & Disease Registry (ATSDR) regarding Andersen Air Force Base. This assessment reports that base activities had resulted in numerous fuel, pesticide, and chemical spills, with contamination identified at several areas of the base.

The Veteran also provided a copy of a May 2003 letter from a congressman to the Secretary of Defense, from the internet, in which the congressman reported that a "Public Health Assessment" received by his staff indicated that dioxin levels had been detected in the soil at Andersen Air Force Base. The congressman added that he had received information from veterans who were stationed on Guam who reported the use of Agent Orange, Agent Blue, and Agent White during the Vietnam era. The report finding dioxin contamination in the soil at Andersen Air Force Base, provided by the congressman to the Secretary of Defense, is also mentioned in another internet article the Veteran submitted in support of his claim.

The Veteran has furnished photographs of sprayed vegetation on Guam and large drums at Andersen Air Force Base. The Veteran stated that, although these were not his photographs, they were typical photographs of Agent Orange and other "rainbow agents" stored and used on Guam. He provided an article, presumably obtained on the internet, entitled "Guam...The Land of the Rosaries" which discusses the presence of dioxin in Guam. Another document presumably printed from the internet reports that Guam was a storage area for Agent Orange during the Vietnam era. This article states that an environmental study and subsequent clean-up were later done at Andersen Air Force Base.

In a May 2010 letter, the Veteran's private physician, Dr. B.R., wrote that he was treating the Veteran for residuals of his Hodgkin's disease. The physician stated that the Veteran had shown him his Air Force service records, photographs showing that he was stationed at Andersen Air Force Base in Guam in 1972-1973, and documents stating that Agent Orange was used at Andersen Air Force Base at that time. Dr. B.R. opined that it was as likely as not that the Veteran's Hodgkin's disease is etiologically due to his exposure to Agent Orange while stationed at Andersen Air Force Base in Guam in 1972-1973.

A May 1973 Performance Report for the period from June 1972 through May 1973 confirms that the Veteran served on temporary duty at Andersen Air Force Base in Guam as a Vehicle Operator. His duties included operating general purpose vehicles; supervising the loading and off-loading of personnel and cargo; and performing operator maintenance as required.

The Board accepts the Veteran's assertions of driving, loading, and off-loading drums as credible and consistent with the circumstances of his service. See 38 U.S.C.A. § 1154(a).

The Board, having considered all the evidence of record, finds that the evidence is at least evenly balanced regarding the question of whether the Veteran was exposed to herbicides during service. In such a situation, the question is to be resolved in favor of the veteran. See Gilbert v. Derwinski, 1 Vet. App. 49, 53-54 (1990).

Accordingly, considering the totality of the evidence, in light of the Veteran's consistent and credible statements, and resolving all doubt in his favor, the Board accepts that the Veteran was exposed to herbicides during his service in Guam.

A May 2007 pathology report reflects that the Veteran was diagnosed with Hodgkin's disease. He subsequently underwent chemotherapy for this condition until December 2007. Given that Hodgkin's disease is a disease that is presumed related to herbicide exposure under 38 C.F.R. § 3.307 and 3.309, service connection is warranted on this basis. 38 U.S.C.A. § 5107(b).

ORDER

Service connection for Hodgkin's disease, claimed as due to in-service herbicide exposure, is granted, subject to the laws and regulations governing the award of monetary benefits.

_____

JOHN Z. JONES
Veterans Law Judge, Board of Veterans' Appeals

Department of Veterans Affairs

NOVEMBER 1, 1968

NCS Guam Communicator

a supplement to the crossroads

UDT Men Stage Big Blow-up On NCS Beach

Deep Hole Dug By Explosives

The jungle setting below was quiet, serene, peaceful. The palm tress reached to the edge of the beach that seemed to be crawling into the sea. To the left, a high cliff overlooked the scene as a mighty protector. A road wound down to the beach, passing several huts as it flattened out on the white sand. The humid air was still; light showers alternated with bright, hot sunshine.

Then down on the beach, a movement. A bright flash, and a crack, much like a whip popping too close to the ear. Suddenly, a gray mass of water makes its geyser-like way to the clouds, reaching a height even with the over-200-foot cliff, then climbing half again as high to reach a point where it can go no higher, but must tumble back to the sea below.

This isn't an account from some fiction book from the library, or a description of a battle by some Vietnam war veteran, but an account of the building of a swimming hole at the NCS Beach. The mad bombers were the Underwater Demolition Team.

Dressed in shorts, some saddled with a knife, looking for all the world like a commando team from old war movies, the UDT men planted over 1500 lbs. of explosives to dig a hole in the coral about 20 yards out from the beach.

Following the big blow-up, the men dragged the bottom of the small inlet clearing away rock, coral and other debris. Their efforts resulted in a bigger area for NCS swimmers, plus uncovering many shelled things for snorkelers to seek.

THE CHARGES were in inflatable cases to facilitate movement in the water when the men reached the site they punctured the bags, letting the charges settle on the ocean floor.

KING THE EXPLOSIVES, a UDT man s to haul the charges into the water.

THE UDT MEN wait for all of the team to line up and drag the charges out to the site for the new hole.

MEMBERS OF THE UDT Team drag the explosives gently into the water. The charges were set to go off at a fraction of a second intervals, sounding like one big explosion.

THROWING WATER OVER 300 FEET in the air, the geyser from the explosion dwarfs the tall palm trees on NCS Beach.

THE FUSE LINE FOLLOWS the men into th water as they plant charges to build a swimmin hole for NCS beach goers.

NCS Guam Communicator

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USAFAND 10/17/84

INSTALLATION RESTORATION PROGRAM

PHASE I: RECORDS SEARCH

ANDERSEN AIR FORCE BASE, GUAM

PREPARED FOR:

UNITED STATES AIR FORCE
HQ SAC / DEPV
OFFUTT AFB, NEBRASKA

WITH THE
ASSISTANCE OF:

HQ AFESC / DEVP
TYNDALL AFB, FLORIDA

SUBMITTED BY:

REYNOLDS, SMITH AND HILLS, INC.
JACKSONVILLE, FLORIDA

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
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19. A search of USAF, state and federal agency records and interviews with past and present base personnel and agency representatives were conducted to identify past hazardous waste generation and disposal practices at Andersen AFB, Guam. Andersen AFB is located on the northeastern end of the island of Guam, Mariana Islands, in the southwest region of the Pacific Island (3,318 miles west of Hawaii, 1,499 miles east of the Phillipines, and 1,563 miles southwest of Japan). Twenty locations and/or facilities were identified as potential hazardous waste sites. Follow-on recommendations included alternate techniques for handling hazardous wastes, confirmation studies and in some cases, closure of existing hazardous waste disposal sites.

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SECURITY CLASSIFICATION

EXECUTIVE SUMMARY

INTRODUCTION

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is known as the Installation Restoration Program (IRP) and consists of four phases: Phase I--Initial Assessment/ Records Search, Phase II--Confirmation and Quantification, Phase III--Technology Base Development, and Phase IV--Operations/Remedial Actions. Environmental Science and Engineering, Inc. (ESE), as a subsidiary of Reynolds, Smith and Hills, Inc. (RS&H), conducted the Phase I study for Andersen Air Force Base (AAFB), with funds provided by the Strategic Air Command (SAC), under Contract No. F08637-83 G0010 5004.

INSTALLATION DESCRIPTION

AAFB is located on the northeastern end of the island of Guam, Mariana Islands, in the southwest region of the Pacific Ocean. The island of Guam is located 3,318 miles west of Hawaii, 1,499 miles east of the Philippines, and 1,563 miles southwest of Japan. The island of Guam is approximately 30 miles in length and varies from approximately 4 to 8.5 miles in width. Communities located near the main base include Yigo and Dededo. In addition to the main base area, other Air Force properties include Northwest Field, Andersen Petroleum Product Storage Annexes 1 and 2, Andersen Water Supply Annex (two locations), Andersen Air Force Station, AAFB South (also known as Andersen Administration Annex and Marbo Annex), Andersen Radio Beacon Annex, Andersen Communication Annexes 1 and 2, and various Andersen family housing annexes. The Air Force currently controls 20,811.12 acres of real property, with the largest section (15,463.28 acres) consisting of the AAFB main base, storage area, and Northwest Field. Many property

holdings have been declared excess and are in the process of being transferred to the Navy and various agencies of the Government of Guam.

After U.S. Forces recaptured Guam during World War II, the Army Air Force constructed three bases: Harmon Field--an aircraft repair and maintenance facility; Northwest Field--a fighter plane base; and North Field--a base designed for B-29 bombers. At the end of the war, Harmon and Northwest Fields were closed. North Field was redesignated AAFB in 1949. Throughout the years of operation, AAFB has been a base of operations for bomber aircraft and their support activities.

Historically, aircraft stationed at Guam have included B-29s, B-50s, B-36s, B-47s, B-52s, and KC-135s. Currently, aircraft assigned to AAFB include B-52s and KC-135s. The B-52 aircraft are permanently assigned to AAFB, whereas the KC-135 aircraft and their associated support units are assigned on a rotational basis. The base is currently under the command of SAC's 3rd Air Division, and support functions are provided by various support groups of the 43rd Strategic Wing.

ENVIRONMENTAL SETTING

Environmental setting data relevant to the evaluation of past waste management practices at AAFB are described in the following paragraphs.

AAFB is located on a limestone plateau on the northern end of Guam. Elevations on the base range from mean sea level (msl) to more than 620 feet (ft) msl. The northern end of the island is characterized by steep limestone cliffs. The northern limestone plateau is relatively flat, except for two hills of volcanic origin [Mount Santa Rosa (858 ft msl) and Mataguac Hill (630 ft msl)] and one limestone dome (Barrigada Hill, 665 ft msl). The area also has numerous sinkholes and natural depressions.

No surface streams exist on the northern end of Guam. Storm water on AAFB is channeled relatively short distances into natural or manmade

depressions in which dry injection wells have been drilled. These dry wells allow infiltration of surface waters into the aquifer. More than 100 of these injection wells have been installed on AAFB.

The major aquifer underlying AAFB is known as the Northern Lens Aquifer and consists of a parabasal unit, a basal unit, and a transition zone. The aquifer consists of a wedge of up to 150 ft of fresh water overlying salt water. Recharge occurs through the downward percolation of precipitation through the highly porous limestone overlying the aquifer and also through the dry injection wells.

Soils on AAFB are very thin and are residuals of weathered limestone and volcanic materials. The soils are very porous, have relatively high levels of organic materials (4 to 6 percent), and are locally known as Guam clay. These soils are highly susceptible to infiltration of contaminants.

Average annual rainfall at AAFB is 90.8 inches, with more than 60 percent occurring during the local wet season (July to November) at an average rate of more than 11 inches per month. Average monthly temperatures are relatively stable throughout the year, varying from a mean low of 75°F to a mean high of 84°F. An extreme minimum of 66°F in January and an extreme maximum of 91°F in August have been recorded.

Several threatened or endangered species are known to occur on AAFB and in the area, including Mariana fruit bat, Guam broadbill, Mariana crow, Micronesian kingfisher, Guam rail, and bridled white-eye. AAFB personnel, working with the Guam Aquatic and Wildlife Resources Division, are trying to both identify and maintain the habitat of the Guam rail. In known habitat areas, a trapping program has been established in an attempt to control the Philippine rat snake, a potential predator of the Guam rail.

As a result of the geohydrological environment and soil characteristics, conditions on AAFB are conducive to contaminant migration. Potential

contaminant migration would occur both vertically and laterally through the porous limestone into the Northern Lens Aquifer, the largest freshwater aquifer used as a potable water source on Guam.

METHODOLOGY

During the course of this investigation, interviews were conducted with base personnel (past and current) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state, and Federal agencies; and field inspections were conducted at past hazardous waste activity sites.

Sites identified as potentially containing hazardous contaminants resulting from past activities have been assessed using the Hazard Assessment Rating Methodology (HARM), in which factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices are considered. The details of the rating procedure are presented in App. G. The HARM system is designed to indicate the relative need for followup action (Phase II).

CONCLUSIONS

The goal of the IRP Phase I Study is to identify sites where there is a potential for environmental contamination resulting from past waste disposal practices and to assess the potential for contaminant migration from these sites. Twenty sites were identified at AAFB as having potential for environmental contamination and have been evaluated using the HARM system. The relative potential of the sites for environmental contamination was assessed, and sites which may require further study and monitoring were identified. These sites, dates of operation or occurrence, and the HARM results are given in Table 1. Site locations are shown in Figs. 1, 2, and 3. Sites of primary concern are those with higher HARM scores which have a higher potential for environmental contamination and should be investigated in Phase II. Sites of secondary concern are those with lower HARM scores and moderate

Table 1. Priority Ranking of Potential Contamination Sources on AAFB

Rank	Site	Figure	Designation	Date of Operation or Occurrence	Score
1	Landfill No. 25	2	LF-25	1945-1962	86
2	Landfill No. 1	1	LF-1	1945-present	65
3	Landfill No. 2	1	LF-2	1947-1974	65
4	Landfill No. 10	1	LF-10	Early to mid-1950s	65
5	Landfill No. 3	1	LF-3	1947-1977	64
6	Stormwater Drainage System, Zone No. 1	1	SDS-1	Late 1940s-present	62
7	Landfill No. 13	1	LF-13	1951-1956	62
8	Firefighter Training Area No. 1	1	FTA-1	1945-1958	59
9	Hazardous Waste Storage Area No. 1	1	HW-1	1950s-1983	58
10	Stormwater Drainage System, Zone No. 3	1	SDS-3	Late 1940s-present	57
11	Firefighter Training Area No. 2	1	FTA-2	1958-present	57
12	Stormwater Drainage System, Zone No. 2	1	SDS-2	Late 1940s-present	56
13	Chemical Disposal Site No. 1	1	CS-1	1970s	55
14	Landfill No. 16	1	LF-16	Late 1950s-early 1960s	54
15	Drum Storage Area No. 2	1	DS-2	?-present	50
16	Chemical Disposal Site No. 2	1	CS-2	1950-1952	45
17	Drum Storage Area No. 1	1	DS-1	?-present	43

Table 1. Priority Ranking of Potential Contamination Sources on AAFB
(Continued, Page 2 of 2)

Rank	Site	Figure	Designation	Date of Operation or Occurrence	Score
18	Chemical Disposal Site No. 3	3	CS-3	1950s-1970s	41
19	Landfill No. 22	3	LF-22	Mid-1950s-early 1960s	38
20	Chemical Disposal Site No. 4	3	CS-4	1950s	37

Source: ESE, 1985.

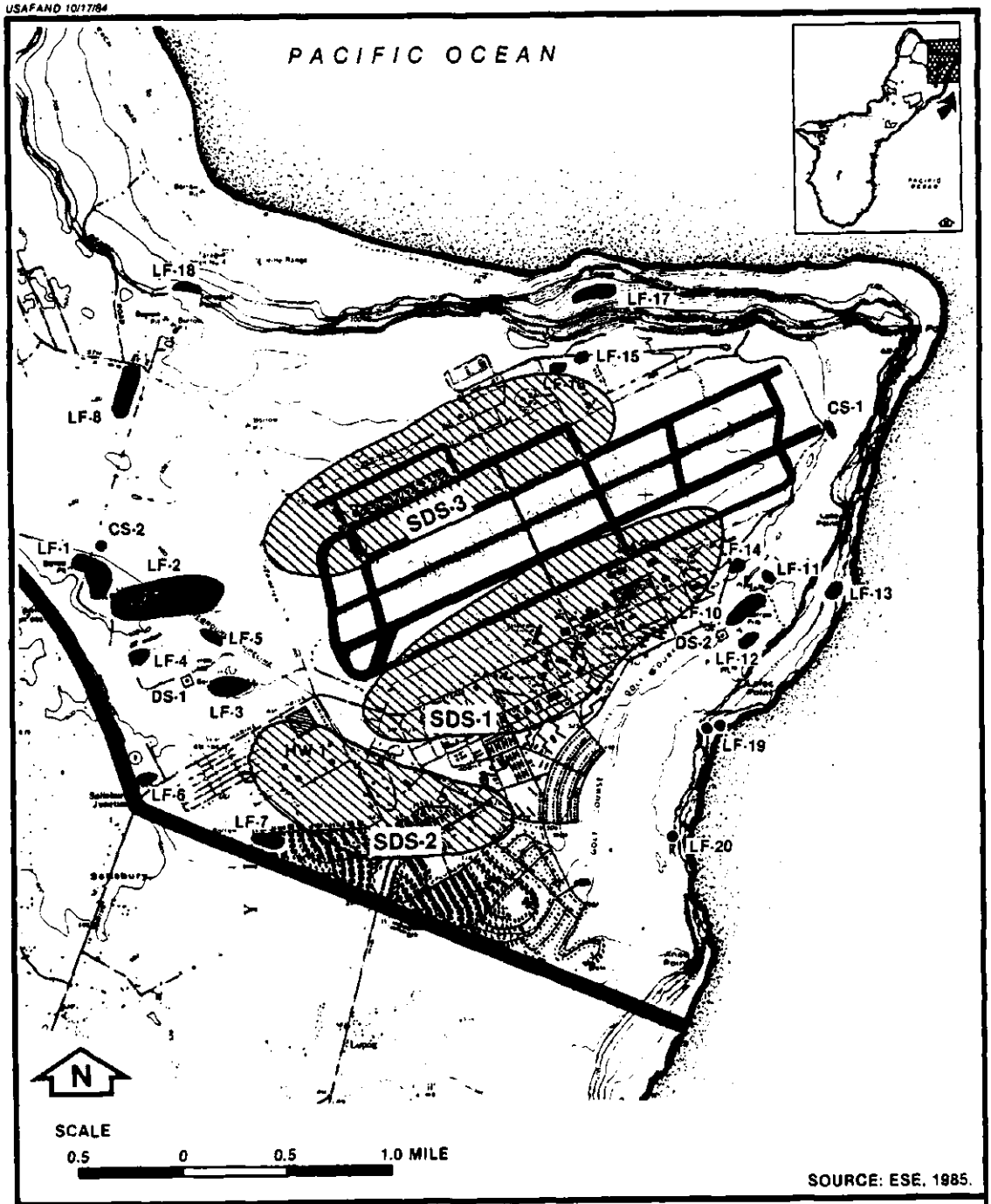

Figure 1
LOCATIONS OF POTENTIAL CONTAMINATION ON EASTERN PART OF AAFB

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Andersen Air Force Base

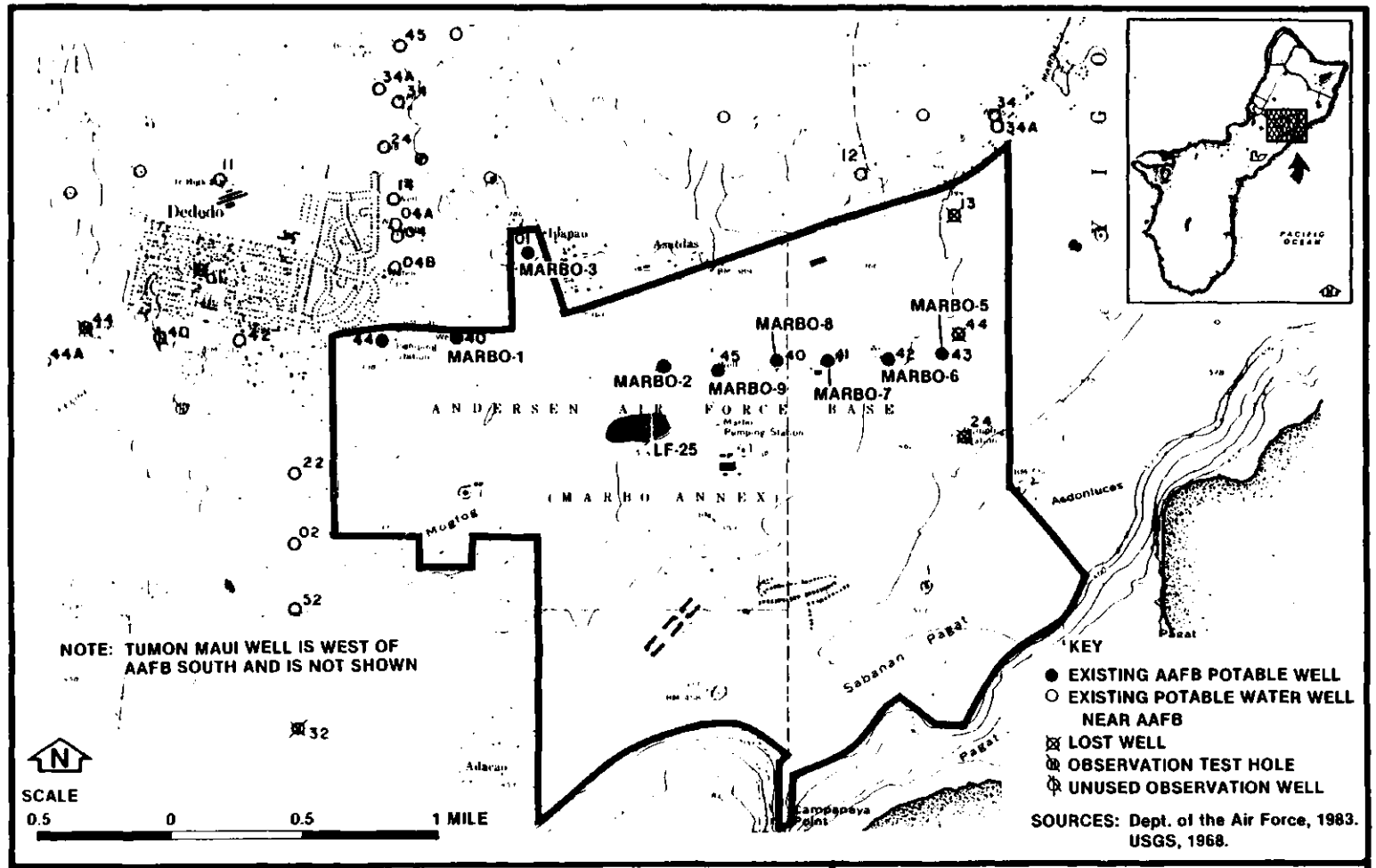

Figure 2
LOCATIONS OF POTENTIAL CONTAMINATION ON AAFB SOUTH (MARBO ANNEX)

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Andersen Air Force Base

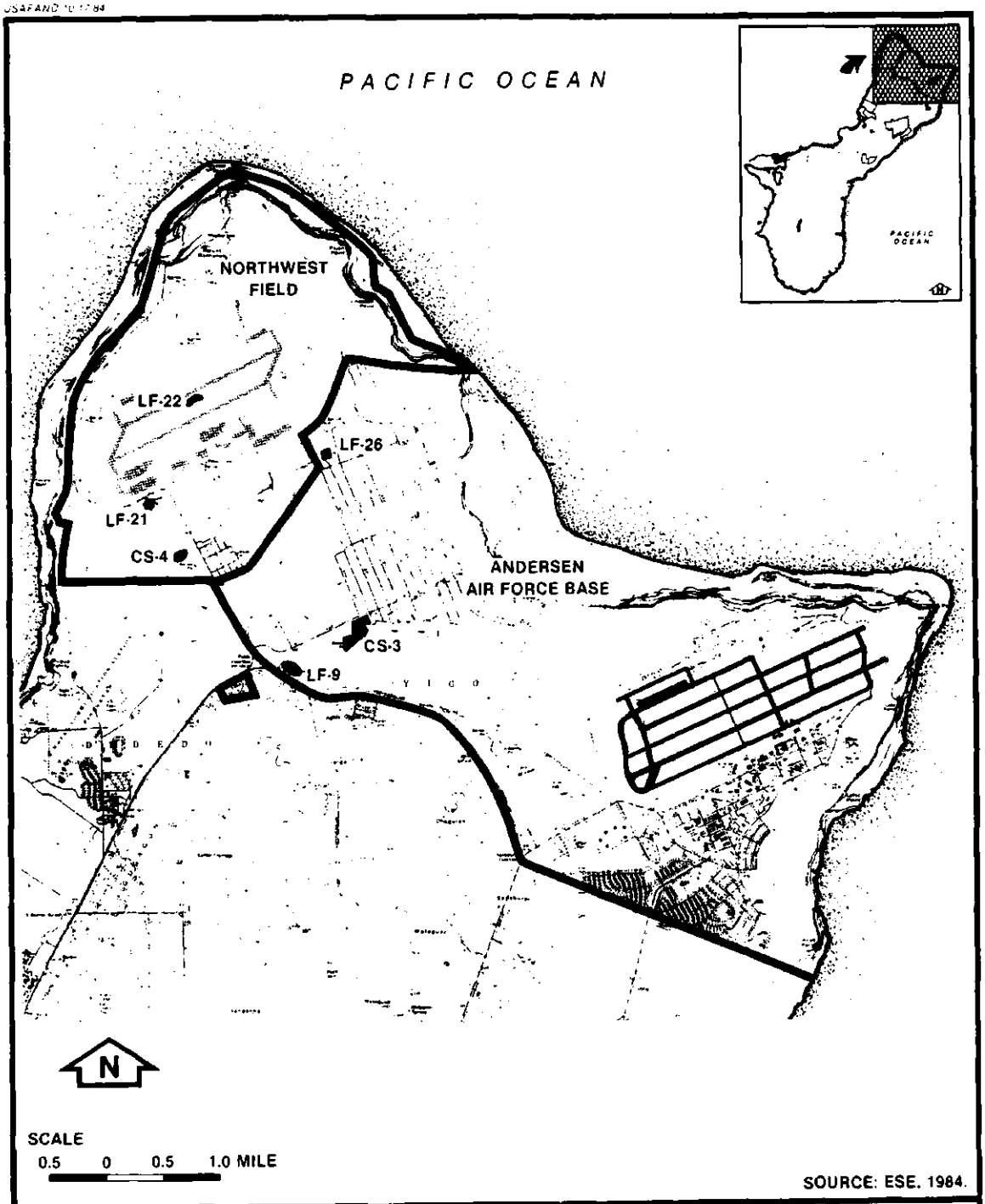

Figure 3
LOCATIONS OF POTENTIAL CONTAMINATION ON WESTERN PART OF AAFB AND NORTHWEST FIELD

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Andersen Air Force Base

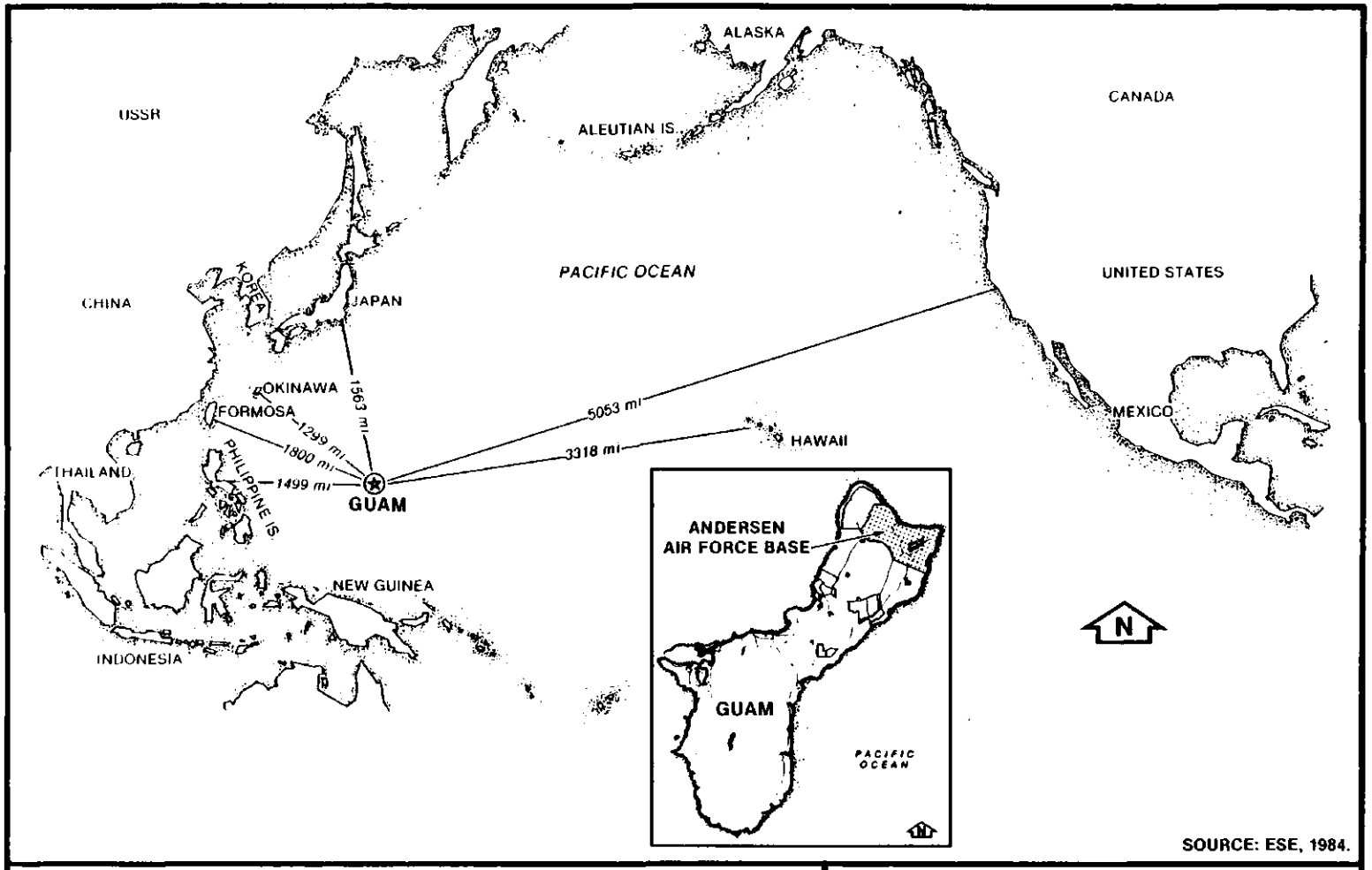

Figure 2.1-1
LOCATION MAP

INSTALLATION
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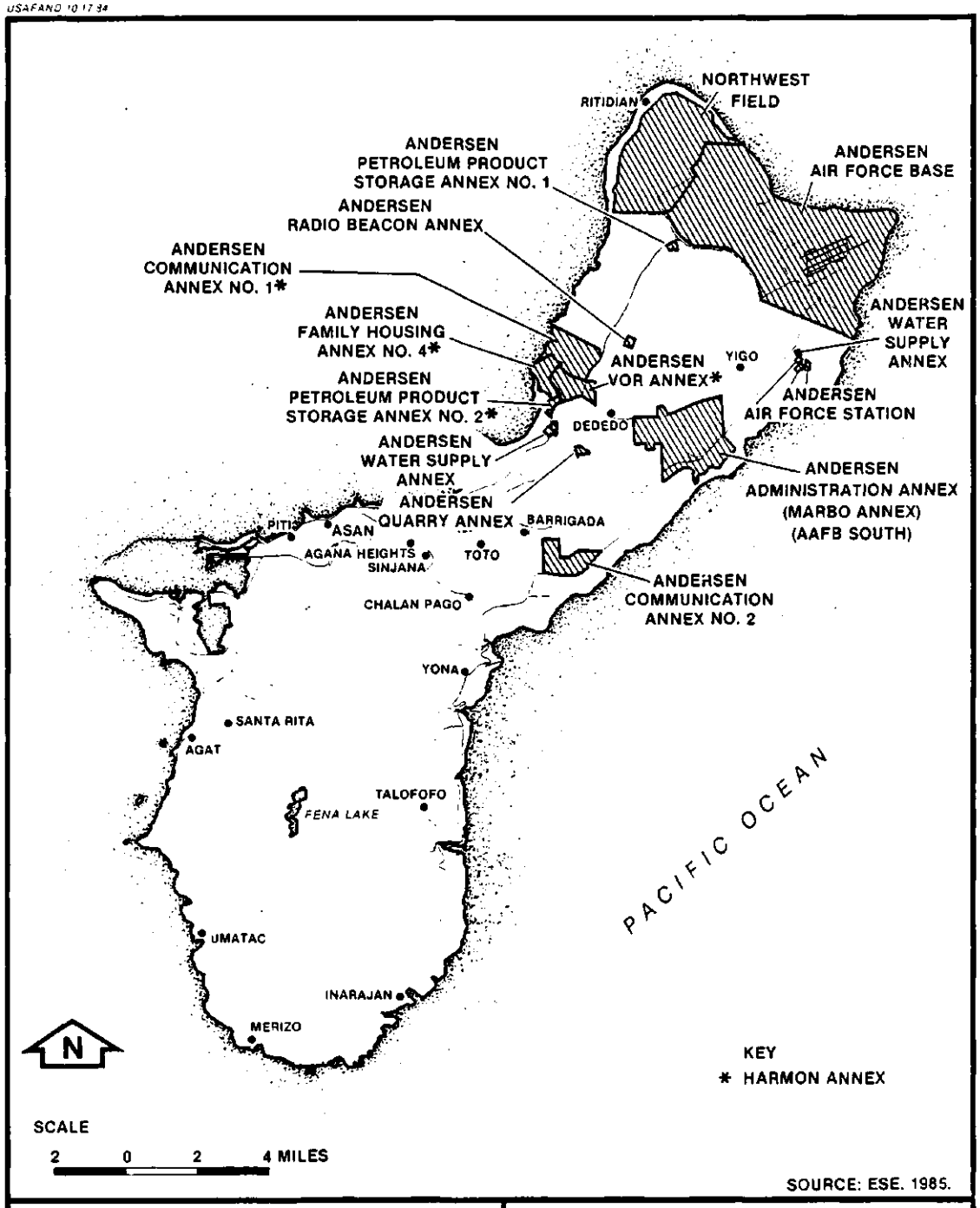

Figure 2.1-2
LOCATIONS OF AAFB PROPERTIES

INSTALLATION RESTORATION PROGRAM
Andersen Air Force Base

2-3

(sent to DPDO), infectious wastes and noncontrol out-of-date pharmaceuticals (sent to the landfill after autoclaving the infectious wastes), infectious materials (incinerated at Bldg. 23003 prior to 1981; now sent to the Naval Base for incineration and disposal), and dilute chemical solutions and solvents and controlled pharmaceuticals (disposed of in the sanitary sewer system). The clinic has been located in Bldg. 26000 since 1956. The veterinary activity, currently located in Bldg. 20011, was located in Bldg. 26000 from 1956 to 1964.

43rd AMS PMEL

The 43rd AMS PMEL operates a laboratory to check the calibration of various instruments. The major waste produced by this operation is metallic mercury removed from various instruments. The mercury is recovered and sent to DPDO for disposal. PMEL is located in Bldg. 286 on AAFB South.

43rd CSG Photographic Laboratory

The 43rd CSG operates photographic laboratories for the processing of black-and-white film, color print film, color slides, and motion picture film. The primary base photographic laboratory has been located in Bldg. 21001 since 1948. Prior to 1968, all wastewaters generated by the laboratory were disposed of in the sanitary sewer system. In 1968, a silver recovery program was initiated. Silver is now recovered from fixing bath solutions (75 gal/mo) and from scrap film, negatives, pictures, and print papers. After silver recovery, the fixing bath solutions and other chemical solutions used in the developing and printing process are disposed of to the sanitary sewer system.

43rd CSG Reproduction Shop

This activity, currently located in Bldg. 25018, was in Bldg. 21000 from 1948 to 1973. Wastes produced by this activity include rags saturated with Blanketrolla® solvent, deglazing solvent, multilith solution, and dichloromethane used to clean the reproduction equipment. Solvents contained in these solutions are usually chlorinated (e.g., TCE,

dichloromethane). The waste rags containing small amounts of these solvents are usually disposed of in the landfill.

43rd AMS Photographic Laboratory

This operation produces only small quantities of rags saturated with methyl alcohol that are used to clean the photographic equipment, including lenses, mounted on aircraft. These rags are disposed of in the sanitary trash. No problems are anticipated from this disposal technique.

Arts and Crafts Photographic Laboratory

This operation, located in Bldg. 25005, generates small quantities of waste fixer and developer, which are disposed of in the sanitary sewer.

4.1.3 PESTICIDE HANDLING, STORAGE, AND DISPOSAL

Pesticides and herbicides are currently being used by the 43rd CES Entomology Section to maintain grounds and structures and to prevent pest-related health problems. Before 1984, the 43rd CES Roads and Grounds Shop was responsible for herbicide applications. Pest-control measures include health-related and structural insect and rodent-control rodent-control programs; weed-control at security fences, parking areas, and utility and antenna sites; and landscape maintenance programs.

Pesticides have been stored and handled in Bldg. 20010 since 1978. During the same period, herbicides have been stored and handled in Bldg. 20021. Prior to 1978, pesticide handling and storage had been conducted in a building which was located where the present MAC terminal stands. For an undetermined length of time up to approximately 1967, pesticides had been stored in an igloo (No. 8479) in the northwestern portion of AAFB.

Records of types and quantities of pesticides used are available from 1982 to present. No record or recollection of disposal of excess or outdated pesticides is available.

Until about 1977, pesticide wastewaters, generated by rinsing spray equipment, were disposed of on the ground at various rinse water sources. Since no designated area was used for repeated disposal of rinse water and due to the dilute concentration of pesticides in these wastes, no significant pesticide residuals are anticipated from these disposal practices. Since 1977, rinse waters have been used as diluent for subsequent formulations of the same pesticides. Empty pesticide containers have always been landfilled. Prior to the mid-1970s, the containers were landfilled without rinsing; subsequent to that time, all containers have been triple-rinsed and punctured or crushed prior to landfilling.

Two incidences of accidental pesticide and herbicide spills have occurred. The most recent spill occurred at the Harmon Annex tank farm on Feb. 8, 1984, when 1,500 gal of a Diuron/water mixture were released from a herbicide sprayer. The spill resulted from a broken hose and created a stream of herbicide which covered approximately 1/3 acre before seeping into the ground. The residual herbicide left on the ground surface was placed in metal drums and removed from the site for subsequent disposal. The spill posed no significant threat to humans or wildlife. There was no water in proximity to the spill. The herbicide spreader was taken for repairs and modifications of the valve system to avoid another incident. The Guam Environmental Protection Agency (EPA) was notified after the spill occurred and offered guidance and inspected the site upon completion of the cleanup. It was found that the cleanup was complete, and no further action was needed (43rd CES, 1984).

Another incident occurred in 1972 at the intersection of Tarague Beach Rd. and Pati Point Rd. At this location, approximately 100 gal of

3-percent malathion were drained from a tank trailer. No report of this incident or related action is available.

4.1.4 PCB HANDLING, STORAGE, AND DISPOSAL

The 43rd CES Electrical Shop performs electrical inspection, maintenance, and installation procedures on AAFB. However, the Public Works Center on the Naval Station (NS) has performed maintenance of transformers on AAFB, including those containing PCB fluids. Reworking has taken place on NS facilities since initial operation of AAFB. In 1976, a program to replace equipment containing PCB dielectric fluid with mineral-oil-filled equipment was initiated by the Navy Public Works Center. A list of transformers containing PCB fluids, transformer locations, and volume of fluid in each transformer is maintained by AAFB. An open storage area (Pad No. 20013, adjacent to Bldg. 20011) is currently used for storage of out-of-service electrical components. An inspection of this area revealed that all transformers had been removed. No evidence of dielectric fluid residues was observed at the site. Several minor leaks have occurred, as noted on the inspection sheet. Any fluids which have leaked are cleaned up by Navy personnel and taken to the Navy Public Works Center for disposal. No past PCB spill sites were identified.

4.1.5 POL HANDLING, STORAGE, AND DISPOSAL

The types of POL used and stored at AAFB include MOGAS, diesel fuel No. 2 (DF-2), fuel oil, kerosene, JP-4, liquified petroleum gas (LPG), petroleum-based solvents, hydraulic fluid, and lube oil.

In addition to fixed storage tanks, drums and smaller containers are used for aboveground storage of incoming and waste materials, mainly solvents, hydraulic fluid, and lube oil.

POL spill management is addressed in the Spill Prevention Control and Countermeasure (SPCC) Plan. This plan is revised regularly to ensure

that it accurately reflects storage capacity and spill prevention/ containment.

Existing Aboveground POL Storage

The aboveground storage tanks range in capacity from 50 to 5,250,000 gal. Total aboveground storage tank capacity for MOGAS, DF-2, fuel oil, and JP-4 is approximately 45,836,000 gal. There were 40 aboveground tanks identified basewide, with spill-containment structures ranging from no containment to complete concrete enclosures. The POL types, capacities, facility numbers, and containment structures (if any) are listed in Table 4.1-3. The majority of the large aboveground tanks were constructed by USAF in the late 1940s.

Existing Underground POL Storage

A total of 110 existing underground storage tanks were identified at AAFB, with a total capacity of 18,580,000 gal. The number of tanks, POL types, capacities, and facility numbers are listed in Table 4.1-4. The majority of the large underground tanks are used for storing JP-4 for aircraft use and MOGAS and DF-2 for vehicular use.

Abandoned POL Storage

Only one abandoned tank was reported at AAFB. The 210,000-gal fuel oil storage tank is located at the old power plant (Bldg. 2618). This aboveground tank was completed in 1976. The tank is empty and does not represent any potential threat to the environment.

Waste POL Storage, Handling, and Disposal

Waste POL at AAFB include waste fuel, lube oil, petroleum-based solvents, and hydraulic fluid. The generation and disposal of waste POL are summarized in Table 4.1-1 (in Sec. 4.1-1).

Wastes are stored at their generation points in drums, aboveground tanks, and underground tanks until the maximum storage capacity is reached. Until 1969, the typical disposal practice for waste POL was

United States
Environmental Protection
Agency

Office of
Public Affairs (A-107)
Washington DC 20460

July 1984

EPA Dioxin Facts

Answers to Commonly Asked Questions

What is dioxin?

The word dioxin is a generic term for a group of 75 related compounds known as polychlorinated dibenzo-p-dioxins (PCDDs), but in popular use it usually refers to the most toxic and carefully studied of these compounds — 2,3,7,8-tetrachlorodibenzo-p-dioxin, or 2,3,7,8-TCDD, or simply TCDD.

Where does dioxin come from?

Nobody produces dioxin (TCDD) on purpose. It is an unwanted but almost unavoidable by-product that comes from manufacturing several commercial substances, chiefly the pesticide 2,4,5-trichlorophenol (2,4,5-TCP). This pesticide is then used as a basic ingredient in the manufacture of several other pesticides, including the herbicides 2,4,5-T and silvex, and the bactericide hexachlorophene. (Pesticide is a general term for chemical products used to destroy or control unwanted insects, plants, fungi, mites, rodents, bacteria, or other organisms.)

How does dioxin get into the environment?

TCDD can enter the environment in several ways; through chemical products contaminated with dioxin; as a component of the wastes that are produced in manufacturing these products; and through the widespread use of contaminated products. Combustion is another possible source of dioxin contamination.

Dioxin can enter waterways and soil in stormwater runoff, through industrial discharges, or by seeping from landfills that contain dioxin-contaminated wastes. Dioxin's solubility in water is quite low, but it attaches itself to soil particles, thus making it more likely to be found in the sediment than in the water itself.

Once in the environment, dioxin can be very persistent. Its half-life in soil is on the order of 5-10 years. Under special circumstances, however, the ultraviolet radiation in sunlight can degrade it over a shorter amount of time.

How does dioxin affect people?

Although scientists disagree on the long-term health effects of exposure to 2,3,7,8-TCDD, tests on laboratory animals indicate that it is one of the most toxic man-made chemicals known. Because information on effects to humans has come mostly from accidental exposures, the data are not definitive. Scientists do agree, however, that exposure to TCDD can cause a persistent skin rash called chloracne, as experienced by some workers exposed to dioxin in the work place or through industrial accidents. Tests on laboratory animals also indicate that exposure may result in a rare form of cancer called soft tissue sarcoma, liver dysfunction, elevated blood cholesterol, nervousness, and other problems.

Much controversy still exists over the use of Agent Orange, a dioxin-contaminated defoliant used during the Vietnam War, and whether some veterans and their children may be suffering from delayed effects of the chemical.

How do people generally come in contact with dioxin?

There are two exposure routes that present the greatest possibilities for health risks. One is through contact with dioxin-contaminated soil and the other is through eating contaminated fish. Dioxin-contaminated soil presents a particular risk to children who ingest it.

At what levels is dioxin a danger to people?

The Centers for Disease Control (CDC) considers 1 part per billion (ppb) of dioxin in soil to be a level of concern in residential areas. (CDC is the federal agency EPA relies on to conduct site-specific exposure and risk assessments whenever hazardous pollutants are found in soil at high levels.) The Food and Drug Administration recommends limiting consumption of fish with 25 parts per trillion (ppt) or greater of dioxin to no more than one meal per week and not eating any fish with greater than 50 ppt of dioxin.

EPA, in conjunction with these federal agencies and State and local health agencies, will issue health advisories and alert people to any precautions they need to take whenever dioxin is detected at these levels. They will also decide what further actions are necessary.

Is it safe to swim or boat in water that contains dioxin?

Local health agencies post signs to alert people when they should not be using a particular body of water for recreational purposes. Since dioxin does not readily dissolve in water, but instead attaches to particles and eventually settles to the bottom, it is not likely to pose a threat to human health unless you disturb any sediment in which dioxin has settled. However, if you have any concerns whatsoever about the safety of the water, for any reason, ask the advice of your local health officials before swimming or boating.

Is it safe to drink water that contains dioxin?

Any drinking water that is suspected of being contaminated with dioxin or any other hazardous chemical should not be consumed. You should contact your local health department to find out the facts, or heed any advice they have given you. They will also advise you on whether or not you should be using an alternative drinking water source. Most water treatment plants can eliminate dioxin during the water treatment process by removing the sediment in which it collects.

Does dioxin affect animals?

The only known incident in the U.S. occurred in Missouri in 1971 when horse arenas were sprayed with high levels of dioxin-contaminated oil. Hundreds of horses became sick and 65 of them died.

What federal agencies are involved in dioxin detection and cleanup?

EPA regulates dioxin under the Toxic Substances Control Act and the Federal Insecticide, Fungicide, and Rodenticide Act and is developing regulations to control it in wastes under the Resource Conservation and Recovery Act. The Food and Drug Administration issues health advisories for dioxin in products for human consumption. The Occupational Safety and Health Administration has jurisdiction over dioxin exposure in the workplace. Issues associated with dioxin in

Agent Orange involving military personnel are handled by the Veterans Administration (VA) and the Department of Defense, although the VA has relinquished control of a project to investigate a link between dioxin and Vietnam veterans to the Centers for Disease Control.

What has industry done about the dioxin problem?

By 1965, some companies had changed their production processes and increased quality control practices in an attempt to reduce the levels of TCDD in the pesticide 2,4,5-T. As the controversy over dioxin increased, these companies instituted practices to further lower dioxin levels, and some companies ceased manufacturing the controversial product altogether. Today there is no domestic manufacturer of the pesticide 2,4,5-T.

What has the federal government done about the dioxin problem?

In 1970, the Department of Health, Education, and Welfare (now the Department of Health and Human Services), the Department of Agriculture, and the Department of Interior suspended many uses of the herbicide 2,4,5-T as a result of a report by the National Institute for Environmental Health Services that is caused birth defects in laboratory mice.

In 1970, the Department of Defense halted the spraying of Agent Orange in Vietnam and in 1978, the Veterans Administration created the Agent Orange Registry to identify veterans who are concerned about possible exposure to Agent Orange.

In 1979, on the basis of controversial evidence that linked forest spraying of 2,4,5-T with an increase in miscarriages among some Oregon women, EPA suspended use of silvex and 2,4,5-T on forests, rights-of-way and pastures, but still allowed spraying on rice fields, fence rows, vacant lots and lumberyards.

In 1981, the Centers for Disease Control began a study to determine if Vietnam veterans are at a greater risk of having children with birth defects.

In 1981, the Food and Drug Administration banned the use of hexachlorophene in nonprescription soaps and deodorants.

In 1981, the Food and Drug Administration recommended that people not eat fish with dioxin levels greater than 50 ppt, and limit their consumption of fish with 25-50 ppt of dioxin. Fish with dioxin below the 25 ppt level are considered safe to eat.

In 1982, EPA required some industries to certify that they were no longer using chlorophenol-type compounds as slime control agents.

In 1983, EPA proposed cancellation of all remaining 2,4,5-T and silvex products. This action was appealed at a hearing by a number of pesticide registrants and users. Until the hearings are completed, as required by law, limited use of 2,4,5-T and silvex may continue.

In 1983, EPA initiated a National Dioxin Strategy to look for areas throughout the country where 2,3,7,8-TCDD may be present in the environment. The strategy provides a systematic framework under which the agency will study the nature of dioxin contamination throughout the U.S. and the risks to people and the environment; clean up dioxin-contaminated sites that threaten public health; find ways to prevent future contamination; and find ways to destroy or dispose of existing dioxin. A National Dioxin Study to investigate the nature and extent of dioxin contamination in the environment will begin this summer and take from 12-15 months. Air, water, soil, and fish sampling will take place in over 1,000 locations across the country.

In 1984, EPA issued a water quality criteria document for 2,3,7,8-TCDD.

Are there ways to safely dispose of or destroy dioxin?

EPA is currently evaluating methods of disposing of or destroying dioxin-contaminated soils and wastes. Established technologies include incineration, chemical degradation, and biological treatment measures, but EPA is working to find other methods of disposal as well. One promising technique is to treat soil with a chemical compound and sunlight. This method holds promise for actually detoxifying the dioxin molecule. Another alternative that is being investigated involves the use of solvents to change dioxin into a soluble form capable of destruction.

Some temporary methods to limit exposure include: excavating highly contaminated soil and removing it to a secure landfill or concrete vault; securing and capping the contaminated area; and using high efficiency vacuums and liquid dust suppressants.

Who can I contact if I have more questions about dioxin?

Each of EPA's 10 regional offices has a community involvement contact who can answer your questions about dioxin. Following are their names, addresses, and telephone numbers.

Debra Prybla Office of Public Affairs U.S. EPA Region 1 JFK Federal Building Boston, MA 02203	(617) 223-4906	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Richard Cahill Office of Public Affairs U.S. EPA Region 2 26 Federal Plaza New York, NY 10007	(212) 264-2515	New Jersey, New York, Puerto Rico, Virgin Islands
Joe Donovan Office of Public Affairs U.S. EPA Region 3 6th and Walnut Sts. Phila., PA 19106	(215) 597-9370	Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia
Hagan Thompson Office of Public Affairs U.S. EPA Region 4 345 Courtland St., NE Atlanta, GA 30308	(404) 881-3004	Alabama, Georgia, Florida, Mississippi, North Carolina, South Carolina, Tennessee, Kentucky
Vanessa Musgrave Office of Public Affairs U.S. EPA Region 5 230 S. Dearborn Chicago, IL 60604	(312) 886-6128	Illinois, Indiana, Ohio, Michigan, Wisconsin, Minnesota
Betty Williamson Office of Public Affairs U.S EPA Region 6 1201 Elm St. Dallas, TX 75270	214) 767-9986	Arkansas, Louisiana, Oklahoma, Texas, New Mexico
Steven Wurtz Office of Public Affairs U.S. EPA Region 7 324 E. 11th St. Kansas City, MO 64106	(816) 374-5894	Iowa, Kansas, Missouri, Nebraska
Nola Cook Office of Public Affairs U.S. EPA Region 8 Suite 900 1860 Lincoln St. Denver, CO 80295	(303) 837-5927	Colorado, Utah, Wyoming, Montana, North Dakota, South Dakota
Deanna Wieman Office of External Affairs U.S. EPA Region 9 215 Fremont St. San Francisco, CA 94105	(415) 974-8083	Arizona, California, Nevada, Hawaii, American Samoa, Guam
Bob Jacobson Office of Public Affairs U.S. EPA Region 10 1200 Sixth Ave. Seattle, WA 98101	(206) 442-1203	Alaska, Idaho, Oregon, Washington

THE UNITED STATES NAVY

INSTALLATION RESTORATION PROGRAM

FINAL

REMEDIAL INVESTIGATION
FOR
IRP SITE 78
SITE-WIDE OPERABLE UNIT

ANDERSEN AIR FORCE BASE, GUAM

VOLUME I of II

0000266461

June 2010

3.1.3.2 Geophysical Survey

An EM geophysical survey was performed during the Phase II RA to define the horizontal extent of suspected buried wastes at the site. The results of the geophysical survey indicated that the locations of most of the anomalies were consistent with the locations of the metallic debris found at the surface or partially buried within mounds (Figures 3-1 and 3-2). Based on the topography of the site, the mounds appear to be the result of construction and regrading of the facilities and the buried materials are an accumulation of debris from across the site. A linear anomaly running east-west across the site appears to correlate with a deposit of clay-rich soil as determined during drilling in the fire training pit (Figures 3-1 and 3-2).

3.1.3.3 Phase II Release Assessment Soil Gas Sample Results

As presented in Table 3-1, soil gas samples were collected during the Phase II RA; their results did not show the presence of compounds above the reporting limits.

3.1.3.4 Phase II Release Assessment Surface Soil Sample Results

As part of the Phase II RA, 15 surface soil samples (including one field duplicate) were collected at areas where there were suspected sources of contamination, such as the former fire training burn pit, drum areas, and any suspected mounds or bermed areas. These surface soil samples were analyzed for SVOCs including PAHs, PCBs, pesticides, total metals, dioxins, and furans.

As presented in Tables 3-2 and 3-3 and Figures 3-1 and 3-2, none of the surface soil samples contained SVOCs, pesticides, or PCB concentrations exceeding the preliminary screening criteria, and six analytes were detected at concentrations exceeding the respective screening levels:

- Benzo(a)anthracene was detected in one surface soil sample at a concentration of 1,300 micrograms per kilogram (µg/kg), exceeding the residential PRG of 620 µg/kg.
- Benzo(a)pyrene was detected in two surface soil samples at concentrations of 870 and 1,800 µg/kg, exceeding the industrial PRG of 210 µg/kg.
- Benzo(b)fluoranthene was detected in two surface soil samples at concentrations of 740 and 1,500 µg/kg, exceeding the residential PRG of 620 µg/kg.
- Dibenz(a,h)pyrene) was detected in two surface soil samples at concentrations of 100 and 160 µg/kg, exceeding the residential PRG of 62 µg/kg.
- Lead was detected in four surface soil samples at concentrations ranging from 720 to 940 mg/kg, exceeding the residential PRG of 400 mg/kg. Two of these samples also exceeded the industrial PRG of 800 mg/kg.
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ) was detected in eight surface soil samples at concentrations ranging from 4.40 to 37.8 nanograms per

kilogram (ng/kg), exceeding the residential PRG of 3.6 ng/kg. Seven of these samples also exceeded the industrial PRG of 16 ng/kg.

3.1.3.5 Phase II Release Assessment Subsurface Soil Sample Results

As part of the Phase II RA, 18 subsurface soil samples (including two field duplicates) were collected at Site 78 at suspected sources of contamination, such as the former fire training burn pit, drum areas, and any suspected mounds or bermed areas. These subsurface soil samples were analyzed for VOCs, SVOCs including PAHs, PCBs, pesticides, total metals, dioxins, and furans.

As presented in Tables 3-2 and 3-3 and Figures 3-1 and 3-2, none of the subsurface soil samples collected contained VOCs, SVOCs, PCBs, pesticides, or total metals at concentrations exceeding the preliminary screening criteria. Only one analyte, TCDD TEQ, was detected in one subsurface soil sample at a concentration of 8.66 ng/kg, exceeding the residential PRG of 3.6 ng/kg.

3.1.4 2005 Delineation Sample Results (EA, August 2006)

Based on the 2003 analytical results, additional surface soil samples were collected in November 2005. Three surface soil samples were collected and analyzed for SVOCs, PAHs, PCBs, pesticides, and total metals. Eighteen surface soil samples (including two field duplicates) were collected in the vicinity of the former firefighter training burn pit and were analyzed for dioxins and furans.

As presented in Tables 3-4 and 3-5 and Figures 3-1 and 3-2, none of the surface soil samples collected contained SVOCs, PAHs, pesticides, or total metals at concentration exceeding the preliminary screening criteria. The following analytes were detected at concentrations exceeding the respective screening levels:

- The PCB Aroclor-1260 was detected in one surface soil sample at a concentration of 5,360 µg/kg, exceeding the residential PRG of 220 µg/kg (Table 3-4).

- TCDD TEQ was detected at 17 surface soil samples at concentrations ranging from 5.59 to 121 ng/kg, exceeding the residential PRG of 3.9 ng/kg. Nine of these samples also exceeded the industrial PRG of 16 ng/kg (Table 3-5).

3.2 Remedial Investigation Results

3.2.1 Site Reconnaissance

During the 2007 RI, several areas of empty drums were identified on the eastern boundary of the site. In addition, a 2-inch underground drain line was discovered and traced to approximately 200 feet of the northwest portion of the former fire training burn pit (Photographs 3-10 and 3-11). The drums are located at the eastern portion of the site where PCBs were reported in surface soil above the industrial PRG. The five intact 55-gallon drums observed during the Phase I RA were not observed during the RI site reconnaissance. The fate of the drums is unknown. Also, a

mound was identified east of the former fire training burn pit that may be an aboveground storage tank berm. None of these areas had been previously identified for sampling.

3.2.2 Remedial Investigation Surface Soil Sample Results

Based upon the results of the previous investigations, additional sampling and analysis were performed in 2007 during the RI to further delineation the extent of contamination. In June 2007, three surface soil samples were collected and analyzed for PCBs and 23 surface soil samples (including two field duplicates) were collected and analyzed for dioxins and furans.

As presented in Table 3-6, PCBs were not detected.

As presented in Table 3-7 and Figures 3-1 and 3-2, TCDD TEQ was detected at concentrations exceeding the preliminary screening level. TCDD TEQ was detected in 17 surface soil samples at concentrations ranging from 4.38 to 300 ng/kg, exceeding the residential PRG of 3.9 ng/kg. Twelve of these soil samples also exceeded the industrial PRG of 16 ng/kg.

To further investigate the site, 12 surface soil samples (including one field duplicate) were collected and analyzed for PAHs, PCBs, and/or total metals. An additional nine surface soil samples (including one field duplicate) were collected and analyzed for dioxins and furans. No PAHs or PCBs were detected at concentrations exceeding the preliminary screening levels.

As presented in Tables 3-8 and 3-9 and Figures 3-1 and 3-2, the following analytes were reported at concentrations exceeding the respective screening levels:

- Lead was detected in three surface soil samples at concentrations ranging from 424 to 1,350 mg/kg, exceeding the residential PRG of 400 mg/kg. One of these soil samples also exceeded the industrial PRG of 800 mg/kg.

- TCDD TEQ was reported in five surface soil samples at concentrations ranging from 9.8 to 108 ng/kg, exceeding the residential PRG of 3.9 ng/kg. Two of these soil samples also exceeded the industrial PRG of 16 ng/kg.

3.2.3 Remedial Investigation Test Pit and Test Trench Results

Four test pits were excavated in June 2007 to depths ranging up to approximately 3 feet bgs. The excavations ranged from 6 to 10 feet in length (Figures 3-1 and 3-2). No debris was noted in any of the test pits. The soil in the test pits consisted primarily of silty clay (Appendix B). One subsurface soil sample was collected from one of the test pits.

To further investigate the site, 11 test trenches were excavated in January 2009 to depths ranging up to approximately 3.5 feet bgs. The excavations ranged from 12 to 50 feet in length (Figures 3-1 and 3-2). Debris in the trenches included burnt wood, miscellaneous metal, plastic, and an outfall pipe in TT-04, TT-05, TT-06, and TT-07. A grayish substance that appeared to be

corroded metal was noted in TT-06. Five subsurface soil samples were collected from four of the test trenches (Photographs 3-12 and 3-13).

The results of these subsurface soil samples are presented below.

3.2.4 Remedial Investigation Subsurface Soil Sample Results

In June 2007, one subsurface soil sample was collected and analyzed for dioxins and furans; the results were below the preliminary screening level (Table 3-7).

To further investigate the site, five subsurface soil samples were collected in January 2009 and analyzed for VOCs, PAHs, PCBs, and total metals. One of the subsurface soil samples was a sample of opportunity collected to characterize a corroded metallic substance encountered in TT-06. As presented in Table 3-8 and Figures 3-1 and 3-2, none of the subsurface soil samples collected contained VOCs, PAHs, or PCBs at concentrations exceeding the preliminary screening criteria. Three analytes were detected at concentrations exceeding the respective screening levels:

- Aluminum was detected in two subsurface soil samples at concentrations of 190,000 and 289,000 mg/kg, exceeding the BTV of 173,500 mg/kg. One of the subsurface samples was the sample of opportunity collected in TT-06.
- Copper was detected in one subsurface soil sample at a concentration of 4,810 mg/kg, exceeding the residential PRG of 3,100 mg/kg.
- Lead was detected in one subsurface soil sample at a concentration of 550 mg/kg, exceeding the residential PRG of 400 mg/kg.

3.2.5 Groundwater Sampling

Although no groundwater monitoring wells are located within Site 78, one monitoring well located in the vicinity has been used to assess groundwater quality (Figure 1-3). The closest monitoring well, IRP-63, is located approximately 1,000 feet southwest (crossgradient) of the site. IRP-63 is sampled twice annually as part of the Andersen AFB LTGM Program. The samples are analyzed for VOCs (including MTBE) and chlorides. Depth to water level at IRP-63 was calculated at 520 feet bgs.

In the 27th sampling round, taken in the fall of 2008, none of the target analytes were detected above MCLs in samples collected from IRP-63. Groundwater monitoring is being handled as a separate issue as a part of the ongoing Basewide Andersen AFB LTGM Program and will not affect the conclusions of the RI (EA, 2009).

3.2.6 Topographic Survey

A topographic survey was performed at the site to provide geospatial reference to support investigative findings. A registered land surveyor completed the surveying activities to

THE UNITED STATES AIR FORCE
INSTALLATION RESTORATION PROGRAM

FINAL

PRELIMINARY ASSESSMENT/SITE INSPECTION WORK PLAN FOR IRP SITES 56, 57, 58, 70, 71, 72, 73, 74, 75, AND 76 AT NORTHWEST FIELD

ANDERSEN AIR FORCE BASE, GUAM

0000266498

September 2006

2. PREVIOUS ENVIRONMENTAL INVESTIGATION RESULTS

Previous investigations conducted at Sites 56, 57, 58, 70, 71, 72, 73, 74, 75, and 76 have included a Records Search (ICF, 1996b) and an ESI Visual Site Inspection (VSI) (ICF, 1996a). Results of the previous investigations conducted at the sites are summarized in the following reports:

- *Installation Restoration Program, Final Records Search for Andersen Air Force Base, Guam* (ICF, 1996b)
- *Final Expanded Source Investigation Visual Site Inspection Report, Andersen Air Force Base, Guam* (ICF, 1996a)

The ESI evaluation included a visual inspection of the area, a records search to determine the operational history of the area, and a regulatory review to evaluate the appropriate program under which the USAF should maintain these sites. These sites were discussed in detail in the Records Search Report and were not evaluated separately during the VSI phase of the effort (ICF, 1996b).

Sites 56, 57, 58, 70, 71, 72, 73, 74, 75, and 76 were all identified during a reconnaissance of the Northwest Field conducted in 1994. According to the Records Search Report, there is no documentation describing any disposal activities at the sites. On 12 November 1962, Typhoon Karen destroyed a majority of the historical documents associated with the Northwest Field. Consequently, most of the historical information presented in the Records Search Report is derived from aerial photographs (ICF, 1996b).

Brief summaries of the Records Search and the ESI VSI conducted at the sites are presented below. The locations of the sites are presented on Figure 1-2.

2.1 Site 56

Site 56 (Waste Pile 8) consists of two areas, Areas A and B (Figure 2-1). Site 56 Area A is an inactive disposal site located in a quarried area between the North Runway and North Taxiway at the Northwest Field. According to the 1956 and 1993 aerial photographs, there is a quarried area and the mounded feature north of the quarried area (ICF, 1996b). The quarry is approximately 800 feet long and 200 feet wide. An abandoned street, located midway between and running parallel to the North Runway and North Taxiway, is situated north of the quarry. The road surface is approximately 6 feet higher in elevation than the surrounding land surface and is constructed of crushed coralline limestone. A waste pile, located just north of this road, covers a 40-foot by 20-foot area and is densely vegetated (ICF, 1996a). Inspection of this area indicated the presence of drums, tires, and canisters. The waste is mixed with crushed coral and soil, and appears to have been bulldozed into a pile.

Site 56 Area B is an inactive disposal site, consisting of an asphalt pile, located on the north side of the North Runway (Figure 2-1). The VSI performed on 24 February 1994 identified a pit in this area. The pit is approximately 40 feet wide by 15 feet deep, and did not contain debris at the

time of the 1994 inspection (ICF, 1996b). An asphalt pile was observed next to the quarried area (Figure 2-1). The asphalt pile is approximately 10 feet by 6 feet in area and approximately 4 feet in height. The asphalt appeared to have been discharged to the ground in a viscous state. The vegetation around the pile appeared to be stressed (ICF, 1996b).

2.2 Site 57

Site 57 (Waste Pile 9) is an inactive disposal area located in a borrow pit that was active during the construction of the Northwest Field (Figure 2-2). Based on the VSI, a pile containing six drums and other waste was identified in the northeast corner of a quarried area located approximately 200 feet south of the North Runway (ICF, 1996a). An old asphalt road runs south from the North Runway, approximately 200 feet west of the waste pile. The borrow pit is parallel to the runway and is approximately 1,700 feet long and 250 feet wide. The waste pile consists of six empty 55-gallon steel drums located in a 20-foot by 20-foot area (ICF, 1996a). The unmarked drums are severely corroded and rusted. Other waste observed in the area during the VSI included light fixtures, electrical components, scrap metal, and rubber. Six corroded gunpowder-filled charges were observed approximately 70 feet northwest of the drums (ICF, 1996a).

2.3 Site 58

Site 58 (Waste Pile 10) is a borrow pit for coral subbase that is located south of the South Runway, approximately 600 feet northeast of the Southwest Crossover (Figure 2-3). The borrow pit was described in the VSI as approximately 300 feet long, 200 feet wide, and 10 to 14 feet deep (ICF, 1996a). Fifteen to 20 unmarked, 55-gallon steel drums are located 150 feet west of the borrow pit, in an area between the South Runway and Service Apron 2066. The drums, which appear to have been bulldozed into a pile, are located in a 60-foot by 30-foot area and are mixed with crushed coral and soil. Some of the drums are overturned and all of them are severely deteriorated.

2.4 Site 70

Site 70 (Waste Pile 11) consists of two areas, Areas A and B (Figure 2-4). Site 70 Area A was identified during the VSI, performed in March 1994. It was described as an inactive waste pile located approximately 150 feet south of service Apron 2097, adjacent to concrete pad T-2016. The waste pile is located in a 12-foot by 20-foot excavation (ICF, 1996a). Waste observed in the excavation included rusted metal, an oily steel bucket, and heavy, unopened, pull-tab canisters. The waste was mixed with crushed coral and soil. Much of the contents of Area A could not be determined because a majority of the material was buried beneath a layer of soil (ICF, 1996a).

Site 70 Area B was identified during the 1994 VSI as a waste pile bounded by 12th, 13th, "M", and "K" Streets (Figure 2-4). A majority of the area between these streets was covered with a layer of waste that varies in thickness. The waste covers an 800-foot by 300-foot area. The waste includes rusted metal debris, metal cans, and glass bottles. One metal gas cylinder with a gauge was also observed (ICF, 1996a).

Both areas were recommended for further evaluation due to the potential presence of hazardous constituents.

2.5 Site 71

Site 71 (Waste Pile 12) consists of an inactive waste pit located between "L" and "H" Streets, east of 16th Street (Figure 2-5). The waste pit is in a heavily vegetated area in a 15-foot by 10-foot excavation. Several unmarked 55-gallon steel drums were observed in the pit during the 1994 VSI. Other waste observed includes sections of 6-inch-diameter steel pipe, telephone poles, electrical components, rusted scrap metal, and broken pieces of concrete (ICF, 1996a). Concrete debris was also observed around the outside of the excavation.

2.6 Site 72

Site 72 (Waste Pile 13) consists of two areas, Areas A and B (Figure 2-6). Site 72 Area A was identified during the 1994 VSI as a grease pit related to vehicle maintenance activities. The 1994 VSI identified concrete pad T-617, approximately 300 feet southwest of the 16th and "H" Street intersection (ICF, 1996a). A rectangular pit with a sump in the bottom is located in the center of the pad. The pit was determined to be used as a grease pit to service vehicles. The pit has a concrete floor and walls, and measures approximately 20 feet by 3 feet and 5 feet deep (ICF, 1996a). A concrete stairway leads to the pit on the north side. On the inside wall of the suspected grease pit there is a 2-foot-long by 6-inch-diameter hole, which may have provided drainage from the pad into the pit. On the south end of the pit floor there is a 15-inch-diameter sump constructed of a steel pipe. The pipe extends 6 inches above the pit floor and approximately 1 foot below the pit floor, but did not appear to have a drainage opening (ICF, 1996b).

Site 72 Area B was identified as an inactive waste pile during the 1994 VSI. The waste pile is located approximately 500 feet east of the 16th and "H" Street intersection near concrete pad T-629. The waste pile is located in a 400-foot by 150-foot area with a treeline located on the northwest and southwest sides of the pile. During the VSI, fifteen 55-gallon steel drums were observed. The drums were upright and grouped together, and were mostly deteriorated and rusted. Stressed vegetation and stained soil were observed next to the drums. Two galvanized steel crates with fibrous, asbestos-like insulated bottoms were next to the concrete pad, approximately 50 feet north of the drums (ICF, 1996a). Two waste piles were also located approximately 150 feet southwest of the drums. The piles were approximately 150 feet by 50 feet and 75 feet by 75 feet in size. The waste piles contained metal beams, wire cable, deteriorated concrete sacks, large metal crates, large hinges on latches, pumps, motors, turbine fans, refrigerators, and hundreds of drum bungs (ICF, 1996a).

Both areas were recommended for further evaluation due to the potential presence of hazardous constituents.

2.7 Site 73

Site 73 (Waste Pile 14) consists of a drum pile that was identified during the 1994 VSI (Figure 2-7). The drum pile is located on the north edge of a quarried area, 150 feet northwest of the 6th and "A" Street intersection. An unimproved access road extends northwest from the end of "A" Street, approximately 400 feet to the south end of the quarry. The area around the quarry is heavily vegetated. Approximately twenty 55-gallon steel drums were observed in an irregular pile that covers a 20-foot by 30-foot area on the western edge of the quarry (ICF, 1996a). Most of the drums are overturned and the drums are rusted, but appeared to be closed and intact. The drums were not marked and the contents are unknown.

2.8 Site 74

Site 74 consists of an abandoned UST identified during the 1994 VSI. The UST is located in a group of concrete pads between the North and South runways, approximately 500 feet southeast of IRP-44 (Figure 2-8). According to historical photographs, the UST is adjacent to concrete pad T-71 (ICF, 1996b). It is cylindrical in shape and estimated to be 5 feet long and 2.5 feet in diameter. The top of the UST is visible and flush with the ground surface. A 6-inch by 6-inch opening was observed on the top of the tank and liquid was observed inside the tank. No odor was noted (ICF, 1996a).

2.9 Site 75

Site 75 consists of three areas, Areas A, B, and C (Figure 2-9). Site 75 Area A consists of two abandoned ASTs located approximately 500 feet north of the Route 3A and "M" Street intersection. The ASTs, which are very deteriorated, are constructed of plate steel and are estimated to be 8 feet tall and 40 feet in diameter (ICF, 1996a). They are surrounded by 3.5-foot-tall earthen berm. Open valves were observed at the base of each tank and are positioned over depressions in the ground surface, indicating the contents of the tank had been flushed from the tanks. A 6-inch-diameter steel pipe was observed extending from each of the ASTs to the edge of the earthen berm. The pipes ran underneath the berm and connected to a single pipe on the northwest side of the bermed area. The pipe was observed to extend from the berm approximately 150 feet toward the Southwest Taxi Loop (ICF, 1996a).

Site 75 Area B consists of a drum disposal area located in a 300-foot by 100-foot by 10-foot-deep quarried area. The quarry is located on the northeast side of the intersection of Perimeter Road and "M" Street. The disposal area contains a group of three 55-gallon steel drums. In addition, a highly corroded 8-inch steel pipe was observed along the north side of the quarry (ICF, 1996a). The purpose of the pipe has not been determined. One of the drums is located 100 feet east of the western terminus of the steel pipe. The drum is rusted through in several areas, and the nearby soil and vegetation is stained black. A mild petroleum odor was noted. A second drum was located on the north side of the pipeline. The drum was overturned and has an open bunghole with approximately two gallons of black, viscous fluid inside (potentially oil). The drum is labeled "IGG 5B 16 55 44 DMC USN". A third drum is located on the north side of the pipeline, approximately 50 feet northwest of the second drum (ICF, 1996a). It was

overturned and approximately 50 percent of the drum was corroded. Eight used oil filters were also observed in and around the drum, near the corroded side of the drum. Several Coca-Cola bottles that were dated 1945 were observed in the area, indicating the waste has been in the area for many decades (ICF, 1996a).

Site 75 Area C consists of a former Imhoff Tank and remnants of two ASTs, adjacent to pad T-357 located between "M" and "K" Streets, approximately 100 feet northeast of 10th Street. There is also a pipeline and a filter field associated with the Imhoff Tank (ICF, 1996b). Named after their inventor, Carl Imhoff, Imhoff Tanks were commonly used to aid in the settling of solids by using an inverted, conical-shaped tank. The pad was identified at the former location of the Imhoff Tank, which was part of a wastewater treatment system that separated solids and liquids from untreated sewage. Reportedly, the Imhoff Tank was located on the concrete pad and drained to a leach field to the northwest. During the 1994 VSI, the tank was no longer present and there was no evidence of a release to the leach field (ICF, 1996a).

The framework for one AST was also observed during the VSI (ICF, 1996a). The AST frame measured 12 feet long by 4 feet wide and was located on a highly corroded metal framework, approximately 6 feet high. Most of the AST was severely rusted away, and there was no visible evidence of its former contents. The purpose of the AST could not be determined by the inspection (ICF, 1996a).

A second AST that was noted on a 1949 USAF map could not be located during the VSI. An elevated area with secondary containment berms was located, but evidence of the AST could not be found (ICF, 1996a).

2.10 Site 76

Site 76 consists of four areas, Areas A, B, C, and D (Figure 2-10). Site 76 Area A consists of a waste pile located approximately 400 feet south of the 11th and "H" Street intersection, 150 feet south of concrete pad T-261. An unimproved access road runs south from "H" Street 400 feet to the east end of the waste pile and loops back to "H" Street. The waste pile is visible from this access road. The waste pile covers an area of approximately 250 feet by 75 feet and is approximately 5 feet high. Ten 55-gallon steel drums were observed partially buried in the ground. The drums were very rusted and corroded and no markings were observed (ICF, 1996a). Other waste observed included metal, wood, and concrete debris. The potential for more buried drums was noted during the VSI. The waste area is sparsely vegetated and is surrounded by a tree line on the west, south, and east sides (ICF, 1996a).

Site 76 Area B consists of a waste pile located approximately 800 feet south of the 11th and "H" Street intersection. The waste pile covered an area of approximately 2.5 acres. The waste pile was observed in a 500-foot by 500-foot area of sparse vegetation along a north-south trending, 150-foot-wide access way. The access way connects an abandoned water tower at a former housing development in the south to an abandoned wellhead near the 13th and 8th Street intersection in the north. The waste observed during the VSI was almost exclusively scrap metal piled in 3- to 4-foot-high mounds that covered the ground almost continuously (ICF, 1996a). A smaller amount of wood, telephone poles, and concrete debris was also observed.

Site 76 Area C consists of a group of three drums located approximately 500 feet north of the 4th and "C" Street intersection. The drums were located near two 50-foot by 50-foot concrete pads; the group was observed on the southeast corner of the southernmost pad. The unmarked drums were upright, intact, very rusty, but not empty. It was not noted if the material in the drums was liquid or solid (ICF, 1996a).

Site 76 Area D consists of a trench containing waste that runs in an east-west trending direction approximately 300 feet east of 5th Street. A former residential housing development is located to the south of the trench. The trench is approximately 3 feet wide by 400 feet long and is approximately 3 feet deep (ICF, 1996a). An abandoned water tower was observed near the eastern terminus of the trench. The waste in the trench consists mostly of household refuse, including bottles, cans, and wood, as well as electronic components and automobile tires. It was noted during the VSI that residents of the former housing development likely used the trench to dispose of household waste (ICF, 1996a).

4.1.8 Subsurface Soil Sampling

Upon completion and evaluation of the DSI and EM survey, subsurface soil samples of opportunity will be collected at Sites 56, 57, 58, 70, 71, 72, 73, 74, 75, and 76 to verify the presence or absence of potential subsurface contaminants. The samples will be collected from exploratory test trenches or test pit excavations or from drilling boreholes.

At Sites 56, 57, 58, 70, 71, 72, 73, and 76, all subsurface soil samples will be collected from exploratory test trenches or test pit excavations and analyzed for VOCs, SVOCs, PAHs, TAL metals, pesticides, and PCBs using USEPA Methods SW8260B, SW8270C, SW8270C SIM, SW6010B, 8081A, and 8082, respectively. Subsurface soil samples from Site 57 will also be tested for explosive residue.

At Sites 74 and 75, all subsurface soil samples will be collected from subsurface borings and analyzed for VOCs, SVOCs, PAHs, and TAL metals, using USEPA Methods SW8260B, SW8270C, SW8270C SIM, SW6010B, respectively.

Analytical results will be compared to residential and industrial PRGs, as well as BTVs, to determine if additional investigative activities or remedial actions are required.

4.1.9 Drum Sampling

When intact drums containing liquid or product are discovered during the DSI or as a result of subsurface investigation activities, drum content samples will be analyzed for parameters compatible with the suspected drum contents, in addition to Toxicity Characteristic Leaching Procedure (TCLP) SVOCs, TCLP pesticides, TCLP PCBs, and TCLP TAL metals, ignitability, and corrosivity, using the USEPA Methods SW8270C, SW8081, SW8082, SW6010B/7471A SW1010, and SW9045C. Per Section 6 of the Basewide QAPP (EA, 2005c), the reactivity test method has been withdrawn by the USEPA due to uncontrollable quality issues.

4.1.10 Surveying

The location of potentially contaminated areas, sampling points, and the boundaries for each site will be surveyed as described in Section 3.1.11. In addition, two permanent concrete survey monuments will be placed at each site as reference points for future work.

4.2 Quality Assurance/Quality Control Samples

As part of the QA/QC program, field and laboratory QA/QC samples will be collected and analyzed by a laboratory. The field QA/QC samples include duplicate, equipment rinsate blank, trip blank, and MS/MSD.

The duplicate samples will be collected at a minimum frequency of 10 percent, and the equipment rinsate blank samples will be collected at the frequency of 5 percent. A trip blank will be provided at the frequency of one sample for every cooler of samples shipped to the laboratory that contains samples for VOC analysis.

The field QA/QC will also include submission of MS/MSD samples at the frequency of 5 percent per matrix per analytical method. The MS/MSD samples will be used as part of the laboratory QA/QC to evaluate the accuracy and precision of the analysis.

The estimated numbers of QA/QC samples for the project are presented on Table 4-1.

Table 4-1. Field Activities Summary for 10 IRP Sites, Northwest Field
Andersen Air Force Base, Guam.

IRP Site	Site Description	Proposed Activities																	
		Proposed Field Activities						Surface Soil					Subsurface Soil						
		Detailed Site Inventory	Brush Clearing	Geophysical Surveying	Number of Test Pits	Shallow Borings	Location Surveying	PAHs (SW8270SIM)	TAL Metals (SW6010B)	Pesticides (8081A)	PCBs (8082)	Explosive Residue	VOCs (SW 8260B)	PAHs (SW8270SIM)	TAL Metals (SW6010B)	Pesticides (8081A)	PCBs (8082)	Explosive Residue
Site 56 (Areas A and B)	Waste Pile 8	X	X	X	2	0	X	16	16	16	16	0	2	2	2	2	2	0
Site 57	Waste Pile 9	X	X	X	2	0	X	16	16	16	16	16	2	2	2	2	2	2
Site 58	Waste Pile 10	X	X	X	2	0	X	16	16	16	16	0	2	2	2	2	2	0
Site 70 (Areas A and B)	Waste Pile 11	X	X	X	2	0	X	16	16	16	16	0	2	2	2	2	2	0
Site 71	Waste Pile 12	X	X	X	2	0	X	16	16	16	16	0	2	2	2	2	2	0
Site 72 (Areas A and B)	Waste Pile 13	X	X	X	2	0	X	16	16	16	16	0	2	2	2	2	2	0
Site 73	Waste Pile 14	X	X	X	2	0	X	16	16	16	16	0	2	2	2	2	2	0
Site 74	Underground Storage Tank	X	X		0	3	X	16	16	0	0	0	6	6	6	0	0	0
Site 75 (Areas A, B, and C)	Aboveground Storage Tank	X	X		0	3	X	16	16	0	0	0	6	6	6	0	0	0
Site 76 (Areas A, B, C, and D)	Mixed Waste Area	X	X	X	2	0	X	16	16	0	0	0	2	2	2	2	2	0

Notes:

PAHs - polycyclic aromatic hydrocarbons
PCBs - polychlorinated biphenyls
TAL - Target Analyte List
VOCs - volatile organic compounds

Citation Nr: 1541192
Decision Date: 09/24/15 Archive Date: 10/02/15

DOCKET NO. 11-23 141) DATE
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On appeal from the
Department of Veterans Affairs Regional Office in Boston, Massachusetts

THE ISSUE

Entitlement to service connection for Parkinson's disease.

REPRESENTATION

Appellant represented by: Gina D. Holness, Attorney

WITNESSES AT HEARING ON APPEAL

Appellant and spouse

ATTORNEY FOR THE BOARD

A. D. Jackson, Counsel

INTRODUCTION

The Veteran had active service from September 1964 to August 1968.

This matter comes to the Board of Veterans' Appeals (Board) on appeal from a December 2010 rating decision of the Department of Veterans Affairs (VA) Regional Office (RO) in Boston, Massachusetts, which denied the above claim.

In April 2012, the Veteran testified at a hearing before the undersigned Veterans Law Judge. The case was remanded in January 2014 and has been returned to the Board for review.

FINDING OF FACT

The evidence is in equipoise on the issue of whether the Veteran incurred Parkinson's disease during active service.

CONCLUSION OF LAW

The criteria for service connection for Parkinson's disease have been met. 38 U.S.C.A. § 1110 (West 2014); 38 C.F.R. §§ 3.303, 3.307, 3.309 (2015).

REASONS AND BASES FOR FINDING AND CONCLUSION

The Veteran currently suffers from Parkinson's disease. He contends that this disease links back to exposure to herbicides during his period of active duty-specifically to a six month temporary duty assignment in Guam on Andersen Air Force Base. There, he alleges that his work as a mechanic included work maintaining trucks that were used primarily for pumping Agent Orange into aircraft which would then disperse it. He was told that this substance was a "defoliant" at the time. He claims that these vehicles would not be cleaned of the

defoliant prior to his work on them. He also claims that the defoliant was used on the perimeter of the base.

Service connection means that a veteran has a disability resulting from disease or injury incurred in or aggravated by active service. 38 U.S.C.A. § 1110; 38 C.F.R. § 3.303(a). Service connection may be granted for any disease diagnosed after discharge when the evidence shows that the disease was incurred in service. 38 C.F.R. § 3.303(d).

If a veteran was exposed to an herbicide agent during active service, a number of diseases, including Parkinson's disease, shall be service connected if the requirements of 38 C.F.R. § 3.307(a)(6) are met even though there is no record of such disease during service. 38 C.F.R. § 3.309(e). There is a presumption of exposure to herbicides (to include Agent Orange) for all veterans who served in Vietnam or the Korean DMZ during the Vietnam era. 38 U.S.C.A. § 1116(f); 38 C.F.R. § 3.307(a)(6). However, the Veteran has not asserted, nor does the record suggest, that he served within the Republic of Vietnam or the Korean DMZ. As such, the presumption of herbicide exposure does not apply, and actual, direct exposure to herbicides must be shown. See Combee v. Brown, 34 F.3d 1039, 1042 (Fed. Cir. 1994).

Service records indicate that the Veteran had a temporary duty assignment at Andersen Air Force Base (AFB) in Guam from September 1966 to March 1967. The RO submitted a request for verification of exposure to herbicides to the U.S. Army and Joint Services Records Research Center (JSRRC) based on the Veteran's records. The JSRRC responded that it was unable to verify or document that the Veteran was exposed to Agent Orange or other tactical herbicides while stationed at Andersen AFB, Guam.

However, the Veteran has provided some evidence corroborating his claim regarding contamination at Andersen AFB on Guam. Specifically, the U.S. Environmental Protection Agency has designated the base a Superfund cleanup site due to the extensive contamination of its soil from various activities engaged in by air force personnel since the early 1940s. The JSRRC stated that to date, the available historical data did not document any Agent Orange or tactical herbicide spraying, testing, storage, dispersal, or usage on the Island of Guam during 1966 through 1967. This indicates that there was no evidence of their usage, not that they were not used. With such an evidentiary background, the Board cannot find that a preponderance of the evidence is against the assertion of in-service herbicides exposure. As such, the Board finds that the Veteran was exposed to herbicides while stationed in Guam.

Although the Board finds that the Veteran was exposed to some type of herbicide while in service, it must point out that presumptive service connection pursuant to 38 C.F.R. § 3.307 and § 3.309 is not warranted. Specifically, although the Veteran is competent to testify as to the use of vegetation killing sprays, he is not competent to testify as to the particular chemical compound of that spray. Section 3.307 specifically defines the type of herbicides required to trigger the presumptive service connection provisions. There is no evidence that the Veteran knew it was of the same type as that used in Vietnam. Therefore, presumptive service connection is not warranted. However, as explained below, direct service connection is established.

The only medical professional who commented on the Veteran's claim to medical nexus between diabetes and service offered a supportive opinion. In an October 2009 letter, William Tosches, M.D. stated that it was more likely than not that the Veteran's Parkinson's disease was related to his exposure to herbicides while stationed in Guam. The supportive opinion has some probative value that tends to favor the claim.

In sum, the Board cannot finds that a preponderance of the evidence of record demonstrates that the Veteran did not experience herbicides exposure during service, or that the in-service exposure is not causally related to the current Parkinson's disease. As such, this is an appropriate case in which to invoke VA's

doctrine of reasonable doubt. 38 U.S.C.A. § 5107(b); 38 C.F.R. § 3.102. A finding of service connection is therefore warranted for Parkinson's disease.

ORDER

Service connection for Parkinson's disease is granted.

P.M. DILORENZO
Veterans Law Judge, Board of Veterans' Appeals

Citation Nr: 1608644
Decision Date: 03/03/16 Archive Date: 03/09/16

DOCKET NO. 14-04 080) DATE
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On appeal from the
Department of Veterans Affairs Regional Office in St. Petersburg, Florida

THE ISSUE

1. Whether new and material evidence has been received to reopen a claim for service connection for Parkinson's Disease.

2. Entitlement to service connection for Parkinson's Disease, claimed as due to herbicide exposure and environmental toxins.

REPRESENTATION

Appellant represented by: Robin E. Hood, Attorney

WITNESSES AT HEARINGS ON APPEAL

Veteran and Spouse

ATTORNEY FOR THE BOARD

Carole Kammel, Counsel

INTRODUCTION

The Veteran served on active duty from April 1966 to January 1970, to include service on the island of Guam.

This appeal is before the Board of Veterans' Appeals (Board) on appeal from a June 2011 rating decision of the St. Petersburg, Florida, Regional Office (RO) of the Department of Veterans Affairs (VA). By that rating decision, the RO considered service connection for Parkinson's Disease for the purposes of retroactive benefits pursuant to Nehmer v. United States Veterans Administration, 712 F. Supp. 1404 (N.D. Cal., May 2, 1989), but continued and confirmed its previous denial of the claim. The Veteran appealed that rating decision to the Board.

In April 2015 and January 2016, respectively, the Veteran and his spouse, M. B., testified before Veterans Law Judges at hearings conducted at the RO. Copies of the hearing transcripts have been associated with the record. During the January 2016 hearing, the Veteran submitted additional medical evidence in support of the claims, with a waiver of initial RO consideration. Thus, a remand to have the RO initially consider this evidence in the first instance is not required. 38 C.F.R. § 20.1304 (2015). At the time of the January 2016 hearing, on the record, the Veteran waived the right to testify before a third Veterans Law Judge. Arneson v. Shinseki, 24 Vet. App. 379 (2011). However, because the Veteran testified regarding the matter on appeal during the pendency of the appeal at separate Board hearings before two Veterans Law Judges, the appeal must be decided by a three-judge panel. 38 U.S.C.A. §§ 7102(a), 7107(c) (West 2014); 38 C.F.R. §§ 19.3, 20.707 (2015).

This appeal has been advanced on the Board's docket pursuant to 38 C.F.R. § 20.900(c) (2015). 38 U.S.C.A. § 7107(a)(2) (West 2014).
FINDINGS OF FACT

1. An unappealed April 2007 rating decision declined to reopen a claim for service connection for Parkinson's Disease, to include as due to chemical exposure. The Veteran did not appeal that decision, and no new and material evidence was received by VA within the applicable appeal period.

2. Evidence received since the final April 2007 rating action relates to an unestablished fact necessary to substantiate the claim for service connection for Parkinson's Disease and raises a reasonable possibility of substantiating the claim.

3. Parkinson's Disease is the result of exposure from environmental toxins during in-service duties as an aerospace ground equipment repairman while stationed at Andersen Air Force Base on the island of Guam.

CONCLUSIONS OF LAW

1. The April 2007 rating decision that declined to reopen a previously denied claim for Parkinson's Disease, is final. 38 U.S.C.A. § 7105 (West 2014); 38 C.F.R. § 20.1103 (2015).

2. New and material evidence has been received since the April 2007 rating action, to reopen a denied claim for service connection for Parkinson's Disease. 38 U.S.C.A. §§ 5108, 7105 (West 2014), 38 C.F.R. § 3.156 (2015).

3. Resolving reasonable doubt in the Veteran's favor, the criteria for service connection for Parkinson's Disease, as secondary to exposure to environmental toxins, have been met. 38 U.S.C.A. §§ 1110, 1112, 1113, 1116, 1131, 1137, 5103, 5103A, 5107 (West 2014); 38 C.F.R. §§ 3.102, 3.159, 3.303, 3.307, 3.309 (2015).

REASONS AND BASES FOR FINDINGS AND CONCLUSIONS

The Veteran seeks to reopen a previously denied claim for service connection for Parkinson's Disease, to include as due to exposure to herbicides or environmental toxins.

An April 2007 rating decision declined to reopen a previously denied claim for service connection for Parkinson's Disease. The RO determined that there was no evidence of any in-service treatment for Parkinson's Disease or post-service evidence relating Parkinson's Disease to service, to include exposure to herbicides or other chemicals. The Veteran did not appeal the April 2007 rating action, nor did he submit any new and material evidence within one year following that decision. 38 C.F.R. § 3.156(b) (2015). The Board notes that within a year of the April 2007 rating action, VA received an August 2007 article titled, "Veteran Seeks Agent Orange Probe," that discussed a retired airman's Congressional inquiry into the use of herbicides at Andersen Air Force Base, Guam for the period from 1960 to 1970. The Board also received a copy of an October 2005 Board decision of another Veteran. In that decision, the Board had awarded service connection for diabetes mellitus secondary to exposure to toxic herbicides during active service at Andersen Air Force Base, Guam. As the newly received article, as well as the October 2005 Board decision, discussed the use of chemicals at Andersen Air Force Base, Guam, they are duplicative of previous articles and studies of record at the time of the April 2007 rating decision, and are, therefore, not new and material. Thus, the April 2007 rating decision became final one year later in April 2008. 38 U.S.C.A. §§ 7104, 7105 (West 2014).

The Board finds that new and material evidence has been received and the claim for service connection for Parkinson's Disease is reopened.

A finally decided claim may be reopened if the claimant presents new and material evidence with respect to a claim which has been previously denied and which is final. 38 U.S.C.A. § 5108; 38 C.F.R. § 3.156. If the claim is so reopened, it will be reviewed on a de novo basis. 38 U.S.C.A. §§ 5108, 7105 (West 2014); Evans v. Brown, 9 Vet. App. 273 (1996); Manio v. Derwinski, 1 Vet. App. 140 (1991).

New evidence means existing evidence not previously submitted to agency decision makers.

Material evidence means existing evidence that, by itself or when considered with previous evidence of record, relates to an unestablished fact necessary to substantiate the claim. New and material evidence can be neither cumulative nor redundant of the evidence of record at the time of the last prior final denial of the claim sought to be reopened, and must raise a reasonable possibility of substantiating the claim. 38 C.F.R. § 3.156(a) (2015). New and material evidence is not required as to each previously unproven element of a claim. Shade v. Shinseki, 24 Vet. App. 110 (2010).

For the purpose of establishing whether new and material evidence has been submitted, the credibility of the new evidence, although not its weight, is presumed. Justus v. Principi, 3 Vet. App. 510 (1992). The presumption of credibility is rebuttable when the evidentiary assertion is inherently incredible or when the fact asserted is beyond the competence of the person making the assertion. King v. Brown, 5 Vet. App. 19, 21 (1993).

Evidence submitted since the final April 2007 rating decision includes, but is not limited to, April 2015 and January 2016 opinions, prepared by M. O., M. D. and A. N, M. D.. That evidence is new as it was not of record at the time of the final April 2007 rating decision. Those opinions are also material because they relate to an unestablished fact necessary to substantiate the underlying claim for service connection for Parkinson's Disease, namely evidence relating to the onset of the disorder, to include his exposure to environmental toxics, such as perchloroethylene (PCE) and trichloroethylene (TCE) during active miliary service at Andersen Air Force Base, Guam. On review, the Board finds that evidence to be new and material. 38 C.F.R. § 3.156(a) (2015); Shade v. Shinseki, 24 Vet. App. 110 (2010); Justus v. Principi, 3 Vet. App. 510 (1992). Thus, the claim for service connection for Parkinson's Disease, to include as due to exposure to herbicides and environmental toxins is reopened.

The Veteran seeks service connection for Parkinson's Disease, to include as secondary to exposure to Agent Orange and environmental toxins.

Service connection may be granted for disability arising from disease or injury incurred in or aggravated by active service. 38 U.S.C.A. §§ 1110, 1131 (West 2014); 38 C.F.R. § 3.303(a) (2015).

Service connection may be granted for any disease diagnosed after discharge, when all the evidence, including that pertinent to service, establishes that the disease was incurred in service. 38 C.F.R. § 3.303(d) (2015). As a general matter, service connection for a disability requires evidence of: (1) the existence of a current disability; (2) the existence of the disease or injury in service, and; (3) a relationship or nexus between the current disability and any injury or disease during service. Shedden v. Principi, 381 F.3d 1163 (Fed. Cir. 2004); Hickson v. West, 12 Vet. App. 247 (1999); Caluza v. Brown, 7 Vet. App. 498 (1995)
.
In this case, Parkinson's Disease is not a chronic disease listed under 38 C.F.R. § 3.309(a). Therefore, the presumptive service connection provisions based on chronic in-service symptoms and continuous post-service symptoms under 38 C.F.R. § 3.303(b) do not apply to this claim. Walker v. Shinseki, 708 F.3d 1331 (Fed. Cir. 2013). As the instant decision grants service connection for Parkinson's Disease on a direct basis, the Board need not consider whether the Veteran is entitled to service connection on a presumptive basis.

A Veteran who had active service in the Republic of Vietnam during the period beginning on January 9, 1962 and ending on May 7, 1975 will be presumed to have been exposed to an herbicide agent during such service unless there is affirmative evidence to establish that the veteran was not exposed to any such agent during that service. 38 U.S.C.A. § 1116(f) (West 2014); 38 C.F.R. § 3.307(a)(6)(iii) (2015). If a Veteran was exposed to an herbicide agent during active service, certain diseases, to include Parkinson's Disease, shall be service-connected if the requirements of 38 C.F.R. § 3.307(a)(6) are met, even though there is no record of such disease during service, provided further that the rebuttable presumption provisions of 38 C.F.R. § 3.307(d) are also satisfied. 38 C.F.R. § 3.309(e) (2015). The disease must have become manifest to a degree of 10 percent or more at any time after service. 38 C.F.R. § 3.307(a)(6)(ii) (2015).

VA has extended the presumption of service connection for diseases listed under 38 C.F.R. § 3.309(e), such as Parkinson's Disease, to Veterans who served in Korea in or near the demilitarized zone (DMZ) between April 1, 1968, and August 31, 1971, or in Thailand at

certain designated bases and whose duties placed him on or near the perimeter of the base, where herbicides were sprayed. The presumption of service connection for diseases exposed to an herbicide agent under 38 C.F.R. § 3.309(e) has not been extended to claims based on service on the island of Guam.

If a Veteran did not serve in the Republic of Vietnam during the Vietnam era or in Korea in or near the DMZ between April 1, 1968, and August 31, 1971, or in Thailand and certain designated bases and with duties in close proximity to the perimeter of the base, then exposure is not presumed; and actual exposure to herbicides must be verified through appropriate service department or other sources in order for the presumption of service connection for a herbicide-related diseased under 38 C.F.R. § 3.309(e) to be applicable. VA Adjudication Procedure Manual, M21-1MR, Part IV, Subpart ii, Chapter 2, Section C, paragraph 10(p).

Notwithstanding the foregoing presumption provisions for herbicide exposure, a claimant is not precluded from establishing service connection with proof of direct causation. Combee v. Brown, 34 F.3d 1039 (Fed. Cir. 1994).

Here, the evidence does not show that the Veteran served in the Republic of Vietnam, Korea, or Thailand, nor does he contend otherwise. Thus, he is not entitled to a presumption of service connection for his Parkinson's Disease as a disability resulting from herbicide exposure. 38 C.F.R. § 3.309(e) (2015). The Veteran may be entitled to service connection for Parkinson's Disease on a direct basis if the evidence establishes that it is related to service, to include exposure to herbicides or environmental toxins.

The Veteran contends, in written statements and in hearing testimony, that he has Parkinson's Disease as a result of exposure to herbicides and environmental toxins, such as TCE and PCE, as a result of having served as an aerospace ground equipment repairman during active duty with the United States Air Force at Andersen Air Force Base, Guam. He maintains that he was exposed to toxic chemicals from working on airplanes and spraying the surrounding grounds. The Veteran contends that after service, he was employed as a stevedore and teacher. During the course of employment as a stevedore, he maintains that he was exposed to chemicals similar to those in Guam.

Initially, the Board finds that the Veteran is currently diagnosed with Parkinson's Disease. Numerous private medical records throughout the appeal show that the Veteran receives treatment for Parkinson's Disease.

Next, the Board finds that the Veteran was exposed to environmental toxins while stationed at Andersen Air Force Base in Guam. The Veteran's military personnel records, to include his service separation form, show that he served an aerospace ground equipment repairman while stationed on Guam from September 23, 1968, to January 22, 1970. During the April 2015 and January 2016 hearings, the Veteran credibly testified that his duties as an aerospace ground equipment repairman required him to spray the airplanes and surrounding grounds with toxic chemicals. In addition, throughout the appeal, the Veteran has submitted numerous articles and studies indicating that various toxic solvents may have been stored or used on Guam. Notably, an article from the Environmental Protection Agency (EPA) listed Andersen Air Force Base, Guam as a toxic site with dioxin contaminated soil and ordered cleanup of the site. Considering that evidence, particularly the article showing that the EPA has detected dioxin contaminated soil, and the Veteran's hearing testimony which is credible, the Board accepts that he was exposed to environmental toxins, such as PCE and TCE, during active service in Guam.

VA received medical opinions, dated in April 2015 and January 2016, prepared by M. O., M. D. and A. N., M. D, which are supportive of the claim. In the April 2015 report, Dr M. O. concluded that "Pesticide Exposure" had been linked to Parkinson's Disease and that there was a good (better than 50 percent chance) that it had affected the Veteran. The Board finds Dr. M. O.'s opinion to be of reduced probative value in evaluating the Veteran's claim because there is no indication that he had reviewed the Veteran's service records, nor did he provide the exact pesticides, aside from listing Agent Orange, that had been linked to the development of Parkinson's Disease or any rationale for the opinion. In the January 2016 report, Dr. A. N. specifically noted that she had been treating the Veteran for Parkinson's Disease since 2008. Dr. A. N. indicated that the Veteran had been exposed to environmental toxins, such as TCE and PCE, during service as an ground equipment repairman in Guam. Dr. A. N. indicated that reports had associated Parkinson's Disease with those toxins. Thus, it was

Dr. A. N.'s opinion that the Veteran's Parkinson's Disease was directly caused by exposure, in part, to TCE and PCE, with a greater than 50 percent probability while in active duty.

Recognition is given to the fact that the opinion from Dr. A. N. did not provide any rationale. There are other means by which a physician can become aware of critical medical facts, notably by treating the claimant for an extended period of time, such as in the case of Dr. A. N.'s long-term treatment of the Veteran since 2008. Nieves-Rodriguez v. Peake, 22 Vet. App. 295 (2008). There is also no other evidence in the record that weighs against Dr. A. N.'s positive opinion. An October 2015 VA examiner provided an opinion that was against a nexus between the Veteran's Parkinson's Disease and his exposure to herbicides without a discussion on the relationship between Parkinson's Disease and environmental toxins, such as PCE and TCE, which is the basis of the Board's award for Parkinson's Disease herein.

Thus, although Dr. A. N.'s opinion is of diminished value given its lack of rationale, it nevertheless places the weight of the evidence in the Veteran's favor, and at least places the evidence in equipoise. Accordingly, the Board finds that the evidence shows that it is at least as likely as not that Parkinson's Disease is due to exposure to environmental toxins during service. Therefore, service connection for Parkinson's Disease as secondary to exposure to environmental toxins is granted. 38 U.S.C.A. § 5107(b) (West 2002); Gilbert v. Derwinski, 1 Vet. App. 49 (1990).

ORDER

Service connection for Parkinson's Disease, secondary to environmental toxins, is granted.

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HARVEY P. ROBERTS
Veterans Law Judge
Board of Veterans' Appeals

_____

BARBARA B. COPELAND
Veterans Law Judge
Board of Veterans' Appeals

_____

MATTHEW W. BLACKWELDER
Veterans Law Judge
Board of Veterans' Appeals

Department of Veterans Affairs

Citation Nr: 1334753
Decision Date: 10/30/13 Archive Date: 11/06/13

DOCKET NO. 04-07 278) DATE
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On appeal from the
Department of Veterans Affairs Regional Office in Waco, Texas

THE ISSUES

1. Entitlement to service connection for type II diabetes mellitus to include as a result of herbicide exposure.

2. Entitlement to service connection for coronary artery disease, status post coronary artery bypass graft, to include as a result of herbicide exposure.

3. Entitlement to service connection for hypertension to include as secondary to diabetes mellitus.

REPRESENTATION

Appellant represented by: Katrina Eagle, Attorney

WITNESSES AT HEARING ON APPEAL

Veteran and his spouse

ATTORNEY FOR THE BOARD

A. Hinton, Counsel

INTRODUCTION

This appeal has been advanced on the Board's docket pursuant to 38 C.F.R. § 20.900(c) (2012). 38 U.S.C.A. § 7107(a)(2) (West 2002).

The Veteran served on active duty from January 1963 to May 1966.

These matters come before the Board of Veterans' Appeals (Board) on appeal from a June 2003 rating decision of the Department of Veterans Affairs (VA) Regional Office (RO) in Waco, Texas, which denied the benefits sought.

These matters have been previously before the Board on multiple occasions. In June 2009, the Board denied the claims on appeal. The Veteran appealed the Board's June 2009 decision to the United States Court of Appeals for Veterans Claims (Court).

In an April 2011 memorandum decision, the Court vacated the Board's June 2009 decision to the extent of the three claims on appeal, while noting that the Veteran had withdrawn his appeal as to two other issues denied in the Board's June 2009 decision. The Court remanded the three claims to the Board for further adjudication.

In September 2011, the Board remanded these issues for additional development in accordance with the April 2011 Court memorandum decision.

In June 2013 the Board remanded the case to the RO to arrange for a Travel Board hearing, which was held before the undersigned Veterans Law Judge in August 2013. At that time the

Veteran made a motion to advance the case on the Board's docket based on financial hardship, which was granted. See 38 C.F.R. § 20.900(c) (2012).

The issues of entitlement to service connection for erectile dysfunction, dyslipidemia, and peripheral neuropathy, all to include as secondary to type II diabetes mellitus or as due to exposure to herbicides, have been raised by the record, but have not been adjudicated by the Agency of Original Jurisdiction (AOJ). Therefore, the Board does not have jurisdiction over them and they are referred to the AOJ for appropriate action.

The issue of entitlement to service connection for hypertension is addressed in the REMAND portion of the decision below and is REMANDED to the RO via the Appeals Management Center (AMC), in Washington, DC.

FINDINGS OF FACT

1. Resolving all reasonable doubt in favor of the Veteran, the evidence establishes that the Veteran's type II diabetes mellitus is due to exposure in service to herbicides to include 2,4-D; 2,4,5-T; TCDD; cacodylic acid; or picloram.

2. Resolving all reasonable doubt in favor of the Veteran, the evidence establishes that the Veteran's coronary artery disease, status post coronary artery bypass graft, is due to exposure in service to herbicides to include 2,4-D; 2,4,5-T; TCDD; cacodylic acid; or picloram.

CONCLUSIONS OF LAW

1. The criteria for service connection for type II diabetes mellitus have been met. 38 U.S.C.A. §§ 1110, 1112, 1113, 1116, 5107 (West 2002); 38 C.F.R. §§ 3.102, 3.303, 3.307, 3.309(e) (2013).

2. The criteria for service connection for coronary artery disease, status post coronary artery bypass graft, have been met. 38 U.S.C.A. §§ 1110, 1112, 1113, 1116, 5107 (West 2002); 38 C.F.R. §§ 3.102, 3.303, 3.307, 3.309(e) (2013).

The Veterans Claims Assistance Act of 2000 (VCAA)

The Board is granting in full the benefits sought on appeal. Accordingly, any error committed with respect to either the duty to notify or the duty to assist was harmless and will not be further discussed.

REASONS AND BASES FOR FINDINGS AND CONCLUSIONS

Applicable Law

In general, service connection may be granted for a disability resulting from disease or injury incurred in or aggravated by service. 38 U.S.C.A. §§ 1110, 1131 (West 2002); 38 C.F.R. §§ 3.303, 3.304. Service connection generally requires credible and competent evidence showing: (1) the existence of a present disability; (2) in-service incurrence or aggravation of a disease or injury; and (3) a causal relationship between the present disability and the disease or injury incurred or aggravated during service. See Davidson v. Shinseki, 581 F.3d 1313, 1316 (Fed. Cir. 2009); Hickson v. West, 12 Vet .App. 247, 253 (1999); Caluza v. Brown, 7 Vet. App. 498 (1995).

Service connection may be granted if a disability is proximately due to or the result of a service-connected disability or if aggravation of a nonservice-connected disorder is proximately due to or the result of a service-connected disability. 38 C.F.R. § 3.310(a).

Some chronic diseases, including diabetes mellitus or cardiovascular-renal disease to include hypertension, are presumed by law and regulation to have been incurred in service, if they become manifest to a degree of ten percent or more within a corresponding applicable

presumptive period. 38 U.S.C.A. §§ 1101, 1112, 1113, 1137; 38 C.F.R. §§ 3.307, 3.309.

There is a presumption of service connection for certain conditions if a Veteran was exposed in service to certain tactical herbicides that were used in Vietnam and some other locations during the Vietnam Era, and which were composed of one or more of the chemicals listed under 38 C.F.R. § 3.307(a)(6)(i).

If a veteran was exposed to an herbicide agent during active military, naval, or air service, certain diseases are presumed to be service connected if the requirements of 38 C.F.R. § 3.307(a)(6) are met, even though there is no record of the disease during service, provided that the rebuttable presumption provisions of 38 C.F.R. § 3.307(d) are also satisfied. 38 U.S.C.A. § 1116(a) (West 2002 & Supp. 2012); 38 C.F.R. § 3.309(e).

The term "herbicide agent" is defined as a chemical in an herbicide used in support of the United States and allied military operations in the Republic of Vietnam during the period beginning on January 9, 1962 and ending on May 7, 1975, specifically: 2,4-D; 2,4,5-T and its contaminant TCDD; cacodylic acid; or picloram. 38 C.F.R. § 3.307(a)(6)(i).

Type II diabetes mellitus is listed as a disease associated with exposure to herbicide agents. During the pendency of the appeal, the provisions of 38 C.F.R. § 3.309(e) were amended to include additional presumptive diseases. See 75 Fed. Reg. 53202 -53216 (Aug. 31, 2010). The additional diseases include ischemic heart disease, which in turn includes coronary artery disease, but does not include hypertension or peripheral manifestations of arteriosclerosis such as peripheral vascular disease.

A veteran who, during active military, naval, or air service, served in the Republic of Vietnam during the period beginning on January 9, 1962 and ending on May 7, 1975, is presumed to have been exposed during such service to an herbicide agent, unless there is affirmative evidence to the contrary. 38 C.F.R. § 3.307(a)(6)(iii). Also, there are guidelines for presumption of exposure based on service in Thailand and Korea during the Vietnam Era. See M21-1MR, IV.ii.2.C.10.p; M21-1MR, IV.ii.2.C.10.q (Dec. 16, 2011).

In making all determinations, the Board must fully consider the lay assertions of record. A layperson is competent to report on the onset and continuity of his current symptomatology. See Layno v. Brown, 6 Vet. App. 465, 470 (1994) (a veteran is competent to report on that of which he or she has personal knowledge).

Lay evidence can also be competent and sufficient evidence of a diagnosis or to establish etiology if (1) the layperson is competent to identify the medical condition, (2) the layperson is reporting a contemporaneous medical diagnosis, or (3) lay testimony describing symptoms at the time supports a later diagnosis by a medical professional. Davidson, 581 F.3d at 1316; Jandreau v. Nicholson, 492 F.3d 1372, 1376-77 (Fed. Cir. 2007). When considering whether lay evidence is competent the Board must determine, on a case by case basis, whether the Veteran's particular disability is the type of disability for which lay evidence may be competent. Kahana v. Shinseki, 24 Vet. App. 428 (2011); see also Jandreau, 492 F.3d at 1376-77.

The Board is charged with the duty to assess the credibility and weight given to evidence. Madden v. Gober, 125 F.3d 1477, 1481 (Fed. Cir. 1997).

When there is an approximate balance of positive and negative evidence regarding any issue material to the determination of a matter, the Secretary shall give the benefit of the doubt to the Veteran. 38 U.S.C.A. § 5107(b).

Analysis

The Veteran claims that his diagnosed type II diabetes mellitus, and his coronary artery disease, status post coronary artery bypass graft, are the result of exposure to herbicides during service while stationed at Pease Air Force Base in New Hampshire, or at Andersen Air Force Base in Guam, during the 1960s.

The Veteran neither claims, nor does the record show, that he served in Vietnam, Korea, or

Thailand. Thus, he is not presumed to have been exposed to an herbicide agent during service. 38 C.F.R. § 3.307(a)(6)(iii). As exposure to the herbicides listed under 38 C.F.R. § 3.307(a)(6)(i) cannot be presumed, neither of the two claimed disabilities-type II diabetes mellitus and coronary artery disease-can be presumptively service connected on the basis of presumed exposure.

In the Veteran's January 2003 application he reported that he had served on a Combat Support Team in Guam in the US Air Force from 1964 to 1966, where his primary job was in the supply warehouse working with clothing that came from military personnel traveling back and forth to Vietnam.

During his August 2013 hearing, he testified that while at Andersen Air Force Base, he was assigned to the Base Equipment Management Office as an inventory specialist. In that role he inventoried equipment and was required to go into the drum lot where the herbicides were stored to count them periodically-every ten days to two weeks. Also, whenever an inspector general team was inspecting, he was assigned to the flight line as a bomb loader.

He also testified that he exercised by running down the fence line every two days; and witnessed spraying outside of barracks and chow halls, and around runways to keep vegetation growth down. The Veteran also discussed pictures on file he submitted showing barrels of herbicides lined up and the brown grass that had been sprayed. He testified that the spraying was necessary due to the high growth rate of plants on the tropical island of Guam.

During the hearing the Veteran's representative commented that a Dow Chemical risk report on file discussed the spraying of herbicides at Andersen Air Force Base during the Vietnam Era, and included information of TCDD contamination that was later measured as 19,000 PPM in some areas of the Base. The representative stated that the contamination occurred from 1960 to as late as 1975.

The Veteran's representative also discussed an Environmental Protection Agency (EPA) report, noting that it referred to herbicide use from 1950 through the 1960s, and that it showed that Andersen Air Force Base was found to have toxic chemicals in the soil, including pesticides.

The Veteran's service personnel records show that he served both at Pease Air Force Base in New Hampshire, from April 1963 to April 1964, and later at Andersen Air Force Base in Guam, from November 1964 to May 1966. His duties included supply specialist and posting clerk.

The Veteran's clinical records on file contain medical evidence showing diagnoses of type II diabetes mellitus, and of coronary artery disease, status post coronary artery bypass graft. The Veteran's coronary artery disease was diagnosed in 2002 and the type II diabetes mellitus was first diagnosed in 2003. The Veteran underwent coronary artery bypass graft in 2003.

In a June 2011 statement by John D. Bagdade, MD (Board Certified Internal Medicine, Endocrinology and Metabolism), he stated he had reviewed the records, and on that basis he opined that the Veteran had exposure to herbicides including Agent Orange while stationed at Pease Air Force Base in New Hampshire and Andersen Air force Base in Guam, and that these environmental exposures resulted in the Veteran's acquired adult-onset diabetes mellitus (type 2 diabetes), that was noted in 2001, and his coronary heart disease requiring coronary artery by-pass surgery in 2003.

As part of the rationale for the opinion, Dr. Bagdade cited medical literature establishing an association between Agent Orange exposure and the claimed disorders. As part of the rationale regarding diabetes, he noted that obesity is the most common cause of insulin resistance, however, the Veteran was not overweight. He also noted there was no family history of the claimed disabilities. Dr. Bagdade concluded that given the documented exposure to the herbicide Agent Orange, and cited scientific evidence, it is more likely than not that the Veteran's acquiring diabetes mellitus, hypertension, dyslipidemia, and coronary heart disease are all related to his exposure to Agent Orange during service.

At a VA examination in March 2012, the examining VA physician assistant diagnosed coronary artery disease, status post coronary artery bypass graft, noting a date of diagnosis of 2002. She also diagnosed diabetes mellitus type II, noting a date of diagnosis of 2002. The examiner specified that the heart condition qualified within the generally accepted definition of ischemic heart disease.

The examiner commented that the diabetes mellitus included complications of peripheral neuropathy, which the examiner diagnosed as diabetic neuropathy. The examiner found that the symptoms attributable to diabetic peripheral neuropathy involved the upper and lower extremities, bilaterally.

The examiner opined that diabetic complications did not include diabetic nephropathy or renal dysfunction or diabetic retinopathy. She opined that erectile dysfunction was at least as likely as not due to diabetes mellitus.

The examiner opined that the Veteran's diabetes and coronary artery disease are both at least as likely as not related to the Veteran's active duty service to include any inservice chemical exposure. The examiner stated essentially that the basis of that opinion was the assumption of the Veteran's exposure to "Agent Orange" during service, and the fact of the diagnoses of diabetes mellitus and coronary artery disease.

The examiner also addressed his opinion as to the likelihood that the Veteran's hypertension or coronary artery disease is causally related to or has been permanently aggravated in severity by the type II diabetes mellitus.

The examiner opined that the hypertension and coronary artery disease are not as likely as not causally related to, or permanently aggravated in severity by, the Veteran's type II diabetes mellitus. The examiner based that opinion on the rationale that the Veteran's coronary artery disease is associated with Agent Orange exposure, and that type II diabetes without renal disease is not a well documented cause of hypertension. The report does not show that any diagnostic testing was performed to rule out any renal pathology.

A May 2012 VA medical opinion (examination) report notes that at the March 2012 VA examination the examiner had based her opinions on the assumption that VA had conceded Agent Orange exposure. The May 2012 VA opinion report instructed the examiner that VA had not conceded exposure to Agent Orange.

The May 2012 VA medical opinion report shows that the examiner from the March 2012 VA examination reviewed the claim file and provided follow-up opinions as to the likelihood of an etiological nexus between the Veteran's service and the claimed type II diabetes mellitus or coronary artery disease, given that herbicide exposure was not conceded. In light of the information that VA did not concede exposure to Agent Orange in service, the examiner opined essentially, that the type II diabetes mellitus and coronary artery disease are both not at least as likely as not causally related to the Veteran's active duty service, but rather, were more likely due to personal risk factors and family history.

The examiner noted a positive family history of diabetes mellitus and coronary artery disease, and a history of smoking for 30 years. The examiner also stated that there was no specific evidence that the Veteran was actually exposed to chemical or other types of contamination at Pease Air Force Base or Andersen Air Force Base.

In a February 2013 statement, Dr. Bagdade cited and relied on a number of pertinent scientific journal articles in support of his opinion relating the claimed diabetes mellitus and coronary artery disease to in-service exposure to herbicides. He opined that the Veteran's type II diabetes mellitus and coronary artery disease, status post coronary artery bypass graft, were more likely than not the consequence of in-service exposure to endocrine disrupting substances like dioxin present in Agent Orange and other persistent organic pollutants that caused a state of insulin resistance.

He opined that this underlying abnormality then contributed to the Veteran's developing the metabolic syndrome of which type 2 diabetes, hypertension, and hyperlipidemia are integral features, and coronary artery disease and arteriosclerotic cardiovascular disease being a later complication.

Dr. Bagdade rebutted the VA examiner's rationale of a family history of diabetes mellitus, by noting that the brother cited had had two tours of duty in Vietnam when he was exposed to Agent Orange, and had received VA disability benefits based on the presumption that the disease was related to that exposure in service.

Dr. Bagdade concluded that, based on the Veteran's clinical course following discharge, together with recent scientific evidence cited, it is more likely than not that the medical

conditions he manifested were all closely related to perturbations in metabolism that are now acknowledged to be consequences of exposure to Agent Orange and other persistent organic pollutants that were documented as present at Pease Air Force Base and Andersen Air Force Base during the Veteran's period of service.

The Record reflects that Dr. Bagdade based his opinion that the Veteran was exposed to the specified chemicals such as Agent Orange on his review of at least some of the records discussed below.

The claim file contains published material addressing the presence and use of herbicides and other pathogenic chemicals, including contamination of soil and water at the Pease Air Force Base and the Andersen Air Force Base. A document titled National Priorities List Site Narrative for Andersen Air Force Base, published on the internet by the U.S. Environmental Protection Agency (EPA), shows that the base was proposed for a Superfund Site in February 1992. That document noted that Andersen Air Force Base had been operational since the 1940s and that sources/locations of hazardous substances there included unlined landfills, drum storage and disposal areas, chemical storage areas, fire training areas, waste storage areas, a laundry, and industrial and flight line operations.

The document noted that substances known to be involved in the Base's operation included: solvents such as trichloroethene (TCE) and paint thinners; dry cleaning fluids; fuels; pesticides; antifreeze; aircraft cleaning compounds; and PCBs. The publication noted that Air Force analyses indicated the presence of lead, chromium, TCE, toluene, and tetrachloroethene in ground water beneath the site. The document noted that more information about the hazardous substances identified in the document could be obtained from the Agency for Toxic Substances and Disease Registry (ATSDR).

A document titled Site Summaries, Pease Air Force Base, published on the internet by the New Hampshire state government contains information regarding a Superfund site involving Pease Air Force Base. The document noted that in 1983 the Air Force initiated installation restoration program activities to assess and control the migration of contamination that have resulted from past operations and disposal practices. The document noted that in 2003 the Air Force released information indicating the presence of waste materials from cleaning certain weapons systems in the 1950s and early 1960s. Past industrial waste disposal practices at Pease between 1956 to 1971 were characterized as "most waste petroleum, oil, and lubricants and solvents combined and burned during fire department training exercises."

A document titled Contaminants of Concern at Pease Air Force Base, published on the internet by the EPA regarding Superfund information, contains a 26 page table citing numerous different contaminants present in ground water, soil, and other media at many different contaminated areas of the Base.

A document titled Public Health Assessment, Andersen Air Force Base, published on the internet by the ATSDR, noted that since World War II Andersen Air Force Base had been the recipient of chemicals used and stored in various locations on the base and spilled during routine operations. Wastes were buried in landfills from 1946 to the late 1970s. The report discussed soil and groundwater contamination beneath landfills and dozens of other areas on base over the years by routine waste disposal, military operations and occasional fuel spills.

The report noted that during the investigations, groundwater underlying Andersen was found to be contaminated with volatile organic compounds at levels above EPA Safe Drinking Water Standards. Results of monitoring nine water supply wells on base during the 1970s showed that chemicals, including solvents, pesticides, fuel products, and some metals had entered water supply wells. Andersen was placed on the EPA's National Priorities List in October 1992 due to the extent of groundwater contamination under the base.

There are a number of additional documents and reports on file, including published scientific studies and a Congressional report titled Hazardous Waste Problems at Department of Defense Facilities, which include evidence of the long-term presence of persistent organic pollutants and other contaminants in the soil and water sources at Andersen Air Force Base, including dioxins, PCBs, and pesticides of the same or similar class as those implicated under 38 C.F.R. § 3.307(a)(6)(i).

The Veteran has also submitted a number of photographs showing storage of barrels, and a

large number of lay statements from former service members who served at Andersen Air Force Base during the relevant period, who attested to the presence of barrels of Agent Orange stored outside at Andersen Air Force Base in Guam, and attested to their exposure to Agent Orange and other pesticides at the base due to leakage and spraying for defoliation during the 1960s.

In a February 2009 letter from the Director, Center for Unit Records Research (CURR), the deputy director stated that CURR was unable to document or verify that the Veteran was exposed to herbicides while serving at Andersen Air Force Base, Guam. He noted that CURR had reviewed the Department of Defense listing of herbicide spray areas and test sites outside of Vietnam, and that Guam was not listed. He also noted that available 3960th Support Squadron unit historical data did not document any herbicide spraying, testing, storage or usage at Andersen.

The Veteran has testified credibly on this matter, and his statements and testimony are corroborated by statements from airmen with whom he served. Notwithstanding the CURR report, the Veteran's testimony regarding his exposure to herbicides at the two Air Force Bases is consistent with the overwhelming evidence on file showing that given his military duties while stationed at Andersen Air Force Base, he was likely exposed to a number of pathogenic chemicals including dioxins, PCBs, or other pesticides, including some combination of pesticide chemicals specified under 38 C.F.R. § 3.307(a)(6)(i).

The evidence on file is, at the very least, in equipoise on the question of whether the Veteran was exposed to herbicides during his period of active service. In such a case, the question must be resolved in the appellant's favor. 38 U.S.C.A. § 5107(b); see also Gilbert v. Derwinski, 1 Vet. App. 49 (1990).

Accordingly, the Board finds, as fact, that the Veteran was exposed to herbicides during service. Given such exposure as a finding of fact, the medical opinions of record support a finding that the Veteran's type II diabetes mellitus and coronary artery disease, status post coronary artery bypass graft were caused by such exposure. Service connection is warranted for both disabilities.

ORDER

Entitlement to service connection for type II diabetes mellitus is granted.

Entitlement to service connection for coronary artery disease, status post coronary artery bypass graft is granted.

REMAND

The Veteran seeks service connection for hypertension. In light of the decision above, given the Veteran's service-connected type II diabetes mellitus and his recognized exposure to herbicides including chemical components of Agent Orange during service, the potential exists for a causal relationship between the claimed hypertension and the type II diabetes mellitus or the herbicide exposure.

The examiner at the March 2012 VA examination, who also provided a follow-up opinion in May 2012, opined that the Veteran's hypertension was not related to the Veteran's diabetes mellitus. She based that opinion on the premise that type II diabetes mellitus without renal disease is not a well documented cause of hypertension.

However, she did not address any potential diabetic pathogenesis unrelated to renal pathology that may link the type II diabetes mellitus to hypertension, such as the role of insulin resistance/hyperinsulinemia, or increased peripheral vascular resistance, or other non-renal diabetic pathology.

The VA examiner also opined that the hypertension was not likely due to herbicide exposure, in part on the basis that: the weight of medical literature was against a relationship of hypertension and exposure to herbicides; the Veteran had other known risk factors for

hypertension including family history and smoking; and there was no specific evidence that the Veteran came into contact with herbicides.

This opinion conflicts with Dr. Bagdade's February 2013 opinion, based on cited scientific evidence, that it is more likely than not that the Veteran became hypertensive as part of the insulin resistance-driven metabolic syndrome acquired from exposure to polychlorinated herbicides present in Agent Orange.

A remand is necessary in order for the Veteran to be examined by VA and an opinion obtained that takes into consideration all of the evidence on file regarding the claim, including recognition of herbicide exposure during service as fact. The Veteran must be given an opportunity to submit statements regarding the onset and continuity of relevant symptoms; and any additional pertinent treatment records not on file must be obtained.

Accordingly, the case is REMANDED for the following action:

1. Obtain any outstanding VA or private treatment records pertinent to the claim for service connection for hypertension.

2. Notify the Veteran that he may submit statements from himself and others who have observed the Veteran; describing their impressions regarding the onset and chronicity of symptoms of hypertension since service or since onset of type II diabetes mellitus.

3. After completion of the above, schedule the Veteran for an examination by an appropriate medical professional to determine the nature extent, onset and likely etiology of any diagnosed hypertension disability found to be present.

The claim file must be made available to and reviewed by the examiner. All indicated studies are to be performed, including testing to rule out diabetic renal pathology; and all findings are to be reported in detail. In offering opinions, the examiner must acknowledge and discuss the Veteran's report of a continuity of relevant symptoms since service or since onset of type II diabetes mellitus or coronary artery disease, or any metabolic/endocrinopathy condition associated with the type II diabetes mellitus or the Veteran's exposure to herbicides in service.

Thereafter, the examiner must opine as to whether it is at least as likely as not that any diagnosed hypertension is:
(i) related to or had its onset in service, or was aggravated in service, to include as due to recognized exposure to herbicides associated with Agent Orange; or
(ii) proximately due to or aggravated by the Veteran's type II diabetes mellitus or his coronary artery disease.
In making these opinions, the examiner must discuss the opinions of Dr. Bagdade in June 2011 and February 2013.

All opinions must be supported by a thorough rationale.

4. Then, following any additional development deemed appropriate, readjudicate the Veteran's claim. If the benefit sought is not granted, a supplemental statement of the case must be issued.

The appellant has the right to submit additional evidence and argument on the matter the Board has remanded. Kutscherousky v. West, 12 Vet. App. 369 (1999).

This claim must be afforded expeditious treatment. The law requires that all claims that are remanded by the Board of Veterans' Appeals or by the United States Court of Appeals for Veterans Claims for additional development or other appropriate action must be handled in an expeditious manner. See 38 U.S.C.A. §§ 5109B, 7112 (West Supp. 2012).

RONALD W. SCHOLZ
Veterans Law Judge, Board of Veterans' Appeals

Department of Veterans Affairs

September 14, 2009

To the Veterans Administration:

For: Sgt Ralph A. Stanton
601 E Swenson
Savannah, Mo 64485

816-262-0097
rstanton@stjoelive.com

My name is Msgt LeRoy Glenn Foster, USAF, Retired. I am writing this letter to testify in support of Ralph A. Stanton's exposure to Agent Orange herbicides which I prepared, mixed and sprayed on Andersen AFB, Guam and all of the off base fuels facilities, cross country pipelines that spanned the island to the Naval Fuel Supply Depot underground storage tanks. I sprayed these herbicides in, on, and around all the places Sgt. Stanton had to work.

I prepared, mixed and sprayed these herbicides to include Agent Orange and Agent Blue herbicides which were packaged in 55 gallon drum containers identified with colored bands and 50 lb dry chemical bags with Monsanto on the bags. I was an A1C and a Sgt during the time frame of 1969 and 1970 and 1971. I worked in the 43rd Supply Squadron Fuels Division and was assigned to on and off base fuels facility operations. I used a five ton blue tractor truck and a yellow 750 gallon tank trailer which was an old MK1 oil and Adi trailer to service C124 Globemaster Aircraft which was converted into a herbicide spraying trailer.

I often would have to spray the entire pipe lines, hydrant pump stations on the flight line, the Quonset huts storing the packaged oil for the B52 bombers, the fuel valve pits, the security fences surrounding the flight line, the fuel storage facilities at Andy I, Andy II, the Liquid Oxygen bldg, the Fuel operations office, the truck refueling hardstands, the refueling fleet checkout area, all of the off base fuel storage facilities at Potts tank farm, Naval Air Station Fuel Booster pump station, Tumon Tank Farm and the entire Cross country pipeline.

I also sprayed at the Yigo and Dededo Packaged Oil warehouse Quonset hut where I operated forklifts to load and unload packaged oil for the B52 bombers jet engine oil. I would work many long hours but sprayed a lot there because of the jungle over growth . Sgt Stanton worked alongside me during the two years we were stationed there together. He often was rebuilding valves, pumps, filters etc. He also had to maintain corrosion control on those fuels systems and was always getting the wind blown spray on him. He would complain to me to keep that shit away from him as it would turn a chalky white on immediate contact.

He and I developed sterility there but never said anything to each other as we both probably thought that was much too personal to talk about. He and I have many serious diseases now and we both probably will not live much longer past 65 if we reach it. I have many friends now that have died in their forties and fifties from these herbicides.

I know that the US Air Force and the Department of Defense know the truth about these herbicides. The denial must end. I am asking our government to be honest now about these Agent Orange herbicides.

I swear to God that all of the above is true and correct.

Signed,

Msgt Leroy G Foster, USAF, Ret.
7524 E MAIN ROAD ROUTE 20
WESTFIELD, NEW YORK 14787-9663
716-232-4001
Retairforceman@aol.com

Witnessed this day of ...Sept..15..2009.
by.....
Notary Public...Suzanne M. Wilson
Notary Public signature.Suzanne M. Wilson
Notary Public date and stamp

SUZANNE M. WILSON
Notary Public, State of New York
Qualified in Chautauqua County
Commission Expires Sept. 22, 20 11

Standard Form 600
Nov. 1952
Bureau of the Budget
Circular A–32
600–102

HEALTH RECORD | **CHRONOLOGICAL RECORD OF MEDICAL CARE**

DATE	SYMPTOMS, DIAGNOSIS, TREATMENT, TREATING ORGANIZATION (Sign each entry)
	USAF DISPENSARY (CLASS B) ANDERSEN AFB, GUAM
	USAF DISPENSARY CLASS B ANDERSEN AFB, GUAM
1 6 OCT 1968	Acne R Foster Vit A Tetracycline 250 BID RTC 2 wks
	Some improvement, but still new lesion Foster RF Astringent BrP Acne lotion hs RTC 2 wks to Dr. Wilson Daley
18 NOV 1968	Acne R Tetracycline 250 BID Foster

SEX	RACE	GRADE, RATING, OR POSITION	ORGANIZATION UNIT	COMPONENT OR BRANCH	SERVICE, DEPT. OR AGENCY
					USAF

PATIENT'S LAST NAME—FIRST NAME—MIDDLE NAME	DATE OF BIRTH (DAY-MONTH-YEAR)	IDENTIFICATION NO.
Foster, Leroy G.		050 38 8104

SOCIAL SECURITY NUMBER _____

CHRONOLOGICAL RECORD OF MEDICAL CARE
Standard Form 600

I am adding this to show that Sgt. Foster is a "Creditable Witness". This medical record shows that Sgt. Foster was being treated for herbicide exposure while on Guam. He was never in Vietnam.

V. COMMENTS OF REPORTING OFFI[illegible] (Be factual and specific. Add any comments [illegible] increase the objectivity of the rating.)

FACTS AND SPECIFIC ACHIEVEMENTS: SSgt Foster established an effective operator maintenance program which greatly reduced system discrepancies and culminated in his section's ability to support numerous fuel handling operations. He maintained excellent rapport with CE and coordinated ground works for Tumon and Potts Tank Farm. He constantly insured that vegetation control of these two areas were continuously performed on a scheduled basis and because of his efforts, these facilities have always been excellent show-cases of the Fuels Management Branch. His excellent supervision and display of leadership resulted in the high morale and work productivity of his section. He has been very effective in accounting for over 17 million gallons of fuel, insuring that fuel is maintained at the highest quality for aircraft fueling. Right after Super Typhoon Pamela on 21 May 1976, SSgt Foster quickly reported to work and immediately made a comprehensive and complete survey of typhoon damage incurred at NAS Booster Station, the Cross-Country pipeline and the two off-base storage tank farms. He voluntarily worked 12 hours per day for over 10 days to restore off-base pumping capability and assisted at the base's mass restoration effort and clean-up program. STRENGTHS: Superior management and leadership ability, coupled with his vast technical knowledge of the bulk storage system are SSgt Foster's most valuable assets. OTHER COMMENTS: SSgt Foster fully supports the Equal Opportunity Program. I recommend him for promotion at the earliest possible time.

VI. REPORTING OFFICIAL

NAME, GRADE AND ORGANIZATION	DUTY TITLE	SIGNATURE / DATE
FRANCISCO R. SAN AGUSTIN, TSgt, FR458-66-1719, 43d Supply Squadron (SAC)	NCOIC Bulk Storage	DATE: 29 June 1976

VII. INITIAL INDORSING OFFICIAL

I concur. SSgt Foster has performed outstandingly since his assignment to Andersen. He has established support with support agencies and maintains the off-base areas in an immaculate condition. He has proven himself to be an outstanding technician as well as a manager.

I am adding this performance report record to show Sgt. Foster duties and that he is a "Creditable Witness".

NAME, GRADE AND ORGANIZATION	DUTY TITLE	SIGNATURE / DATE
JAMES O. BURDETTE, SMSgt FR259-52-6292, 43d Supply Squadron (SAC)	Fuels Management Officer	DATE: 30 June 1976

VIII. ADDITIONAL INDORSEMENT

I concur. I observed the efforts of SSgt Foster at least weekly. He is indeed an asset to this organization. His areas of responsibility are maintained in such a manner that promotes harmonious community relations and creates a favorable image for Andersen Air Force Base.

NAME, GRADE AND ORGANIZATION	DUTY TITLE	SIGNATURE / DATE
JACK D. WESTFALL, Colonel 235-54-0545FR, 43d Supply Squadron (SAC)	Commander	DATE: 1 July 1976

IX. ADDITIONAL INDORSEMENT

NAME, GRADE AND ORGANIZATION	DUTY TITLE	SIGNATURE / DATE

☆ GPO : 1972 O - 470-666

Rating Decision	*Department of Veterans Affairs* *VA Regional Office*		Page 1 01/24/2011
NAME OF VETERAN Leroy G. Foster	VA FILE NUMBER 050 38 8104	SOCIAL SECURITY NR 050-38-8104	POA DISABLED AMERICAN VETERANS	COPY TO DAV

ACTIVE DUTY			
EOD	RAD	BRANCH	CHARACTER OF DISCHARGE
08/11/1967	03/25/1983	Air Force	Honorable
03/26/1983	11/30/1987	Air Force	Honorable

LEGACY CODES			
ADD'L SVC CODE	COMBAT CODE	SPECIAL PROV CDE	FUTURE EXAM DATE
	1		None

I am presenting this record to show that Sgt Foster is a "Creditable Witness". The VA has approved his agent orange exposure case for his disabilities caused by his exposure on Guam.

JURISDICTION: Reopened Claim Received 09/22/2009

ASSOCIATED CLAIM(s): 023; New/Reopen; 09/22/09
291; Specially Adapted Housing; 07/29/10
290; Automobile Allowance; 07/29/10

SUBJECT TO COMPENSATION (1. SC)

7017-7005 ARTERIOSCLEROTIC HEART DISEASE, S/P CORONARY ARTERY BYPASS, CLAIMED AS ISCHEMIC HEART DISEASE DUE TO EXPOSURE TO AGENT ORANGE
Service Connected, Peacetime, Incurred
Static Disability
100% from 08/14/1995
100% from 09/25/1995 (38 CFR 4.30)
100% from 12/01/1995
30% from 12/01/1996
100% from 09/22/2009

5242 DEGENERATIVE CHANGES OF THE LUMBAR SPINE
Service Connected, Peacetime, Incurred
Static Disability
40% from 11/05/2004

5299-5242 DEGENERATIVE DISC DISEASE AT C5-C6 AND C6-C7
Service Connected, Peacetime, Incurred
Static Disability
10% from 08/12/1992
20% from 11/25/1996
30% from 09/22/2009

7804 SCAR, CHEST AREA, CORONARY ARTERY BYPASS DONOR SITE
Service Connected, Peacetime, Incurred
10% from 09/27/1995

5215	RESIDUALS, FRACTURE RIGHT WRIST Service Connected, Vietnam Era, Incurred 0% from 12/01/1987 10% from 07/11/2001
7828-7800	RESIDUAL SCARRING FROM ACNE VULGARIS, CLAIMED AS CHLORACNE DUE TO EXPOSURE TO AGENT ORANGE Service Connected, Peacetime, Aggravated Static Disability 10% from 09/22/2009
5227	RESIDUALS, FRACTURE RIGHT RING FINGER Service Connected, Peacetime, Incurred 0% from 12/01/1987
7805	SCAR, RIGHT LEG, CORONARY ARTERY BYPASS DONOR SITE Service Connected, Peacetime, Incurred 0% from 09/27/1995

COMBINED EVALUATION FOR COMPENSATION :

0% from 12/01/1987
10% from 08/12/1992
100% from 08/14/1995
100% from 09/25/1995 (38 CFR 4.30)
100% from 09/27/1995
50% from 12/01/1996
60% from 07/11/2001
70% from 11/05/2004
100% from 09/22/2009
Individual Unemployability Granted from November 5, 2004

SPECIAL MONTHLY COMPENSATION :

S-1 Entitled to special monthly compensation under 38 U.S.C. 1114, subsection (s) and 38 CFR 3.350(i) on account of arteriosclerotic heart disease, s/p coronary artery bypass, claimed as ischemic heart disease due to exposure to Agent Orange rated 100 percent and additional service-connected disabilities of degenerative changes of the lumbar spine, degenerative disc disease at C5-C6 and C6-C7, independently ratable at 60 percent or more from 09/22/2009.

S-1 Entitled to special monthly compensation under 38 U.S.C. 1114, subsection (s) and 38 CFR 3.350(i) on account of arteriosclerotic heart disease, s/p coronary artery bypass, claimed as ischemic heart disease due to exposure to Agent Orange rated 100 percent and additional service-connected disabilities of degenerative changes of the lumbar spine, degenerative disc disease at C5-C6 and C6-C7, residual scarring from acne vulgaris, claimed as chloracne due to exposure to agent orange, residuals, fracture right wrist, scar, chest area, coronary artery bypass donor site, independently ratable at 60 percent or more from 09/22/2009.

imposed on offerors, contractors, or members of the public.

Gregory D. Showalter,

Army Federal Register Liaison Officer.

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DEPARTMENT OF DEFENSE

Department of the Navy

Record of Decision for the Disposal and Reuse of Surplus Navy Property Identified in the Guam Land Use Plan Update (GLUP '94)

SUMMARY: The Department of the Navy (Navy), pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. 4332(2)(C) (1994), and the regulations of the Council on Environmental Quality that implement NEPA procedures, 40 CFR parts 1500–1508, hereby announces its decision to dispose of surplus Navy property identified in the GLUP 94, Guam Land Use Plan Update (A Plan for Department of Defense Real Estate on Guam), dated April 1995 (GLUP '94). This surplus property is located in the United States Territory of Guam.

Navy analyzed the impacts of the disposal and reuse of GLUP '94 surplus Navy property in an Environmental Impact Statement (EIS) as required by NEPA. The EIS analyzed three reuse alternatives and identified the Reuse Plan for GLUP '94 Navy Properties, dated October 1996 (Reuse Plan), prepared by the GLUP '94 Reuse Planning Committee and the Guam Economic Development Authority (GEDA), as the GEDA Recommended Alternative. The Government of Guam is the Local Redevelopment Authority for these surplus properties, as defined in the Department of Defense Rule on Revitalizing Base Closure Communities and Community Assistance, 32 CFR § 176.20(a).

The alternative chosen will use the GLUP '94 Navy properties for parks and recreation, historic and natural resource conservation, residential, commercial, resort, industrial, and agricultural land uses, and extensive regional roadway improvements. These land uses will meet the Navy goals of achieving local economic redevelopment, creating new jobs, and providing additional housing, while limiting adverse environmental impacts and ensuring land uses that are compatible with adjacent property. Selection of the specific means to achieve the proposed redevelopment is in the hands of the acquiring entities and the local zoning authorities.

Background

In 1993, the Commander in Chief, United States Pacific Command assigned Navy to lead a review of all military land requirements on the island of Guam and develop a master plan for future DoD land use. Navy and the Department of the Air Force (Air Force) established the Guam Land Use Working Group to do a comprehensive review of military mission related land requirements on Guam.

Navy prepared and distributed a resulting master plan, known as the GLUP '94. The GLUP '94 recommended consolidation of military activities in the northern and southern parts of the island and it identified more than 8,000 acres of releasable Air Force and Navy properties.

Under the authority of the Defense Base Closure and Realignment Act of 1990, Public Law 101–510, 10 U.S.C. 2687 note (1994), the 1995 Base Realignment and Closure (BRAC) Commission recommended that Navy dispose of the property declared releasable under the GLUP '94, with appropriate restrictions. These recommendations were approved by President Clinton and accepted by the One Hundred Fourth Congress in 1995.

Description of the Property

The EIS analyzed the disposal and reuse of 2,798 acres of the 8,081 acres identified in the GLUP '94. The analysis excluded the GLUP '94 property owned by Air Force, Naval Air Station (NAS) Agana property covered under separate environmental documentation, 50 acres at Barrigada that will be transferred to the National Guard Bureau, 24 acres consisting of the Agana, Piti and Tanguisson Power Plants that Navy plans to convey by special legislation and agreement, and 23 acres at New Apra Heights which was conveyed by the Secretary of Health and Human Services to the Government of Guam for the construction of the Agat-Santa Rita Wastewater Treatment Plant. In addition to the GLUP '94 properties, the EIS analyzed the 92-acre NAS Agana Officers Housing property that was recommended for closure by the 1995 BRAC Commission.

During the Federal screening process, the National Guard Bureau requested an interagency transfer of base closure property on Guam. Navy plans to transfer about 50 acres located in Barrigada to the National Guard Bureau for use in training activities and construction of additional facilities to support the Guam Army National Guard. This property consists of about 24 acres currently leased to the Guam Army National Guard and an additional 26 acres contiguous to the 24-acre site.

The 20 GLUP '94 surplus Navy properties considered in the present NEPA study range in size from 2 acres to 698 acres and are found in the northern, Barrigada, central, and southern regions of Guam. Navy currently has no operations at any of the 20 properties slated for disposal. Combined, the 20 properties contain about 320 residential units and 17 structures that were formerly used for operations, training, printing, communications, storage, commercial, recreation, agriculture, infrastructure, and support activities. The open space and undeveloped areas contain vacant fields, closed landfills, a beach park, wetlands, ravine forests and forests with limestone soils, savanna grassland, and steeply sloped, heavily vegetated areas. There is a commercial quarry operation located on one property. There are also archaeological sites eligible for listing on the National Register of Historic Places on nine of the properties.

Navy designated, in GLUP '94, the names and location numbers for each property. The northern region contains five properties totaling 824 acres: The Federal Aviation Administration (FAA) Housing (N2) property; the Harmon Annex (N3) property; the Marine Drive Utility (N4b) property; the Tamuning Telephone Exchange (N4c) property; and the NAS Officers Housing property (a non-GLUP '94 property) located at former NAS Agana.

The Barrigada region contains four GLUP properties totaling 773 acres: The Barrigada Route 16 (N5a) property; the Barrigada Route 15 (N5b) property; the Barrigada Hawaiian Rock (N5c) property; and the Barrigada Antenna Site (N5d) property.

The central region contains five GLUP properties totaling 953 acres: The Nimitz Hill Enlisted Housing (N10a) property; Nimitz Hill Vacant Lands (N10b) property; the Sasa Valley (N12a) property; the Tenjo Vista (N12b) property; and the Polaris Point (N14) property.

The southern region contains six GLUP properties totaling 271 acres: The New Apra Heights (N15) property; the Route 2A (N16) property; the Affleje/Rizal Beach (N17) property; the Old Apra Heights (N18) property; the Navy Ordnance Annex North (West Parcel) (N19a) property; and the Navy Ordnance Annex North (East Parcel) (N19b) property.

The Environmental Analysis Process

Navy published a Notice Of Intent in the **Federal Register** on April 10, 1998, announcing that Navy would prepare an

EIS for the disposal and reuse of surplus Navy property on Guam. On May 7, 1998, Navy held a public scoping workshop at the Chamorro Village in Agana, Guam; The scoping period concluded on May 26, 1998.

Navy distributed the Draft EIS on May 14, 1999, and commenced a 45-day public review and comment period that was extended until September 15, 1999. Both oral and written comments were received. On August 26, 1999, Navy held a public hearing at the Guam Hilton hotel in Agana.

Navy's responses to the public comments concerning the Draft EIS were incorporated in the Final EIS (FEIS), which was distributed to the public on September 27, 2000, for a review period that concluded on October 23, 2000. Navy received one letter commenting on the FEIS.

Alternatives

In the FEIS, Navy analyzed the environmental impacts of three reuse alternatives. Navy also evaluated a ''No Action'' alternative that considered leaving the property in caretaker status with Navy maintaining the physical condition of the property, providing a security force, and making repairs essential to safety.

In Guam Executive Order No. 96–19, dated July 9, 1996, the Governor of Guam, Carl T.C. Gutierrez, assigned the requirement to develop and implement a reuse plan for the GLUP '94 properties to Guam Economic Development Authority (GEDA). Also in this order, the Governor created the GLUP '94 Reuse Planning Committee to assist GEDA in this task. In October 1996, the Reuse Planning Committee and GEDA prepared the Reuse Plan for GLUP '94 Navy Properties. The Reuse Plan was approved by the Guam Legislature on December 23, 1996, and signed by the Governor of Guam on January 2, 1997.

The Reuse Plan provides general land use descriptions and estimated acreage. The Reuse Plan does not quantify development densities, such as number of and sizes of buildings and structures. The Reuse Plan also does not provide details of the infrastructure and roadway improvements required to support its proposed redevelopment of the properties.

In order to analyze potential impacts on the environment, such as infrastructure, traffic, population change, and socioeconomic conditions, Navy made projections of the future development to estimate the number and size of the buildings and structures at each property that would be consistent with the Reuse Plan. Navy considered roadway expansion, easements, site constraints and used the then-applicable *I Tano-ta Land Use Plan* to estimate development densities.

The *I Tano-ta* provided a framework to manage growth and land development on Guam. The plan provided guidelines for development intensities and zoning code performance standards. The *I Tano-ta* was passed by the Guam Legislature on April 17, 1998, as Guam Public Law 24–171, and went into effect on May 1, 1999. However, the Guam Legislature repealed the law within a few days. Currently, the Governor of Guam has responsibility to act on the future of the *I Tano-ta*. GEDA has indicated that regardless of the status of the *I Tano-ta*, the proposed land uses under the Reuse Plan remain valid.

The Alternative Selected

The selected alternative, identified in the FEIS as the GEDA Recommended Alternative, proposes a mix of land uses for the 20 properties including development of parks, recreational areas, historical and natural resource conservation projects, residential, commercial, resort, industrial, and agricultural land uses, as well as extensive regional roadway improvements.

The FAA Housing (N2) property covers about 698 acres along the coast of the Philippine Sea less than one mile south of Anderson Air Force Base. There were 89 residential units on this property that provided housing for FAA and Navy personnel, and these units were demolished due to irreparable damage from Typhoon Paka in 1997. The remainder of the land contains undeveloped forests with limestone soils. The selected alternative will develop a 128-room resort hotel, a 225-acre 18-hole golf course, and 390 single-family residential units. Conservation and recreational areas will be set aside to protect the natural and cultural resources located on the cliff line.

The Harmon Annex (N3) property, covering seven acres in an undeveloped area south of the FAA Housing property, contains a two-story building (Building 50) and a storage shed. The structures are surrounded by grass fields and paved areas. The selected alternative will develop Building 50 as a community center.

The Marine Drive Utility (N4b) property, covering 25 acres north of Marine Drive (Route 1) and west of Route 3, contains Building 169, a former Stars and Stripes facility. This grassy property is divided by an electric substation and is constrained by utility easements. The selected alternative will develop 150,000 square-feet of space for commercial activities.

The two-acre Tamuning Telephone Exchange (N4c) property is found below the cliff line of Tiyan (NAS Agana) on the south side of Marine Drive. The exchange contains two buildings surrounded by paved areas. The selected alternative plans demolition of the two buildings an development of about 27,000 square feet of space of commercial activities.

The NAS Officers Housing property at Tiyan covers 92 acres on top of a steep bluff. The selected alternative plans demolition of the existing 136 residential units. This alternative will also develop the Navy Post Exchange building as a neighborhood commercial center. The Government of Guam plans to build the Laderan Tiyan Parkway along the property's perimeter, which will provide an alternate access across the Tiyan plateau for the A.B. Won Pat Guam International Airport.

The Barrigada Route 16 (N5a) property, covering 345 acres, is found about one half mile southwest of Tiyan, south of the Naval Communication Areas Master Station Western Pacific Barrigada, and east of the National Guard Armory and P.C. Lujon School. Most of the property is open area for agriculture, athletic fields, and closed landfills. The selected alternative will develop a 42-acre recreational park, a 20-acres sports complex, and 100,000 square feet of space for industrial activities and warehouses. The remainder of the property will support agriculture.

The Barrigada Route 15 (N5b) property, located east of the Barrigada Route 16 parcel and the Navy's Admiral Nimitz Golf Course, covers 358 acres. Most of the land is undeveloped except for a vacant FAA Communications Building used most recently for golf course maintenance equipment storage. This property also contains closed landfills. The selected alternative will build about 1,500 affordable single-family residential units here.

The Barrigada Hawaiian Rock (N5c) property, covering 15 acres, is found east of Route 15 and adjacent to the southeastern corner of the Barrigada Route 15 (N5b) property. Hawaiian Rock Products Corporation operates a quarry facility of 10 acres of the property. The selected alternative will allow the quarry operations to continue. This alternative will also permit development of about 3,000 square feet of space for industrial facilities and warehouses.

The Barrigada Antenna Site (N5d) parcel is found east of Route 15 and covers 55 acres that formerly supported

a Navy transmitter antenna. One building and four homes built by trespassers are located on the property's north end. The selected alternative will demolish these buildings; it will allow for construction of about 220 affordable single-family residential units and 10,000 square feet of space for commercial activities.

The Nimitz Hill Enlisted Housing (N10a) property covers 120 acres in the central region in the municipality of Asan. This property contains 78 residential units, recreational facilities, and a Quonset hut. The enlisted housing was part of the larger United States Naval Station, Nimitz Hill Annex that extended to the southeast. The Department of Defense Education Activity High School and Navy's Flag Circle housing are located to the southwest. The selected alternative will use the existing residential units for affordable and social service housing and it will allow for construction of an additional 80 single- and multi-family residential units here. This alternative will use the recreational facilities and it will preserve the property's steep slopes and dense vegetation.

The Nimitz Hill Vacant Lands (N10b) parcel covers 183 acres south of Route 6 and the Nimitz Hill Enlisted Housing (N10a) property. A Navy Public works Center sewage pumping station is located in the northern part of the property. The selected alternative will develop about 100,000 square feet of space in the northern part of the property for commercial and cultural facilities, such as hotels, shopping centers, theaters, museums and art galleries. In the southern part of the property, this alternative will build about 200 affordable residential townhouses along Mount Alutom Road. The remaining undeveloped forests will be set aside for hiking trails and conservation.

The nine-acre Sasa Valley (N12a) property, found in the central region municipality of Piti, was part of a former Navy tank farm. There are no structures on the property and it is steeply sloped and heavily vegetated. The selected alternative will allow for possible expansion of the Guam Veterans Cemetery located to the north and set aside the remainder of the property for conservation.

The Tenjo Vista (N12b) parcel, covering 559 acres, contains steeply sloped forests and wetlands. The property is located to the east of Route 1 (Marine Drive), the Polaris Point (N14) property, and both Inner and Outer Apra Harbor. There are active and inactive petroleum lines that lie beneath the property; the center of the property was a tank farm. The selected alternative will develop about 3,000 square feet of space for commercial activities along Marine Drive and it will set aside about 480 acres for conservation.

The Polaris Point (N14) property covers 82 acres and is found west of Marine Drive across from the Tenjo Vista (N12b) property. Polaris Point Access Road crosses the property from east to west and provides access to the retained Polaris Point Navy facilities. Outer Apra Harbor lies northeast of the property and Inner Apra Harbor lies southwest. There are wetlands on the northern part of the property. The southern part of the property contains one building and concrete berms remaining from the former Naval Supply Depot drum storage and waste facility. The selected alternative will develop about 50,000 square feet of space for industrial activities and warehouses and it will also preserve the wetlands.

The New Apra Heights (N15) property, covering 102 acres of undeveloped land, is found in the southern region municipality of Santa Rita. Steep slopes and swamp forest wetlands characterize the site. The selected alternative will support the development of a Government of Guam wastewater treatment plant, the widening of Routes 2A and 5, and set aside the remainder of the property for conservation.

The Route 2A (N16) property, covering 15 acres, is found in the southern region in the municipality of Sanata Rita and west of the New Apra Heights (N15) property. The property contains foundations from a demolished building. The selected alternative plans development of about 32,000 square feet of space for commercial and office uses.

The Aflleje/Rizal Beach (N17) property covers 16 acres and is found in the southern region in the municipality of Santa Rita. The property is bounded on the north by the Apra Harbor Naval Complex; on the east by Shoreline Drive (Route 2) and the Public Works Center Guam landfill; on the south by The War in the Pacific National Historical Park; and on the west by Agat Bay. The selected alternative will continue use of the property as a beach park and for conservation.

The Old Apra Heights (N18) property, a linear strip of undeveloped land located east of Cross Island Road (Route 17) in the municipality of Santa Rita, covers 13 acres. The property is traversed by access roads (driveways) that lead to private residence found further to the east. There is a Guam Power Authority electrical substation adjacent to the southern part of the property. The selected alternative will develop industrial activities on about 4.5 acres to support the Guam Power Authority's activities. This alternative will also develop 5,000 square feet of space for small neighborhood businesses on the remaining 8.5 acres.

The Navy Ordnance Annex North (west) (N19a) property covers 50 acres and it consists of undeveloped land with steep slopes and dense vegetation. It is found in the municipality of Santa Rita along Route 5 and surrounds the Tupo Reservoir. The selected alternative uses the property for parks and recreational activities.

The Navy Ordnance Annex North (east) (N19b) property, covering 52 acres, is found directly east of the Navy Ordnance Annex North (west) property on the other side of Route 5. Seventeen vacant residential units are in the southern part of the property, while the northern part of the property is undeveloped. The selected alternative will use the existing residential units and allow for development of about 11,000 square feet of space to support development of a youth camp.

Other Alternatives

Navy analyzed a second ''action'' alternative, described in the FEIS as the Lower Intensity Alternative. This alternative considers development of the GLUP '94 properties with more open space and less construction. Under this scheme, some existing facilities will be renovated rather than expanded, and fewer new buildings will be built.

In general, the Lower Intensity Alternative reduces the build-out proposed by the selected alternative by one-half. It proposes a smaller resort at the FAA Housing parcel, and would not develop a golf course. Residential development is reduced, with most of the residential units to be located in the northern and Barrigada regions. There would be less commercial development in residential neighborhoods. The Lower Intensity Alternative develops about half of the square footage proposed by the selected alternative for commercial facilities and warehouses. This alternative develops no industrial facilities at the Polaris Point (N14) property. Finally, the Guam Veterans Cemetery, the barrigada Sports Complex, and agricultural activities in Barrigada are not expanded.

Navy analyzed a third''action'' alternative, described in the FEIS as the Higher Intensity Alternative. Reuse would be similar to that proposed under the selected alternative, but with an increase in development densities approaching the maximum allowed

under Guam's then-applicable I Tano-ta land use and zoning guidelines. The Higher Intensity Alternative would allow for more new construction and development than that proposed under the selected alternative.

The Higher Intensity Alternative develops a larger resort in the northern region and it builds a 27-hole golf course at the FAA Housing (N2) property. This alternative builds a larger building at the Harmon Annex (N3) property for educational, office or community center activities. The Higher Intensity Alternative also develops larger residential subdivisions on all the properties where housing was proposed under the selected alternative. Compared to the selected alternative, the Higher Intensity Alternative would double the amount of proposed square footage of commercial and industrial facilities on several properties. This alternative also allows the Guam Power Authority to build a base load-generating power plant on the Rizal/Aflleje Beach (N17) property.

Environmental Impacts

Navy analyzed the direct, indirect, and cumulative impacts of each alternative. Effects on soils, geology, topography, hydrology, air quality, land use compatibility, noise, cultural resources, terrestrial biota and habitat, marine environment, roads and traffic, infrastructure, socioeconomic conditions, public services, and public health and safety are discussed in detail in the Environmental Impact Statement.

Significant Effects

The selected alternative will have a significant impact on land use compatibility. The proposed residential development on the Barrigada Route 15 (N5b) property is incompatible with the existing Hawaiian Rock Products Corporation quarry operations located on the Barrigada Hawaiian Rock (N5c) property. These incompatibilities could be mitigated by the use of buffers, screening, setbacks, and noise attenuation measures. This alternative would not have a significant impact on visual resources.

The selected alternative will have significant noise impacts on the new housing to be built on the NAS Officers Housing property and in the Barrigada region. The proposed residential development at the NAS Officers Housing property would be subject to vehicular noise along the proposed Laderan Tiyan Parkway. The proposed residential development in Barrigada would be subject to noise generated by the Hawaiian Rock Products Corporations' quarry operations. The impacts from noise could be mitigated by the use of buffers and noise attenuation measures.

The selected alternative could have a significant unmitigable impact on cultural resources. Pursuant to Section 106 of the National Historic Preservation Act of 1966, 16 U.S.C. 470f, (1994), and its implementing regulations, Protection of Historic Properties, 36 CFR part 800, Navy conducted a cultural resource assessment and determined that nine GLUP properties are known to contain historic sites, structures, or objects that are either listed or eligible for listing on the National Register of Historic Places. These nine properties are FAA Housing (N2), Barrigada Route 15 (N5A), Barrigada Route 16 (N5B), Nimitz Hill Enlisted Housing (N10A), Nimitz Hill Vacant Lands (N10B), Sasa Valley (N12A), Tenjo Vista (N12B), Polaris Point (N14), and Rizal/Aflleje Beach (N17).

Navy has completed consultation with the Advisory Council on Historic Preservation and the Guam Historic Preservation Officer pursuant to Section 106 and its implementing regulations. These consultations identified actions that Navy must take before it conveys GLUP '94 property and actions that the acquiring entities must take to avoid or mitigate adverse impacts on the archaeological sites that are listed or eligible for listing on the National Register. These obligations were set forth in a Programmatic Agreement, dated July 13, 2000, among Navy, the Advisory Council on Historic Preservation, and the Guam Historic Preservation Officer.

Navy will include a protective deed covenant in the conveyance documents for all historic properties. The provisions in the deed covenant will require that the acquiring entities: Obtain the express written permission of the Guam Historic Preservation Officer prior to undertaking actions that would disturb the ground of a historic site, make reasonable efforts to prevent vandalism or other disturbances, and permit the Guam Historic Preservation Officer the right to inspect the archaeological site at all reasonable times.

Under terms of the Programmatic Agreement, all projects sponsored, funded or authorized by the Government of Guam or GEDA that have the potential to affect historic properties will undergo review in accordance with Title 21 Guam Code Annotated, Chapter 76, Historical Objects and Sites (1994). As the selected alternative will develop several properties containing historic sites, the Guam Historic Preservation Officer's permission must be obtained and archaeological data recovery or other protective measures may be required.

The selected alternative will have significant impacts on traffic and circulation. By the year 2010, traffic volumes on affected roadway segments will increase from as little as one percent to as much as 40 percent on heavily affected routes. Implementation of this alternative will impact key intersections in the northern, Barrigada, and southern regions of Guam. With the exception of one northern region intersection at Routes 1 and 16, these impacts could be mitigated by the installation of traffic signals and turning lanes, realignment of intersection approaches, widening of roads, and increasing alternative transportation programs.

The selected alternative will have a significant cumulative impact on the demand for electricity. The demand for electricity by this alternative and other planned developments on Guam would require the Guam Power Authority to develop new electrical capacity earlier than previously projected. The selected alternative will upgrade or replace the electrical distribution systems at each property during redevelopment.

The selected alternative will have a significant impact on schools. This alternative's proposed residential development will substantially increase the number of students in the northern, Barrigada, and southern regions of the island. Local schools in Guam are already at capacity and in some cases the schools are over capacity. The Reuse Plan does not propose to build new schools on the GLUP properties.

The selected alternative will have significant cumulative impacts on Guam's health care, police, fire protection, and civil defense services. The new residential development in the northern and Barrigada regions proposed by the selected alternative and other planned developments on Guam will substantially increase the demand for these public services.

Less Than Significant Impacts of Disposal and Reuse

The selected alternatives will not have a significant impact on soils, geology, or topography. The Guam Environmental Protection Agency requires soil erosion control measures for new construction that will minimize soil erosion. Guam is located in a highly active seismic region. New construction activities will be required to meet current building codes governing seismic safety.

The selected alternative will not have a significant impact on storm water runoff and drainage patterns, surface and groundwater quality, or aquifer recharge potential. This alternative will alter drainage patterns and substantially increase the quantity of storm water runoff on eight properties (Harmon Annex, Marine Drive Utility, Tamuning Telephone Exchange, NAS Officer Housing, Barrigada Route 15, Antenna Site, Nimitz Hill Enlisted Housing, and Nmitz Hill Vacant Lands), with the largest increase (48 percent) at the proposed Barrigada Route 15 residential development. Runoff will be controlled by measures imposed by the Guam Environmental Protection Agency. Compliance with regulatory requirements, Best Management Practices, and spill prevention plans will minimize the potential for future groundwater contamination. The selected alternative will not have a significant impact on aquifer recharge potential.

Six GLUP '94 properties contain flood hazard zones: Tamuning Telephone Exchange, Barrigada Route 16, Tenjo Vista, Polaris Point, Route 2A, and Aflleje/Rizal Beach. Development in flood zones must comply with Guam's floodplain management regulations. Additionally, in accordance with Executive Order 11988, Floodplain Management, 3 CFR 117 (1978), Navy will place a notice in the conveyance document that describes those uses that are restricted under Federal and local floodplain regulations.

Five properties contain wetlands: Barrigada Route 16, Barrigada Route 15, Tenjo Vista, Polaris Point, and New Apra Heights. Compliance with Federal and local regulations governing development in wetlands will prevent significant impacts. Additionally, in accordance with Executive Order 11990, Protection of Wetlands, 3 CFR 121 (1978), Navy will place a notice in the conveyance document that describes those uses that are restricted under Federal and local wetland regulations.

The selected alternative will not have a significant impact on air quality. Compliance with the regulatory requirements that control emissions, such as the Clean Air Act, 42 U.S.C. 7401–7671q (1994), and Guam's Air Pollution Control Standards and Regulations, Guam Public Law 24–322 (1998), will prevent significant impacts from stationary sources. Emissions from vehicular sources are not expected to exceed Federal regulations; therefore, no significant impacts on air quality are anticipated.

The selected alternative will not have a significant impact on terrestrial biota and habitats. Navy consulted with the United States Fish and Wildlife Service under section 7 of the Endangered Species Act of 1973, 16 U.S.C. 1536 (1994). In a letter dated January 18, 2000, the Fish and Wildlife Service concurred with Navy's determination that the proposed disposal and reuse, as outlined in the Reuse plan, of the surplus Navy properties is not likely to adversely affect the following Federally-listed endangered species on Guam: the fire tree (*Serianthes nelsonii*), Mariana crow (*Corvus kubayi*), Mariana fruit bat (*Pteropus mariannus mariannus*), Mariana common moorhen (*Gallinula chloropus guami*), and the Federally-listed threatened green sea turtle (*Chelonia mydas*).

The acquiring entities will be required to prepare Environmental Protection Plans (EPPs) pursuant to the Water Pollution Control Act, Title 10, Guam Annotated Code, Part 2, Ch. 47. EPPs are management plans that identify protective measures and constraints for individual projects that must be submitted to Guam environmental Protection Agency for review and approval. The Government of Guam and the Fish and Wildlife Service executed a Memorandum of Understanding (MOU) to establish and maintain a program for the conservation of Federally listed threatened and endangered species.

The selected alternative will not have significant impact on marine resources or Federally listed threatened or endangered marine species. Navy engaged in consultation with the National Marine Fisheries Service under section 7 of the Endangered Species Act. In a letter dated December 23, 1999, the National Marine Fisheries Service concurred that the proposed disposal and reuse of the surplus Navy properties would not likely adversely affect Federally listed threatened or endangered marine species.

The selected alternative will not have significant impacts on potable water, wastewater collection and treatment facilities, and the capacity for solid waste disposal. The Guam Waterworks Authority has projected that the island will have an excess capacity of 10 million gallons per day (mgd) of potable water in 2010. The projected demand for potable water under the selected alternative will be about 1.5 mgd, which is below the available excess capacity of 10 mgd.

There is adequate capacity available at the three wastewater treatment plants (the Northern District Wastewater Treatment Plant (WWTP), the Agana WWTP, and the Agat WWTP) that are planned to service the GLUP properties. The selected alternative will upgrade or replace the wastewater and treatment distribution systems at each property during redevelopment.

The selected alternative assumed that new solid waste facilities would be developed because the Ordot Landfill, which has no excess capacity, will close. The amount of solid waste generated by this alternative is projected to be less than three percent of the total municipal solid waste generated on Guam in the year 2008. Guam's Integrated Solid Waste Management Plan recommends the reuse, recovery, and recycling of solid waste to lessen the impacts on solid waste facilities.

The selected alternative will not have significant adverse socioeconomic impacts. This alternative will create over 2,000 jobs that will generate a payroll of about $32 million per year. It is expected that residents of Guam will fill the new commercial and industrial jobs.

The selected alternative will not have a significant impact on the environment as a result of the use of petroleum products or the use or generation of hazardous substances by the acquiring entity. Hazardous materials used and hazardous wastes generated by the Reuse Plan will be managed in accordance with Federal and local laws and regulations.

Implementation of the selected alternative will not have an impact on public health and safety at the GLUP '94 properties. Navy will inform future property owners about the environmental condition of the property and may, when appropriate, include restrictions, notifications, or covenants in deeds to ensure the protection of human health and the environment in light of the intended use of the property. After the property is conveyed, Navy will assist the acquiring entities in the removal and disposal of newly discovered unexploded ordnance to the extent required by then-applicable federal laws and regulations and then-applicable Navy and DoD policies, subject to Congressional authority and the availability of appropriated funds.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 3 CFR 859 (1995), requires that Navy determine whether any low income and minority populations will experience disproportionately high and adverse human health or environmental effects from the proposed action. Navy analyzed the impacts on low income and minority populations pursuant to Executive Order 12898. The FEIS addressed the potential human health,

socioeconomic, and environmental effects of the various proposed alternatives. Minority and low-income populations residing within the regions where the GLUP properties are located will not be disproportionately affected.

Navy also analyzed the impacts on children pursuant to Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, 3 CFR 198 (1998). Under the selected alternative, the largest concentration of children would be present in the residential, educational, and recreational areas. The selected alternative would not pose any disproportionate environmental health or safety risks to children.

Mitigation

Implementation of Navy's decision to dispose of the surplus property does not require Navy to implement any mitigation measures. Navy will take certain actions to implement existing agreements and regulations. These actions are treated as agreements or regulatory requirements rather than mitigation.

The FEIS identified and discussed those actions that will be necessary to minimize or avoid the impacts associated with the reuse and redevelopment of the GLUP '94 Navy surplus property. The acquiring entities, under direction of Federal and local agencies with regulatory authority over protected resources, will be responsible for implementing necessary mitigation measures following disposal of the property.

Comments Received on the Final EIS

Navy received comments on the FEIS from the Earthjustice Legal Defense Fund, a private organization writing on behalf of the Center for Biological Diversity. All of the substantive comments concerned issues already discussed in the FEIS.

Regulations Governing the Disposal Decision

Since the proposed action contemplates a disposal under the Defense Base Closure and Realignment Act of 1990 (DBCRA), Public Law 101–510, 10 U.S.C. 2687 note (1994), Navy's decision was based upon the environmental analysis in the FEIS and application of the standards set forth in the DBCRA, the Federal Property Management Regulations, 41 CFR part 101–47, and the Department of Defense Rule on Revitalizing Base Closure Communities and Community Assistance, 32 CFR parts 174 and 175.

Conclusion

The Local Redevelopment Authority has determined in its Reuse Plan that the GLUP '94 surplus Navy properties should be used for various purposes including parks and recreational, historical and natural resource conservation, residential, commercial, resort, industrial, and agricultural activities. The property's location, physical characteristics, existing infrastructure, as well as current uses of adjacent property make it appropriate for the proposed uses.

Although the ''No Action'' Alternative has less potential for causing adverse environmental impacts, this alternative would not result in more efficient Navy operations or lower operational costs. Additionally, it would not foster local economic redevelopment and would not create new jobs.

The acquiring entities, under the direction of Federal and local agencies with regulatory authority over protected resources, will be responsible for adopting practicable means to avoid or minimize environmental harm that may result from implementing the Reuse Plan.

Accordingly, Navy will dispose of the GLUP '94 surplus Navy property in a manner that is consistent with the Government of Guam's Reuse Plan for the property.

Dated: March 2, 2001.

Duncan Holaday,

Deputy Assistant Secretary, (Installations and Facilities).

[FR Doc. 01–6047 Filed 3–9–01; 8:45 am]

BILLING CODE 3810–FF–M

DEPARTMENT OF ENERGY

[Docket Nos. FE C&E 01–48, C&E 01–49, C&E 01–50 and C&E 01–51, Certification Notice—197]

Office of Fossil Energy; Notice of Filings of Coal Capability of GenPower McIntosh, LLC, FPLE Rhode Island State Energy, L.P., Freestone Power Generation, L.P., and Carville Energy, LLC, Powerplant and Industrial Fuel Use Act

AGENCY: Office of Fossil Energy, DOE.

ACTION: Notice of filing.

SUMMARY: GenPower McIntosh, LLC, FPLE Rhode Island State Energy, L.P., Freestone Power Generation, L.P., and Carville Energy, LLC, submitted coal capability self-certifications pursuant to section 201 of the Powerplant and Industrial Fuel Use Act of 1978, as amended.

ADDRESSES: Copies of self-certification filings are available for public inspection, upon request, in the Office of Coal & Power Im/Ex, Fossil Energy, Room 4G–039, FE–27, Forrestal Building, 1000 Independence Avenue, SW., Washington, DC 20585.

FOR FURTHER INFORMATION CONTACT: Ellen Russell at (202) 586–9624

SUPPLEMENTARY INFORMATION: Title II of the Powerplant and Industrial Fuel Use Act of 1978 (FUA), as amended (42 U.S.C. 8301 *et seq.*), provides that no new baseload electric powerplant may be constructed or operated without the capability to use coal or another alternate fuel as a primary energy source. In order to meet the requirement of coal capability, the owner or operator of such facilities proposing to use natural gas or petroleum as its primary energy source shall certify, pursuant to FUA section 201(d), to the Secretary of Energy prior to construction, or prior to operation as a base load powerplant, that such powerplant has the capability to use coal or another alternate fuel. Such certification establishes compliance with section 201(a) as of the date filed with the Department of Energy. The Secretary is required to publish a notice in the **Federal Register** that a certification has been filed. The following owners/operators of the proposed new baseload powerplants have filed a self-certification in accordance with section 201(d).

Owner: GenPower McIntosh, LLC, (C&E 01–48).

Operator: General Electric International, Inc.

Location: Effingham County, Georgia.

Plant Configuration: Combined-cycle.

Capacity: 529 MW.

Fuel: Natural gas.

Purchasing Entities: Wholesale power market.

In-Service Date: January 2004.

Owner: Rhode Island State Energy Partners, L.P., (C&E 01–49).

Operator: FPLE Rhode Island State Energy, L.P.

Location: Johnston, Rhode Island.

Plant Configuration: Combined-cycle.

Capacity: 535 MW.

Fuel: Natural gas.

Purchasing Entities: The New England wholesale energy market..

In-Service Date: July 1, 2002.

Owner: Freestone Power Generation, L.P., (C&E 01–50).

Operator: Freestone Power Generation, L.P.

Location: Freestone County, Texas.

Plant Configuration: Combined-cycle.

Capacity: 1,050 MW.

Fuel: Natural gas.

THE UNITED STATES AIR FORCE

INSTALLATION RESTORATION PROGRAM

FINAL

SECOND
FIVE-YEAR REVIEW OF RECORD OF DECISION
FOR
MARBO ANNEX OPERABLE UNIT

ANDERSEN AIR FORCE BASE, GUAM

August 2009

THE UNITED STATES AIR FORCE INSTALLATION RESTORATION PROGRAM

FINAL

SECOND FIVE-YEAR REVIEW OF RECORD OF DECISION FOR MARBO ANNEX OPERABLE UNIT

ANDERSEN AIR FORCE BASE, GUAM

August 2009

Approved By:

MICHAEL M. MONTGOMERY Date
Assistant Director, Federal Facilities and Site Cleanup Branch
U.S. Environmental Protection Agency, Region 9

Second Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from Waste LAN)*: MARBO Annex Operable Unit

EPA ID *(from Waste LAN)*: CERCLIS Identification No. GU6571999519

Region: Pacific Ocean	**State:** Guam	**City/County:** Yigo

SITE STATUS

NPL status: **X** Final Deleted Other (specify) _____

Remediation status (choose all that apply): Under Construction **X** Operating **X** Complete

Multiple OUs?* **X** Yes: MARBO Annex; Site-wide No	**Construction completion date**: 17 July 1998

Has site been put into reuse? Yes **X** No

REVIEW STATUS

Lead agency: EPA State Tribe **X** Other Federal Agency: United States Air Force

Author(s) name: Toraj Ghofrani, P.E. and Scott Moncrief, P.G.

Author(s) title: Environmental Engineer and Deputy Program Manager	**Author(s) affiliation:** USAF Contractor

Review period:** 02 March 2004 to 02 March 2009

Date(s) of site inspection: 09 / 09 / 2008

Type of review: Post-SARA Pre-SARA NPL-Removal only
Non-NPL Remedial Action Site **X** NPL State/Tribe-lead
Regional Discretion

Review number: 1 (first) **X** 2 (second) 3 (third) other (specify)

Triggering Action:
Actual RA Onsite Construction at OU # _____ Actual RA Start at OU # _
Construction completion Previous Five-Year Review Report
X Other (specify): USEPA concurrence with the first five-year review.

Triggering action date *(from WasteLAN)*: 06 July 2004

Due date *(five years after triggering action date)*: 06 July 2009

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Second Five-Year Review Summary Form, Continued

Site 20

Issues

- Vehicle access, pig wallows, and small trees continue to threaten the structural integrity of the *Soil Cover*. The *Soil Cover* is subject to frequent island natural disasters such as typhoons and earthquakes that can damage the structural integrity of the *Soil Cover*.

Recommendations and Follow-up Actions

- Continue O&M program, with annual inspections to check the structural integrity of the *Soil Cover*, drainage channels, and the riprap. Maintenance should occur at least semi-annually to mow and control brush and trees. Sword grass at the site should not be mowed lower than four inches above the ground, as shorter grass cover are more susceptible to erosion.

Protectiveness Statement

Based on the review of existing data and site inspections, the remedy at Site 20 is protective of human health and the environment because exposure pathways that could result in unacceptable risks are being controlled.

Sites 22, 23, 24, 37, and 38

As recommended in the first five-year review for the MARBO Annex OU, Sites 22, 23, 24, 37, and 38 were not included in the second five-year review on the basis that no new source of contamination was found during the second five-year review period.

Sites 41, 42, 43

No interim removal actions have been implemented at Sites 41, 42, or 43, and the selection of the final remedies is pending a ROD. A RI/FS was completed for these sites in 2008 and identified *Soil Removal (Unrestricted Land Use)* as the preferred remedial alternative for all three sites. It is anticipated that the *Soil Removal* alternative would provide clean closure with minimal administrative effort and no associated long-term monitoring costs.

MARBO Annex Groundwater

Issues

- LTGM data indicates TCE concentration are increasing in production well MW-1.

Recommendations and Follow-up Actions

- Continue to monitor sampling data from this well and share with Andersen AFB potable water supply facility managers.

Protectiveness Statement

The remedy for MARBO Annex groundwater is protective of human health and the environment because exposure pathways that could result in unacceptable risks are being controlled.

Other Comments

A ROD Amendment is planned to be completed for MARBO Annex groundwater by December 2009. The ROD Amendment will include a TI Waiver for the requirement of achieving MCLs in the aquifer. The amended remedy for MARBO Annex groundwater is *Long-Term Groundwater Monitoring with Contingency for Wellhead Treatment.* The ROD Amendment removes natural attenuation as a component of the remedy. The change in remedy will have no effect on the protectiveness.

EXECUTIVE SUMMARY

This is the second five-year review to evaluate if remedies that were implemented for the Record of Decision (ROD) for the Marianas Bonins Command (MARBO) Annex Operable Unit (OU) are still protective of human health and the environment. The five-year review has been completed in accordance with the United States Environmental Protection Agency (USEPA) Comprehensive Five-Year Review Guidance, June 2001, USEPA 540-R-01-007, and Office of Solid Waste and Emergency Response No. 9355.77-03B-P. To complete this second five-year review of the Final MARBO Annex OU ROD, dated July 1998, all relevant activities that have been performed and data and documents that have been generated since the implementation of remedial action have been reviewed.

The first five-year review recommended that, unless a new source of contamination was found during the second five-year review period, Sites 22, 23, 24, 37, and 38 should not be discussed in this second five-year review document. Based on a records search (Appendix A) and the site inspection in September 2008, no new source of contamination was found at Sites 22, 23, 24, 37, and 38. Accordingly, only a brief mention of these sites is included in this second five-year review of the MARBO Annex OU ROD.

Site 20 is classified as an *Operating Remedial Action* (RA), as the RA has been implemented but residual COCs have been left in place at concentrations that do not allow for unrestricted use of or unlimited access to the land. Since completion of the first five-year review, the quarterly inspection reports were the only data generated with regard to Site 20. The remedy at Site 20 is protective of human health and the environment since exposure pathways that could result in unacceptable risks are being controlled as intended by the ROD.

The land and resource use at Site 20 has not changed. With COC-impacted soil beneath the soil cover, the future land use at Site 20 remains restricted. The site and vicinity are still inactive and therefore the exposure assumptions for the human health risk assessment (HHRA) and ecological risk assessment (ERA) are still valid. No new human health or ecological exposure pathways or receptors have been identified. The toxicity data and USEPA residential Regional Screening Levels (RSLs) for Site 20 contaminants of concern remain unchanged or less stringent than the 1995 residential Preliminary Remediation Goals (PRGs) therefore rendering no changes in the 1995 HHRA results or the effectiveness of the selected remedy. Based on the site inspection, the integrity of the soil cover is still intact. However, as long as the site is accessible, the structural integrity of the soil cover may be compromised due to vehicle traffic, small trees, and pig wallows. Therefore, annual inspections and periodic maintenance of soil cover should be performed to ensure continued protection of human health or environment. Site 20 should be included in the next five-year review.

Based on human health and ecological risk assessments, MARBO Annex Groundwater is impacted by trichloroethene (TCE) and tetrachloroethene (PCE) in deep groundwater samples collected from monitoring wells IRP-29 and IRP-31 at concentrations above their respective MCLs (5 micrograms per Liter). Monitoring data indicate impacted groundwater zones exist between approximately 400 feet ground surface (bgs) to 470 feet bgs (TCE plume) and between 420 feet bgs and 490 feet bgs (PCE plume). The exact source of TCE and PCE remains unknown. The 1998

ROD selected remedial action for MARBO Annex Groundwater was *Natural Attenuation with Wellhead Treatment*, which was to eliminate the risk of direct exposure to TCE and PCE. Institutional controls (ICs) were a component of the remedy and consisted of Land Use Restrictions and Long-Term Groundwater Monitoring.

During the first five-year review, the remedy was found to be functioning as intended in the 1998 ROD and was still protective of human health and the environment. The remedy for MARBO Annex groundwater is protective of human health and the environment since exposure pathways that could result in unacceptable risks are being controlled.

During the second five-year review period, natural attenuation was determined to be ineffective in remediating the TCE and PCE in MARBO Annex Groundwater. Monitoring data suggested that neither physical (e.g., dilution) nor biological processes (e.g., reductive dehalogenation) were operating to significantly attenuate TCE or PCE in the deep part of the freshwater lens. As a result, a ROD Amendment was prepared for MARBO Annex Groundwater which included a Technical Impracticability Waiver which waives the Applicable or Relevant and Appropriate Requirement of meeting the MCL in the aquifer. The ROD Amendment is planned to be signed by December 2009. The change in remedy has no effect on the site protectiveness. MARBO Annex Groundwater should be included in the next five-year review.

Sites 41, 42, and 43 are located in the MARBO Annex; however, they are included in the Site-wide OU. The Remedial Investigation/Feasibility Study (RI/FS) document for these sites is currently under agency review. All three sites contain COCs, for which the FS indicates *Soil Removal* as the preferred remedial alternative (RA). Under this RA the COCs would be cleaned up and there would be no restrictions on future land use at any of the three sites (including residential land use). A ROD for these sites has not yet been completed. Sites 41, 42, and 43 should be included in the next five year review.

The next and third five-year review of the MARBO Annex OU ROD is due five years from the USEPA's approval of this review, and should include review of the remedies for Sites 20, 41, 42, and 43, and for MARBO Annex Groundwater. The related review period will be from 02 March 2009 to 02 March 2014.

3.0 BACKGROUND

3.1 General Background

3.1.1 Overview of the First Five-Year Review

The first five-year review of the MARBO Annex OU ROD included an evaluation of the post-ROD status of six IRP sites (Sites 20, 22, 23, 24, 37, and 38), and the groundwater beneath the MARBO Annex (Figure 1-2). The ROD review also evaluated the status of three additional IRP sites pending final remedy selection that were part of another OU but were located with in the boundaries of the MARBO Annex. The review organized the evaluated sites with respect to their media of concern, i.e. soil-related COCs and groundwater-related COCs.

3.1.1.1 Evaluated Sites Referred for No Additional Five-Year Reviews

As no new sources of contamination were identified during the document review and site inspection conducted for the first five-year review of Sites 22, 23, 24, 37, and 38, future five-year reviews were not recommended.

3.1.1.2 Evaluated Sites Subject to Additional Five-Year Reviews

Five-year reviews must be performed for Site 20 and the MARBO Annex groundwater because their selected remedies are considered *Operating RAs*, as they have been implemented but leave residual COCs in place at concentrations that do not allow for unrestricted use or unlimited access.

The selected remedy for Site 20 consisted of a *Soil Cover with Institutional Controls (ICs)*. During the first five-year review site inspection of Site 20, there were concerns regarding pig wallowing activity and small tree roots at the site that jeopardized the integrity of the *Soil Cover* in protecting the human health and the environment (EA, 2004). A regular quarterly Operations and Maintenance (O&M) program was therefore recommended to verify and maintain the integrity of the *Soil Cover* at Site 20. As part of the quarterly O&M program, "event driven" inspections were recommended to verify the integrity of the *Soil Cover* after natural disasters, such as typhoons or earthquakes. Furthermore it was recommended that signs be posted at the boundaries of the site restricting intrusive activities that would damage the *Soil Cover*, such as driving trucks, trenching, or excavating (EA, 2004). The integrity of the soil cover at Site 20 has been evaluated during the second five-year review through site inspection and the review of quarterly O&M records, and the findings are presented in this document.

The 1998 ROD selected remedy for the MARBO Annex groundwater consisted of *Natural Attenuation with Institutional Controls* to achieve the remediation goal of decreasing trichloroethene (TCE) and tetrachloroethene (PCE) concentrations in the aquifer to levels below Maximum Contaminant Level (MCL). Through physical processes of dispersion and dilution, the timeframe to achieve cleanup goals (MCLs) was estimated at 10 to 40 years, assuming a continued source of PCE and TCE did not exist (EA, 1998a). Supplemental to the natural attenuation were three ICs that included:

- **Land Use Restrictions** to monitor and restrict groundwater access in areas impacted by TCE/PCE,
- **Groundwater Monitoring** to monitor TCE/PCE and confirm the stability of TCE/PCE plumes in the MARBO Annex, and
- **Existing Wellhead Treatment** to ensure public health risk is within the acceptable range at existing USAF production wells.

During the first five-year review of the MARBO Annex OU ROD, it was determined that the overall timeframe for the groundwater remedy to effectively reduce the concentrations of the TCE/PCE to below MCLs, may take longer than 40 years (EA, 2004). At the conclusion of the first five-year review, it was recommended that if, during the second five-year review period, monitored natural attenuation (MNA) did not appear to be effectively reducing TCE and PCE concentrations in MARBO Annex Groundwater, the MARBO Annex OU ROD would be amended to either specify an active remediation method or a TI waiver to achieve the applicable or relevant and appropriate requirement (ARAR) of meeting the drinking water MCL in the aquifer (EA, 2004).

A ROD Amendment for the MARBO Annex groundwater remedy will be completed by December 2009 (EA and Metcalf & Eddy [EA/M&E], 2009a). The amended remedy is *Long-Term Groundwater Monitoring with Contingency for Wellhead Treatment*, with a TI Waiver which waives the requirement of achieving MCLs in the aquifer.

3.1.1.3 Evaluated Sites Pending Final Remedy Selection

Sites 41, 42, and 43 (formerly AOCs 54, 55, and 56, respectively) located in the MARBO Annex were designated as part of the Site-wide OU (previously referred to as the Basewide OU) and were not included in the MARBO Annex OU ROD. These sites were evaluated in the first five-year review because they are located within the MARBO Annex; however, a final remedy was not selected. A ROD is currently under development. Because a final remedy has still not been selected under the Site-wide OU, an update of the status of these sites is included in this review.

3.1.2 Environmental Setting of MARBO Annex

MARBO Annex OU is located on a broad, uplifted limestone plateau that is underlain by volcanic rocks (Figure 3-1). The limestone plateau includes numerous sinkholes and ranges in elevation from 300 to over 500 feet above mean sea level (msl). The sinkholes are very porous and provide rapid infiltration of surface water to the underlying fresh water aquifer, rendering no permanent surface water bodies at the MARBO Annex.

The surface of the limestone plateau is interrupted by two volcanic peaks, Mount Santa Rosa and Mataguac Hill, which are located northeast and north of the MARBO Annex, respectively (Figure 3-1). These low-permeability volcanic outcrops extend into the subsurface to form a lateral barrier that directs the groundwater flow towards the Tumon Bay (Figure 3-1). According to groundwater monitoring data (EA, 2008b), the groundwater at the MARBO Annex is encountered at approximately 281 to 400 feet below ground surface (bgs). Based on the 2001

Guam Water Quality Standards, the fresh or saline groundwater at the MARBO Annex is categorized as a G-1 Resource Zone for potable water (Guam EPA, 2001). Consequently, any wastewater discharges within the G-1 Resource Zone is regarded as tributary to the potential potable groundwater supply and must be free of pollutants.

Water extracted from production wells in the MARBO Annex supplies Andersen AFB. Currently, seven of the nine Andersen AFB production wells (MW-series wells) located on the MARBO Annex (Figure 1-2) are used for water production, and they can yield upwards of approximately 3.0 million gallons per day (mgd), to meet the average Base consumption of 2.0 mgd (EA, 2008c).

Although there are housing developments (Wilson Homes, Contingency Barracks, and the Andersen South Housing Area) within the MARBO Annex, they have been unoccupied since 1996 (Figure 1-2). The nearest populated areas are in the nearby villages of Dededo located approximately 50 feet west, Yigo located approximately 150 feet north, and Mangilao located approximately 25 feet east of the MARBO Annex. As of 2000, the combined population of Dededo and Yigo was approximately 62,000, which comprises approximately 40 percent of the island's population (United States Census Bureau, 2001). Dispersed, low-density populations characterize the area between these villages and the MARBO Annex.

MARBO Annex is located in the interior of Guam, away from the coastal cliff line and marine environments. Therefore, the MARBO Annex is not within the range of the critical habitats of threatened or endangered species such as the Mariana crow (*Corvus kubaryi*), the Mariana fruit bat (*Pteropus mariannus*), the Fire tree (*Serianthes nelsonii*), and the Ufa-Halomtano tree (*Heritiera longipetiolata*) (Department of Aquatic and Wildlife Resources, 1988).

3.1.3 MARBO Annex Land and Resource Use

Presently, MARBO Annex properties are inactive. According to the Andersen AFB archives, the MARBO Annex was developed for military housing, warehouses, industrial support facilities, and operational facilities. From 1944 through 1950, MARBO Annex was under the jurisdiction of the Naval Government of Guam. Following the Organic Act of 1950, the United States Government took control of the MARBO Annex and administration was transferred to the United States Navy (USN). By 1956 all operations at the MARBO Annex had ceased, except for the USN Power Plant and the water production wells. On 25 June 1958, the USAF assumed control of the MARBO Annex. Based on review of available Real Estate Property records at Andersen AFB, all temporary buildings on the MARBO Annex were removed prior to June 1960 (EA, 2004).

Subsequent to finalizing the MARBO Annex OU ROD in 1998, various land parcels have been transferred or have been proposed for transfer to other Federal or territorial agencies (EA, 1998a). Two parcels, covering 81 acres and 395 acres, respectively, have been transferred to the Government of Guam (Figure 3-2). The 81-acre parcel contains an active Guam Waterworks Authority (GWA) production well (Y-20) and included the planned construction of a high school. The 231-acre parcel contains a fire station and an active GWA production well (Y-19), and future land use plans include construction of a police station. Another 1,569-acre parcel was

offered to the United States Marines, for training facilities, however in 2003 the Marines indicated that they were no longer interested in acquiring the property. The USAF is currently considering alternate plans for future disposition of this parcel. Another 224-acre parcel is being retained by the USAF for a variety of purposes. An area near Site 20 is being retained to ensure ICs are maintained in compliance with the MARBO Annex OU ROD. Several linked areas are being retained to support the USAF groundwater production and distribution system at the MARBO Annex. Two areas (the MARBO Laundry and the Army and Air Force Exchange Service Warehouse) are being retained for USAF warehousing activities. Currently, the MARBO Annex consists of approximately 2,010 acres of land.

3.2 Background of Sites Included in this Five-Year Review

3.2.1 Background of Site 20

3.2.1.1 General Description of Site 20

Site 20 is classified as an *Operating RA*, as the RA has been implemented but residual COCs have been left in place at concentrations that do not allow for unrestricted use of or unlimited access to the land. An *Operating RA* may require management in perpetuity.

Site 20 is located in the south-central portion of the MARBO Annex (Figure 1-2). Site 20 is an abandoned quarry that was partially filled with waste and covered with soil and vegetation. The site was divided into two broad areas of concern with respect to the potential for contamination. Area A included the *Buried Waste Area* and consisted of approximately 1.84 acres of fill, averaging 10.8 feet in thickness, and a small area covered with 10 empty, deteriorated drum remnants. Area B included numerous mounds of soil, some of which were covered with construction debris, municipal trash, and metal debris (EA, 1998b).

3.2.1.2 Former, Current, and Future Land Use at Site 20

As previously discussed, Site 20 was formerly used as quarry and was subsequently an area where waste materials were disposed. Access is currently restricted and ICs have been placed on the site to restrict future use because COCs at the site pose potentially unacceptable risks to human health. There are currently no plans to modify existing land use; however, any future land use at Site 20 must include provisions for mitigating exposure of future human receptors to COCs remaining onsite.

3.2.1.3 History of Contamination at Site 20

According to the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA), Area A had surface soil contamination that required a RA. The COCs identified at Site 20 included lead, pesticides (4,4'- dichlorodiphenyldichloroethene [4,4-DDE], 4,4-dichlorodiphenyltrichloroethene [4,4-DDT], dieldrin, alpha chlordane, and gamma chlordane), and the polychlorinated biphenyl (PCB) Aroclor 1260, as shown in Table 3-1 (EA, 1997). The calculated exposure point concentrations (EPCs) that were used for the HHRA in the MARBO Annex RI/FS (ICF, 1996) are presented in Table 3-1 along with their respective

Background Threshold Value (BTV) and the 1995 residential Preliminary Remediation Goal (PRG) (USEPA, 1995):

Table 3-1. Comparison of Site 20 EPCs to 1995 Residential PRGs and BTVs used for the HHRA.

COC	EPC (mg/kg)	1995 Residential PRG (mg/kg)	BTV (mg/kg)
4,4'-DDE	6.7	1.3	NA
4,4'-DDT	6.2	1.3	NA
Dieldrin	0.12	0.028	NA
Alpha chlordane	0.44	0.34	NA
Gamma chlordane	0.38	0.34	NA
Aroclor 1260	4.4	0.066*	NA
Lead	3,604	400	166

* = PRG is based on total PCB concentration; prior to 2000 there was no PRG for Aroclor 1260.
BTV = Background Threshold Value
COC = contaminant of concern
EPC = Exposure Point Concentration
mg/kg = milligrams per kilogram
NA = not applicable; BTV is applicable only for inorganic compounds (metals).
PRG = Preliminary Remediation Goal

3.2.1.4 Initial Response at Site 20

The COCs detected in Site 20 soils were determined to be relatively stable and immobile; therefore, no immediate response was required.

3.2.1.5 Basis for Taking Action

The basis for taking action at Site 20 was excessive cancer to residential receptors (2×10^{-4}) and non-cancer (HI=4) risks associated with elevated concentrations of Aroclor 1260, pesticides, and lead in surface and subsurface soils in the *Buried Waste Area* (Figure 3-3). Though the condition of the COC-impacted soil did not require an immediate initial response, an RA was proposed for the site to protect the future human and ecological receptors.

3.2.2 Background of Site 41

3.2.2.1 General Description of Site 41

Site 41 is located adjacent to Marine Drive (Figure 1-2), covers approximately 8 acres, and is flat to gently sloping. Site 41 includes the foundations (concrete pads) of former operational support buildings such as a tool shop, a carpenter shop, a generator shop, a heavy vehicle shop, and vehicle maintenance shops. In addition, a vehicle maintenance pit associated with the former heavy vehicle shop was located at the site. Due to past operations at the former shops, potentially hazardous materials were suspected to have been discharged to the soils.

3.2.2.2 Current and Future Land Use at Site 41

Currently, the site is inactive and there are no plans to modify existing land use, however, redevelopment of this area is likely at some future date given the limited available land on Guam.

3.2.2.3 History of Contamination at Site 41

Based on the analysis of 105 surface soil samples (including 10 duplicate samples), lead was detected at concentrations ranging from 19.6 to 53,300 milligrams per kilogram (mg/kg) (EA, 2008a). At the time the HHRA was performed, 2004 USEPA Region 9 PRGs were used to conduct the risk screening; however, they have since been superseded by 2009 USEPA Regional Screening Levels (RSLs) (USEPA, 2004; USEPA, 2009). For lead, the residential and industrial RSLs are equivalent to the corresponding PRGs; 400 mg/kg and 800 mg/kg, respectively. The average concentration of lead in surface soil samples (1,257 mg/kg) exceeds both residential and industrial RSLs, as shown in Table 3-2. Therefore, lead in surface soil was identified as a COC, posing potentially unacceptable risks to future residential receptors and current industrial workers at the site.

Table 3-2. Comparison of Site 41 EPCs to Residential RSLs and BTVs.

COC	EPC (mg/kg)	2009 Residential RSL (mg/kg)	2009 Industrial RSL (mg/kg)	BTV (mg/kg)
Lead	1,257	400	800	166

BTV = Background Threshold Value
EPC = Exposure Point Concentration
mg/kg = milligrams per kilogram
RSL = Regional Screening Level

Lead was not detected in any subsurface soil samples at concentrations exceeding the residential PRG (400 mg/kg).

3.2.2.4 Initial Response at Site 41

The COC detected in Site 41 soils (lead) was determined to be relatively stable and immobile in the weathered limestone soils; therefore, no immediate response was required.

3.2.2.5 Basis for Taking Action at Site 41

The future use of Site 41 is undetermined; therefore, the site may be potentially developed for future residential or commercial use. The basis for taking action at Site 41 was related to elevated concentrations of lead in surface soil (Figure 3-4). There are no toxicity values published by USEPA to quantify cancer risks from lead using the standard HHRA methodologies; therefore, no HHRA was conducted for Site 41. The USEPA Region 9 residential PRG and RSL were based on the output of the Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model for residential exposures. According to USEPA guidance, lead is assessed through the use of the blood-lead model, which uses the average concentration of lead in soil.

Though the condition of the lead-impacted soil did not require an immediate initial response, an RA has been proposed for the site to protect future human and ecological receptors.

3.2.3 Background of Site 42

3.2.3.1 General Description of Site 42

Site 42 is located approximately 900 feet south of Marine drive (Figure 1-2), covers approximately 1.5 acres, and is flat to gently sloping. Site 42 is a former gas station with two associated rusted aboveground storage tanks (ASTs). Due to past operations, discharge of fuel constituents to the soil may have occurred.

3.2.3.2 Current and Future Land Use at Site 42

Currently, the site is inactive and there are no plans to modify existing land use; however, redevelopment of this area is likely at some future date given the limited available land on Guam.

3.2.3.3 History of Contamination at Site 42

Based on the analysis of 26 surface soil samples (including two duplicate samples), lead was detected at concentrations ranging from 25.6 to 3,370 mg/kg (EA, 2008a). At the time the HHRA was performed, 2004 USEPA Region 9 PRGs were used to conduct the risk screening; however, they have since been superseded by 2009 USEPA RSLs. For lead, the residential and industrial RSLs are equivalent to the corresponding PRGs; 400 mg/kg and 800 mg/kg, respectively. The average concentration of lead in surface soil samples (485 mg/kg) exceeds the residential RSL, as shown in Table 3-3. Therefore, lead in surface soil was identified as a COC, posing potentially unacceptable risks to future residential receptors at the site.

Table 3-3. Comparison of Site 42 EPCs to Residential RSLs and BTVs.

COC	EPC (mg/kg)	2009 Residential RSL (mg/kg)	BTV (mg/kg)
Lead	485	400	166

BTV = Background Threshold Value
EPC = Exposure Point Concentration
mg/kg = milligrams per kilogram
RSL = Regional Screening Level

Lead was not detected in any of the subsurface soil samples at concentrations exceeding the residential RSL (400 mg/kg).

3.2.3.4 Initial Response at Site 42

The COC detected in Site 42 soils were determined to be relatively stable and immobile in the weathered limestone soils; therefore, no immediate response was required.

3.2.3.5 Basis for Taking Action at Site 42

The future use of Site 42 is undetermined; therefore, the site may be potentially developed for future residential or commercial use. The basis for taking action at Site 42 was related to elevated concentrations of lead in surface soil (Figure 3-5). There are no toxicity values published by USEPA to quantify cancer risks from lead using the standard HHRA methodologies. As previously discussed, lead is assessed through the use of the blood-lead model, which uses the average concentration of lead in soil compared to the results of the IEUBK Lead Model for residential exposures. Though the condition of the lead-impacted soil did not require an immediate initial response, an RA has been proposed for the site to protect future human and ecological receptors.

3.2.4 Background of Site 43

3.2.4.1 General Description of Site 43

Site 43 is located west of the former MARBO Laundry (Figure 1-2), covers approximately 35 acres, and is flat to gently sloping. Site 43 includes the foundations (concrete pads) of former operational support buildings including a welding shop, battery shop, concrete vault, machine shop, carpenter shop, motor pool garage, paint shop, warehouses, generator shed, grease stand, steam shop, supply shed, preventative maintenance shop, sign paint shop, refrigerator shop, plumbing shop, and electric shop. Due to past operations at the shops, potentially hazardous materials were suspected to have been discharged at the site.

3.2.4.2 Current and Future Land Use at Site 43

Currently, the site is inactive and there are no plans to modify existing land use; however, redevelopment of this area is likely at some future date given the limited available land on Guam.

3.2.4.3 History of Contamination at Site 43

Based on the analysis of 173 surface soil samples (including 5 duplicates) and 33 subsurface soil samples (including 4 duplicates), arsenic, cadmium, lead, Aroclor 1254, and benzo(a)pyrene, in surface soil, and arsenic and vanadium, in subsurface soil, were identified as COCs (Table 3-4) (EA, 2008a). These COCs were detected at concentrations exceeding the residential PRGs, and or BTVs, posing potentially unacceptable risks to future residential receptors and current industrial workers at the site.

At the time the HHRA was performed, 2004 USEPA Region 9 PRGs were used to conduct the risk screening; however, they have since been superseded by 2009 USEPA RSLs. The residential RSL for benzo(a)pyrene is more stringent (0.015 mg/kg) than the residential PRG, and the residential RSLs for cadmium and vanadium are less stringent (70 and 390 mg/kg, respectively) than their respective residential PRGs (Table 3-4). These changes are not significant enough to alter the conclusions of the RI/FS for Site 43, as most of these COCs are collocated with other COCs that are targeted for removal.

Table 3-4. Comparison of Site 43 EPCs to Residential PRGs, Residential RSLs, and BTVs.

COC	EPC (mg/kg)	2004 Residential PRG (mg/kg)	2009 Residential RSL (mg/kg)	BTV (mg/kg)
Surface Soil				
Arsenic	116	0.39	0.39	62
Cadmium	226	37	70	6.5
Lead	9,390	400	400	166
Aroclor 1254	31	0.22	0.22	NA
Benzo(a)pyrene	83	0.06	0.015	NA
Subsurface Soil				
Arsenic	64	0.39	0.39	62
Vanadium	225	78	390	206

BTV = Background Threshold Value
EPC = Exposure Point Concentration
mg/kg = milligrams per kilogram
NA = not applicable; BTV is applicable only for inorganic compounds (metals).
PRG = Preliminary Remediation Goal
RSL = Regional Screening Level

3.2.4.4 Initial Response at Site 43

The COCs detected in Site 43 soil samples were determined to be relatively stable and immobile in the weathered limestone soils; therefore, no immediate response was required.

3.2.4.5 Basis for Taking Action at Site 43

The future use of Site 43 is undetermined; therefore, the site may be potentially developed for future residential or commercial use. The basis for taking action at Site 43 was related to arsenic, cadmium, Aroclor 1254, and benzo(a)pyrene in surface soil, and arsenic and vanadium in subsurface soil. These COCs posed either potentially unacceptable non-cancer and/or cancer risks to current industrial workers and future residential receptors (Figures 3-6 through 3-9). Lead in surface soil also posed potentially unacceptable risks to current industrial workers and future residential receptors.

3.2.5 Background of MARBO Annex Groundwater

3.2.5.1 Description for MARBO Annex Groundwater

Since 1989, the quality of the MARBO Annex groundwater has been evaluated at least semi-annually through a network of groundwater monitoring points (EA, 2008b). The Long-Term Groundwater Monitoring (LTGM) Program for Andersen AFB was initiated in October 1995 to ensure compliance with CERCLA, RCRA, Clean Water Act, Safe Drinking Water Act, and all ARARs, with the goals of:

- establishing baseline groundwater elevation and water quality data at monitoring and production wells,
- evaluating the baseline data and identifying critical sampling locations,

- installing new monitoring wells in those critical sampling locations, and
- determining modifications to monitoring points, monitoring frequency, and analytical methods.

Since the LTGM Program was initiated in 1995, 26 rounds of groundwater sampling have been conducted at the MARBO Annex. Currently, 18 monitoring and three production wells are sampled as part of the LTGM Program at the MARBO OU. Nine of the monitoring wells and the three production wells are "shallow" wells that are screened across the top of the freshwater lens. Five of the monitoring wells are "deep" wells that are screened near the base of the freshwater lens. The "deep" wells are screened at depths approximately 90 to 100 feet lower than the screened intervals of the nearby "shallow" wells, to monitor water quality near the base of the freshwater lens. Two of the monitoring wells are open-boreholes that fully penetrate the freshwater lens. The two Guam Power Authority monitoring wells are fully screened across the freshwater lens. The analytical results for monitoring points in the LTGM Program are provided in Appendix B.

The northern half of Guam exhibits characteristics of a Simple Carbonate Island, a Carbonate-Cover Island, and a Composite Island according to the type of Carbonate Island Karst Model (Mylroie et al., 2001). As presented in Figure 3-1, the two volcanic peaks of Mount Santa Rosa and Mataguac Hill create a channel that directs the groundwater flow toward Tumon Bay.

Groundwater is the principal source of drinking water for Guam and is the source of freshwater for other uses. Currently, the karst limestone of the Northern Guam Lens (NGL) produces approximately 40 million gallons of freshwater per day for public use (EA, 2008c). Even though Guam receives approximately 100 inches of rainfall per year, surface water does not exist on northern Guam due to the highly permeable, eogenetic, karst limestone.

The hydrogeology model of the NGL is complex due to 400 feet of karstic geologic features with secondary dissolution channelization and water production pumping. Groundwater velocities can vary significantly and hydraulic conductivities of up to 20,000 feet per day have been observed at MARBO Annex (ICF, 1997). The vast majority of rainfall percolates through the vadose zone and creates a freshwater lens that floats atop a transition zone underlain by marine water due to density effects. The freshwater lens is approximately 100 feet thick and subject to highly conducive groundwater flow. A brackish transition zone (mixing zone) of approximately 20 feet thick exists between the freshwater lens and the underlying marine water (EA, 2008c).

The rapid infiltrating recharge to the upper portion of the freshwater lens propagates quickly (within weeks to months) to coastal discharge areas via seeps and/or large-scale dissolution features (EA, 2008c). The rapidly infiltrating recharge has created strongly oxidized groundwater conditions throughout the fresh water lens, as evidenced by shallow and deep dissolved oxygen concentrations generally ranging from 5 to 8 milligrams per Liter (mg/L) and oxidation-reduction potential ranging from 100 to 500 millivolts (EA, 2008c). The strong lateral flow component that is observed in the upper portion of the freshwater lens is not evident in the basal portion of the lens, based on contaminant trends.

Based on the extensive data-set collected over the course of the MARBO Annex LTGM Program, it is apparent that the elevation and thickness of the freshwater lens vary in response to rapid flush of short-term rainfall events, moderate-term seasonal rainfall and monsoonal wind effects on sea level, and long-term fluctuations due to El Nino/Southern Oscillation events and eustatic sea level rise. The short- and long-term rainfall events have lead to cyclic variation on the thickness of the groundwater lens, based on cyclical chloride level observations (20 and 200 mg/L) in deep groundwater monitoring wells (EA, 2008c).

3.2.5.2 Former, Current, and Future Land Use above MARBO Annex Groundwater

As previously discussed, land use at the MARBO Annex consisted of residential housing, military warehousing, and industrial support facilities. Currently, land use comprising the general area above the PCE- and TCE-impacted portion of the MARBO Annex OU groundwater aquifer is inactive. As part of the selected remedy in the MARBO Annex OU ROD, ICs restrict property deeds pertaining to the installation of water supply wells on properties affected by PCE- and TCE-impacted groundwater (Figure 3-10) (EA, 1998a). Re-development of this area is likely at some future date given the limited available land on Guam.

3.2.5.3 History of Contamination for MARBO Annex Groundwater

Based on historical groundwater monitoring results, TCE and PCE are identified as COCs in MARBO Annex groundwater. TCE has been detected in deep groundwater samples collected from GPA-1, GPA-2, and MW-2 (456, 458, and 368 feet bgs, respectively) at concentrations above the MCL of 5 micrograms per Liter (µg/L). PCE has been detected in deep groundwater samples collected from IRP-29 (475 feet bgs), at a concentration above the MCL of 5 µg/L. Both TCE and PCE have been detected in deep groundwater samples collected from IRP-31 (456 feet bgs), at concentrations above their respective MCLs of 5 µg/L (Figure 3-11). With the exception of IRP-14 (382 feet bgs), TCE and PCE have either been non-detect or detected at concentrations below the MCL in all shallow monitoring wells. For IRP-14, PCE concentrations in groundwater samples have shown a historic decrease from concentrations that were initially above the MCL of 5 µg/L to concentrations that are consistently below half the MCL. The exact source of TCE and PCE remains unknown based on the completed investigation of all potential TCE and PCE sources in MARBO Annex soil (EA, 2008a; EA, 2008c).

3.2.5.4 Initial Response for MARBO Annex Groundwater

Although the TCE and PCE plumes have been considered relatively immobile, the COCs detected in the MARBO Annex groundwater poses potential human health risks via groundwater production to the municipal water supply. The ROD for MARBO Annex OU, included long term groundwater monitoring of monitoring and production wells and wellhead treatment for three production wells in the MARBO Annex (MW-1, MW-2, and MW-3), until TCE and/or PCE concentrations were consistently below MCLs. Wellhead treatment on production well MW-2 was implemented as stated in the remedy; however, MW-2 was taken out of production in 1998 when the air stripping tower used to treat the water was fouling due to frequent carbonate build-up and the well was no longer required to meet demand. Wellhead treatment was therefore

discontinued at MW-2. Production wells MW-1 and MW-3 continue to produce potable water and have never required wellhead treatment.

3.2.5.5 Basis for Taking Action for MARBO Annex Groundwater

The basis for taking action for MARBO Annex groundwater was to protect human health, in accordance with the Remedial Action Objectives (RAOs) through implementation of ICs, against the presence of TCE and PCE in MARBO Annex groundwater at concentrations exceeding MCLs.

Agent Orange on Guam Affidavit

My name is Brian Moyer and my date of birth is March 31, 1955 and I was born in Detroit, Michigan. When I was 18 years old after graduation from high school I enlisted in the United States Marine Corps after going through Basic Training at MCRD San Diego, California and more training at infantry Training School in Camp Pendleton. It was back to MCRD San Diego to attend Sea Duty Indoctrination School were we trained on ships protocol and ships security issues with regards to nuclear weapons.

After completion of Sea Duty School I was ordered to Marine Detachment USS Proteus AS-19 which was home ported at Apra Harbor, Guam and arrived at my duty station in February 1974 and rotated back to the US mainland in February 1976. The crew from the Proteus also participated in Operation New Life and sailors and marines from the Proteus worked in the Orote Pointe refugee camp that housed thousands of Vietnamese national who fled from South Vietnam when Saigon fell to North Vietnam in April of 1975.

When we got time to get away from our duties on the Proteus we would go to various points on Guam such as Talafofo Falls, swimming at Natural Pools, snorkeling in any of the many bays around Guam. We would also go exploring in the jungle and go up to the top of Mount Lamlam. On one of our adventures of exploring we ended up at the above ground fuel lines that ran from Apra Harbor which is in the lower central, southern part of Guam all the way to Andersen AFB which is at the far north end of Guam.

Three other marines and I had to climb over the double stacked pipelines to keep going on our walk through the jungle but what I remember is that there was no thick dense vegetation growing there and I wondered how that was maintained. I found out from M/Sgt Leroy Foster in conversation approximately six months ago that he sprayed herbicides (Agent Orange) along the fuel line route for ten years on Guam.

I also was sent to Andersen AFB, Guam to attend a firefighting school in the first three months of my arrival to Guam and the Proteus were we were taught by Air Force staff how to extinguish fires with fire extinguishers all the way up to entering and fighting fires in a concrete block house that burning tires in it. The small fire were set ablaze in split 55 gallon oil drums and we put out the fires with a regular ABC rated fire extinguishers. I later found out that the fuel that was lit on fire for us to extinguish was the remnants of the fuel and Agent Orange mixture from the 750 gallon tank trailer that M/Sgt Foster used for vegetation control around Andersen AFB, Guam.

I also remember being told by one of the instructors at the Fire Fighting School that there was a "slight contamination problem with one of the wells and that if the water in the drinking fountain smelled or tasted like aviation fuel not to drink it." I was getting a drink and could taste and smell something like gasoline and spit it out and if I recall correctly the training staff had someone bring coolers of water out to the training site.

One of my other duties on the Proteus was "driver" and I was issued a military driver's license and I would end up driving up to Andersen AFB at least twice on average four times a month to pick up new personal or drop off out going personal who were returning to the mainland. I remember driving

through the main gate at Andersen AFB and looking to my left and seeing all these densely packed trees that stood about six to eight feet tall which appeared to be impenetrable.

The thing that sticks the most in my mind is that those dense growing trees were all brown in color and there were no leaves on them which didn't make sense because Guam is a tropical island approximately 400 mile north of the Equator and everything is green on Guam because of the climate and rainfall. I thought maybe the trees were intentionally burned and then Air force staff would come through with a bulldozer and plow everything away from the security fences. I found out many years later that was where M/Sgt Foster had sprayed Agent Orange type herbicides.

One other thing that I recall about going through Andersen AFB whether to go to the terminal or going to Tarague Beach is that the area that I described by the main gate fence line never "greened up" never ever did see that thick tangle of trees grow leaves on them.

Another marine named James Kuiken who resides in Vienna, Virginia and I also walked across a big field where there was hardly any grass growing to go look and climb around inside a gutted out B-52 Bomber at Andersen AFB, Guam. I found that that field had also been sprayed with herbicides by M/Sgt Foster.

At Apra Harbor I remember seeing a work party of sailors from the Proteus walking along the inner fence line and picking up trash and litter and a small trailer spray rig attached to small tractor moving along the fence line and out on the perimeter areas were the tree line started. I don't know who was driving the tractor or what was being sprayed but again years later a former crew member would state that it was Agent Orange being deployed.

I swear this affidavit is accurate and true to the best of my memory and if I am telling any lies, falsehoods or fabrications that I will be held accountable in a court of law in any jurisdiction of the United States and it Territories.

Respectfully Submitted on 24TH of January, 2017

Brian Moyer X

Signed + Sworn to me this Day January 24th 2017

KAREN D. ROBINSON
Commission # FF 245627
Expires September 4, 2019
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United States Government Accountability Office

Report to Congressional Addressees

November 2018

AGENT ORANGE

Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations

GAO-19-24

November 2018

AGENT ORANGE

Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations

GAO Highlights

Highlights of GAO-19-24, a report to congressional addressees

Why GAO Did This Study

The tactical herbicide Agent Orange was first produced in 1964, and some 12 million gallons were shipped from U.S. ports to Southeast Asia from 1965 to 1970. DOD suspended its use in 1970 and incinerated remaining stockpiles at sea in 1977. Congress has expressed long-standing interest in the effects of Agent Orange exposure.

The House report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that GAO review the government's handling of Agent Orange on Guam. This report examines (1) information the federal government has about the procurement, distribution, use, and disposition of Agent Orange; (2) DOD and VA efforts to make information about where Agent Orange and its components were tested and stored available; and (3) challenges associated with Agent Orange testing. GAO reviewed agency policies, documents, and available archival records that GAO identified; interviewed DOD, VA, and other agency officials; and met with a non-generalizable sample of 38 veterans and a veterans service organization.

What GAO Recommends

GAO is making six recommendations, including that DOD develop a process for updating its list of Agent Orange testing and storage locations, and that DOD and VA develop a process for coordinating the communication of information on where Agent Orange was known to have been present. DOD concurred with four recommendations. VA concurred with one recommendation and non-concurred with one recommendation.

View GAO-19-24. For more information, contact Brian Lepore at (202) 512-4523 or leporeb@gao.gov

What GAO Found

Available shipment documentation indicates that nearly all of the Agent Orange procured was either used in U.S. military operations in Southeast Asia, used for testing, damaged, or destroyed. However, some records are incomplete, such as shipment documentation and logbooks that identify ports where vessels stopped on the way to Southeast Asia. GAO obtained and reviewed shipment documentation for over 12.1 million of the 13.9 million gallons of Agent Orange procured by the Department of Defense (DOD). GAO reviewed logbooks for 96 percent (152 of 158) of those shipments and identified that vessels stopped at various ports on the way to Southeast Asia, including at least one vessel carrying Agent Orange that stopped at Guam. While the logbooks GAO reviewed identify when vessels left various ports as they traveled to and from Vietnam, they do not show whether and how much cargo was loaded or unloaded at those ports.

DOD's official list of herbicide testing and storage locations outside of Vietnam that is posted on the Department of Veterans Affairs' (VA) website is inaccurate and incomplete. For example, the list lacks clarity in descriptive information and omits both testing and storage locations and additional time periods covered by testing events. Also, the list has not been updated in over a decade, though DOD and VA have obtained reports on its shortcomings since 2006. Both DOD and VA communicate with veterans in response to inquiries about Agent Orange, but some veterans GAO met with expressed confusion regarding how to obtain information on potential exposure. DOD officials acknowledged this confusion and stated that veterans are contacting multiple agencies to obtain such information. However, DOD and VA have not established a formal process for coordinating on how best to communicate information to veterans and the public regarding the presence of Agent Orange outside of Vietnam. Without a reliable list with complete and accurate information and a formal process for DOD and VA to coordinate on communicating this information, veterans and the public do not have quality information about the full extent of locations where Agent Orange was present and where exposure could potentially have occurred.

Challenges exist with testing for Agent Orange today due to degradation of the herbicide's two chemical components and a potential for sources of contamination other than the herbicide. According to scientific research, the half-life (average time for components to decrease by half of the original amount) of Agent Orange's two chemical components—n-butyl 2,4-D and n-butyl 2,4,5-T—in soil can range from several days to many months, depending on conditions. The suggested half-life of the dioxin 2,3,7,8-TCDD—a by-product of the 2,4,5-T manufacturing process—is much longer, but there are multiple sources of dioxins, including the burning of wood and waste. DOD and the U.S. and Guam Environmental Protection Agencies are testing for the acid form of the components of Agent Orange at Andersen Air Force Base on Guam. While acknowledging the low probability of conclusively identifying the components of Agent Orange on Guam, DOD has made a decision to move forward with testing to address veterans' and the public's concerns, and it expects to complete the updates for the sampling and analysis plan, field sampling, analysis, and reporting in early 2019.

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DD	2,3,7,8-tetrachlorodibenzo-p-dioxin
	2,4-dichlorophenoxyacetic acid
	2,4,5-trichlorophenoxyacetic acid
	Department of Defense
	Environmental Protection Agency
	Federal Insecticide, Fungicide, and Rodenticide Act
	Department of Veterans Affairs

November 15, 2018

Congressional Addressees

From the 1940s to the 1970s, the U.S. government developed and tested tactical herbicides in the United States and abroad. These tactical herbicides were known as "rainbow herbicides" and included Orange, Purple, Pink, Green, Blue, and White.[1] Tactical herbicides were intended for use by the U.S. military in the conflicts in Korea and Vietnam, but were not intended for use on U.S. military installations. During the mid-1960s, U.S. chemical companies manufactured and shipped large quantities of tactical herbicides to Vietnam for use by the U.S. military to eliminate enemy cover and destroy the enemy's crops. The tactical herbicide designated "Orange"—later known as Agent Orange—was first produced in 1964, and approximately 12.1 million gallons were shipped to Southeast Asia from several U.S. ports between 1965 and 1970.[2] The Department of Defense (DOD) suspended the use of Agent Orange in Vietnam in 1970 and incinerated remaining stockpiles at sea in 1977.

In 1984, the U.S. Environmental Protection Agency (U.S. EPA) determined that a form of dioxin that is a by-product of the manufacturing process of one of the two components of Agent Orange had been associated with a number of health effects, including cancer, in exposed animals and in humans, including children.[3] The Agent Orange Act of 1991, as amended, established a presumption of service connection for certain diseases manifesting in veterans by way of exposure to herbicide agents while deployed in the Republic of Vietnam at any time beginning January 9, 1962, and ending on May 7, 1975.[4] The act also required that

[1]Consistent with House Report 115-200 including a provision for us to conduct this review, this report focuses primarily on the tactical herbicide Agent Orange and its components. Tactical herbicides were developed specifically by DOD to be used in combat operations.

[2]In this report, we use the term "Agent Orange" following the language in our prior reports. However, DOD officials use the term "Herbicide Orange" in referring to the same agent.

[3]Environmental Protection Agency, *Health Effects Assessment for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin*, EPA-540/1-86-044, September 1984. As we describe later in this report, there are many sources of dioxin contamination in addition to the dioxin that was formed as the by-product of the manufacturing process for one of the components of Agent Orange.

[4]Pub. L. No. 102-4, § 2 (1991) (codified as amended at 38 U.S.C. § 1116). Service connection is a factor the Department of Veterans Affairs considers in determining whether to grant disability compensation to a veteran.

whenever the Secretary of Veterans Affairs determined that a positive association existed between humans' exposure to an herbicide agent and the occurrence of a disease in humans, the Secretary shall prescribe regulations providing that a presumption of service connection was warranted for that disease.[5] The Department of Veterans Affairs (VA) has developed procedures to assess veterans' claims for disability compensation for exposure to Agent Orange and provides on its website a list of locations where tactical herbicides were thought to be tested, stored, or destroyed. Both DOD and U.S. EPA have conducted some remediation of dioxin-contaminated sites where these herbicides were known to be present in the United States.[6]

There has been long-standing congressional interest in and concern about the effects of exposure to herbicides such as Agent Orange. Although DOD policy restricted the domestic use of tactical herbicides, the House Armed Services Committee has expressed concern that additional exposures to Agent Orange may have occurred on Guam.[7] House Report 115–200 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that we review the government's handling of Agent Orange on Guam. In response to both this provision and a separate request letter, this report examines (1) the extent to which the federal government has information about the procurement, distribution, use, and disposition of Agent Orange or its components at locations in the United States and its territories, including Guam; (2) the extent to which DOD and VA have complete and accurate information about where Agent Orange and its components were tested and stored and communicated this information to veterans and the public; and (3) challenges associated with testing for Agent Orange.

We scoped this review to include locations where Agent Orange or its components were tested, distributed, and stored in the United States and its territories.[8] For each objective, we reviewed agency documents and

[5]The requirement to prescribe regulations when the Secretary determines such an association exists ceased to be in effect on September 30, 2015. 38 U.S.C. § 1116(e).

[6]Over the past decade, Congress has also appropriated funds for the remediation of dioxin-contaminated sites in Vietnam.

[7]H.R. Rep. No. 115-200, at 113-114 (2017).

[8]For this review we are including only veterans; we are excluding DOD civilians or the civilian populations at those locations where potential herbicide exposure could have occurred.

policies; interviewed officials from DOD, VA, and U.S. EPA, as well as from the government of Guam; and met with some veterans and a veterans service organization.

For objective one, we obtained through archival research available shipping and agency records, including U.S. military correspondence and logistics reports, and we reviewed these documents to trace the federal government's procurement, distribution, use, and disposition of Agent Orange and its components. We analyzed this documentation, hereinafter referred to as shipment documentation, to prepare summary information on the quantities of Agent Orange and the vessels that carried the shipments.[9] We used this information to obtain official Navy and merchant vessel logbooks—hereinafter referred to as logbooks—to the extent that they were available, to identify the routes the vessels took from U.S. ports to Vietnam and back, and to identify any port calls made en route.[10]

For objective two, we obtained documentation from DOD and analyzed archives search reports and other environmental studies for several U.S. installations to identify additional locations where Agent Orange or its components were tested and stored in the United States and its territories. We compared the results with information DOD has provided to VA for public dissemination on testing and storage locations of tactical herbicides in the United States and its territories. We also compared the results with DOD policies for conducting records research and responding to inquiries related to past environmental exposures. We reviewed the process by which DOD and VA communicate with veterans, to include providing information about where Agent Orange was tested and stored. We compared the communication process with DOD's policy on assessing long-term health risks and with VA's process for determining benefits based on veterans' claims, and we assessed the extent to which DOD and VA had responded to reports related to the information on locations that were posted on VA's website.

[9]We used the best available records to identify the amounts of Agent Orange we refer to in this report, but these figures should be seen as estimates.

[10]For those voyages for which we were not able to locate logbooks, we obtained copies of the vessels' shipping articles. Shipping articles are the articles of agreement between the captain of a ship and the seamen with respect to wages, length of time for which they are shipped, and related matters. They provide the dates and locations for different personnel actions but do not necessarily identify every port of sailing for a voyage, and thus do not provide complete documentation of the route taken by a vessel.

For objectives one and two, we held six discussion sessions with a non-generalizable sample of veterans—four sessions in person in Hawaii and Guam, and two sessions that were moderated via telephone from Washington, D.C.—to discuss veterans' experiences specific to Agent Orange. A total of 38 individuals attended the sessions, which ranged from 1 to 10 participants per session. During the sessions, we discussed information that individuals received from DOD, VA, and other federal agencies about any links between exposure to herbicides and negative health effects, or the potential that they could have been exposed to Agent Orange or its components at locations where Agent Orange was manufactured, transported, stored, used, or destroyed.[11] We also asked the veterans whether they believed they had been exposed to Agent Orange in Vietnam, Guam, or another location, and, if so, to describe the circumstances of the exposure. At the discussion sessions in Hawaii and Guam, we also requested participants to complete a short questionnaire about their military service and their recollections about experiences with herbicides during their military service.

For objective three, we reviewed scientific literature and agency documents regarding the degradation and sources of the components of Agent Orange and an associated dioxin contaminant. This review included documents from the Agency for Toxic Substances and Disease Registry and reports and protocols from U.S. EPA, the World Health Organization, and the Centers for Disease Control and Prevention. We also reviewed the draft and final plan for testing for the presence of the components of Agent Orange at three sites at Andersen Air Force Base on Guam. We compared the information outlined in the testing plan with scientific literature on the environmental fate of the components of Agent Orange and other Agent Orange testing methodologies. We conducted a site visit to Guam and visited the three sites where testing was subsequently done. We also spoke with cognizant officials at DOD, U.S. EPA, and Guam EPA about testing for the components of Agent Orange. Further details on our scope and methodology can be found in appendix I.

[11]DOD, VA, and Guam EPA officials worked to schedule three discussion sessions for participants to attend on Guam, but only two of those sessions had attendees present. Thus, for the purposes of this report, we are using only the two Guam-located discussion sessions in which attendees were present. In addition to veterans, a few civilians, including spouses accompanying some veterans, were present at some discussion sessions. We handled any comments these individuals provided separately from those provided by veterans.

We conducted this performance audit from May 2017 through November 2018 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Composition of Agent Orange

Agent Orange is composed of two different chemical components—the n-butyl ester forms of 2,4-dichlorophenoxyacetic acid (hereinafter referred to as n-butyl 2,4-D) and 2,4,5-trichlorophenoxyacetic acid (hereinafter referred to as n-butyl 2,4,5-T)—that are manufactured separately and then combined to form the tactical herbicide.[12] The U.S. EPA has determined that there was not adequate data either to support or to refute that the acid or ester forms of 2,4-D can cause cancer in humans.[13] In 2015 the International Agency for Research on Cancer classified 2,4-D as possibly causing cancer to humans, since there was inadequate evidence in humans and limited evidence in experimental animals.[14] According to an Institute of Medicine report, information on the toxic effects of 2,4,5-T alone is sparse.[15] However, in the 2,4,5-T manufacturing process, the dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin (hereinafter referred to as

[12]Agent Orange is composed of 50 percent 2,4-D in its n-butyl ester form and 50 percent 2,4,5-T in its n-butyl ester form. The ester form of the chemicals breaks down into 2,4-D and 2,4,5-T when it undergoes a reaction with water. The specifications for Agent Orange were revised later in the 1960s to include specifications for Orange II (50 percent n-butyl 2,4-D and 50 percent isooctyl ester 2,4,5-T) and Orange III (66.6 percent n-butyl 2,4-D and 33.3 percent n-butyl 2,4,5-T).

[13]Environmental Protection Agency, reregistration eligibility decision for 2,4-D, June 2005.

[14]International Agency for Research on Cancer, *DDT*, *Lindane, and 2,4-D, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, vol.113 (Lyon, France: June 2-9, 2015).

[15]The National Academies of Sciences, Engineering, and Medicine, *Veterans and Agent Orange: Update 2014* (Washington, D.C.: 2016) [hereinafter NASEM, 2016].

2,3,7,8-TCDD) is formed, particularly when the reaction temperature is excessive.[16]

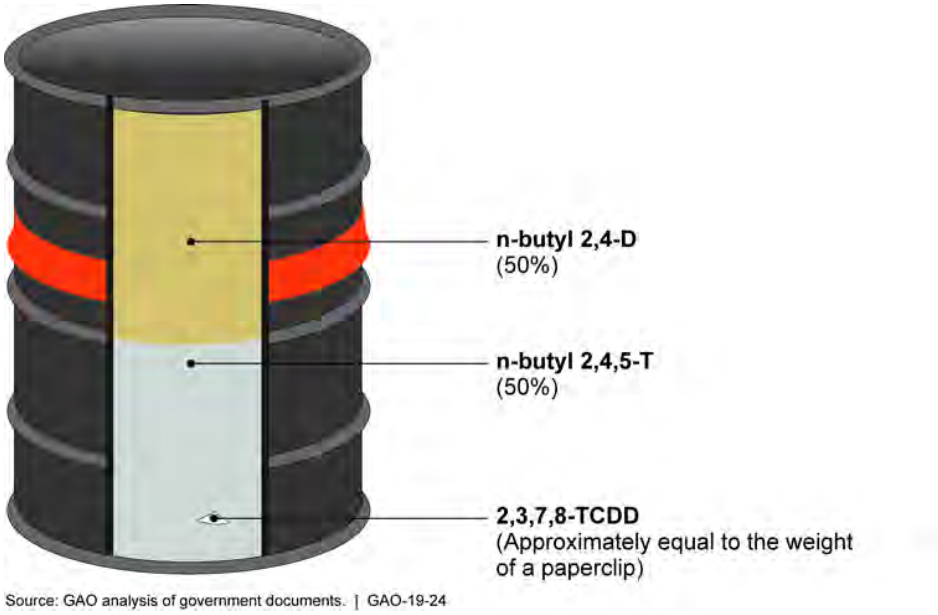
The World Health Organization has determined that dioxins are highly toxic and can cause a variety of illnesses, including reproductive and developmental problems and damage to the immune system. The World Health Organization reports that 2,3,7,8-TCDD, a human carcinogen, is the most toxic dioxin-related compound.[17] Moreover, according to the National Academies of Sciences, Engineering, and Medicine report, 2,3,7,8-TCDD has been shown by researchers to be very toxic in animals.[18] Figure 1 depicts the proportion of the components of Agent Orange and the amount of 2,3,7,8-TCDD contamination that would be present in an average 55-gallon drum.

[16]According to the World Health Organization, dioxins are a group of chemically related compounds that are persistent environmental pollutants. Dioxins can be released into the environment through a variety of means, to include the burning of materials such as wood and waste, the combustion of fossil fuels, and certain industrial activities. According to the U.S. EPA, in the 2,4,5-T manufacturing process, a dioxin compound (2,3,7,8-TCDD) is formed, particularly when the reaction temperature is excessive, most commonly at temperatures above 160º Celsius.

[17]World Health Organization, *Exposure to Dioxins and Dioxin-Like Substances: A Major Public Health Concern* (Geneva, Switzerland: 2010); National Toxicology Program, *14th Report on Carcinogens*, U.S. Department of Health and Human Services, 2016.

[18]NASEM, 2016.

Figure 1: Composition of Agent Orange



Source: GAO analysis of government documents. | GAO-19-24

Note: Agent Orange is composed of a mixture of 50 percent 2,4-dichlorophenoxyacetic acid (2,4-D) in its n-butyl ester form and 50 percent 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in its n-butyl ester form, plus a contaminant, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). This figure shows 50 percent of each chemical as if separated, but in actuality the chemicals would be mixed together and packaged in 55-gallon drums. According to archival sources, a drum of Agent Orange weighed approximately 600 pounds.

Agent Orange Origins and Life Cycle

The Crops Division of the U.S. Army Chemical Corps was established at Camp Detrick (now Fort Detrick), Maryland, in 1943 to conduct anti-crop research, development, and engineering. In 1944 the Crops Division was given the mission of developing chemical compounds to destroy or reduce the value of crops. These chemical compounds were intended to rapidly clear vegetation in military operations in order to eliminate concealed enemy positions, improve air and ground observations, and destroy or reduce the value of crops. Initial field trials at Camp Detrick were small-scale efforts involving test plots typically 6 by 18 feet in size, and the herbicides being tested were usually applied using a hand sprayer. Over the following three decades, DOD collaborated with the U.S. Department of Agriculture, universities, and private companies to conduct testing activities ranging from laboratory experiments to spray

tests of larger-scale aerial dissemination of a variety of chemical compounds throughout the United States, U.S. territories, and abroad.[19]

The tactical herbicides used by the U.S. military in Vietnam were formulations based on tests of thousands of different chemical compositions at Camp Detrick in an effort to determine chemical agents and chemical compounds that would meet specific requirements. The U.S. military developed and tested six tactical "rainbow" herbicides that it used during the Vietnam War era—Pink, Purple, Green, Blue, White, and Orange. The chemical component n-butyl 2,4,5-T, which is known to have been contaminated with 2,3,7,8-TCDD, was present in four of these six tactical herbicides—specifically, Agents Pink, Purple, Green, and Orange.[20] In late 1961, DOD began color-coding the herbicide formulations that it was testing in aerial spray trials in Vietnam and elsewhere in Southeast Asia. The tactical herbicides, which were used for a variety of different purposes, to include defoliation and crop destruction, were identified by colored bands placed around the drums, as shown in figure 2. Beginning in 1962, the U.S. Air Force received shipments of Agents Pink, Purple, and Green to supply the first spray missions for Operation Ranch Hand, the program for defoliation and crop destruction missions during the Vietnam War.[21] Agent Purple was similar to the herbicide formulation that was later designated "Orange," but it was more costly to purchase.[22] Agents Blue and White were used in Vietnam extensively along with Agent Orange after 1964, but they were of a different chemical composition and did not contain any form of 2,4,5-T, the component that produced 2,3,7,8-TCDD as a by-product of the manufacturing process.

[19]We discuss DOD's list of locations and dates where these testing activities were conducted in more detail later in this report.

[20]Agents Blue and White did not contain any form of 2,4,5-T and thus did not contain the associated contaminant, 2,3,7,8-TCDD. Rather, Agent Blue contained cacodylic acid, an arsenic compound. The components of Agent White, which was commercially available as Tordon 101, were n-butyl 2,4-D and picloram.

[21]In 1961 President Kennedy authorized DOD to begin aerial spraying of tactical herbicides to defoliate the jungle canopy and to destroy food sources in Vietnam. Under the project name "Ranch Hand," U.S. military personnel conducted these operations primarily from C-123 aircraft and from helicopters from January 1962 to January 1971.

[22]According to archival sources, Agent Purple was replaced by Agent Orange for use in Vietnam in late 1964. Agent Purple contained the two components of Agent Orange but in different proportions. It also contained another form of one of those two components.

Figure 2: 55-Gallon Drums of Agent Orange in Vietnam Showing Orange Bands

Source: National Archives and Records Administration. | GAO-19-24

Note: Photo by Kelly Air Force Base.

Of the tactical herbicides, Agent Orange was used the most extensively in Vietnam. In 1964 DOD began to procure large quantities from U.S. manufacturers for military use in Vietnam. The first shipment of Agent Orange arrived in Saigon in February 1965 by merchant vessel. Together, nine manufacturers produced a total of approximately 13.9 million gallons of Agent Orange,[23] and DOD is estimated to have used approximately 12.1 million gallons between 1965 and 1970 in operations in Vietnam, and much smaller quantities in Korea and Thailand.[24]

Evidence from animal and epidemiologic studies of adverse effects from Agent Orange exposure led the U.S. government to restrict the use of 2,4,5-T in April of 1970 and led DOD to temporarily suspend the use of Agent Orange. In 1972 the U.S. Air Force consolidated the approximately 1.36 million gallons of the herbicide that had remained unused in Vietnam

[23]The manufacturers of Agent Orange were Dow, Monsanto, Hercules, Thompson-Hayward, Diamond-Alkali/Shamrock, Uniroyal, Thompson, Agrisect, and Hoffman-Taft.

[24]Available records indicate that approximately 19,250 gallons of Agent Orange were shipped to Korea in March 1968. We were unable to determine precise quantities shipped to or used in Thailand due to a lack of records. As we note later in this report, the estimated amounts used varied over the decades, and we are using the figure of approximately 12.1 million gallons based on the latest update from the National Academy of Sciences' Institute of Medicine.

and shipped them for storage on Johnston Island in the Pacific.[25] DOD held its remaining stocks of Agent Orange—approximately 860,000 gallons—within the continental United States, at the Naval Construction Battalion Center Gulfport, Mississippi, until those stocks were also shipped toward Johnston Island in June 1977. All of these remaining stocks of Agent Orange were incinerated at sea aboard the M/T *Vulcanus* by September 1977.[26]

Comparison between Tactical and Commercial Herbicides

In addition to the tactical herbicides used during the Vietnam War era, the U.S. military also used commercial herbicides to manage vegetation on its installations. The U.S. military managed tactical herbicides differently from commercial herbicides. According to DOD officials and archived military specifications, tactical herbicides were not authorized for use on lands owned by, or otherwise managed as military installations and were not to be diverted for domestic use.[27] DOD developed military specifications for the tactical herbicides that provided detailed information on product requirements, quality assurance, packaging, and precautionary statements that prohibited domestic use.[28] The tactical herbicides were centrally managed, first by the Army Chemical Corps and later by the U.S. Air Force Logistics Command. Agent Orange used in Vietnam was formulated for aerial spraying by aircraft and helicopter and applied at full strength without additional solvents at a rate of 3 gallons per acre. Agent Orange is soluble in diesel fuel and organic solvents, but it is insoluble in water, so equipment was cleaned using diesel fuel rather than water.

[25]Johnston Island is located in the North Pacific Ocean, 717 nautical miles from Hawaii.

[26]Available records show that some of the stocks of Agent Orange from Vietnam had been mixed with other herbicides when they were redrummed for shipment to Johnston Island. According to an Office of Air Force History monograph, the U.S. EPA research permit, which was used for incineration of the stocks of Agent Orange from the continental United States, did not authorize the incineration of any material other than Agent Orange. As a result, the mixed herbicide drums were segregated from the other drums until the U.S. EPA approved their destruction in August 1977 under a special permit for the incineration of the stocks on Johnston Island. The records did not identify the quantities of these other herbicides, but they reported that a total of approximately 2.3 million gallons of Agent Orange were destroyed.

[27]We obtained and reviewed copies of the military specifications for Agent Orange from December 1965, September 1967, and October 1969.

[28]Department of the Army, MIL-D-51239 (MU), *Military Specification, Defoliant LNX (U)* (Dec. 30, 1965). These military specifications were subsequently updated in September 1967 and again in October 1969.

bicides, conversely, were widely available worldwide for
n management at military installations, to include
tation adjacent to flightlines or along perimeter fencing.
s developed federal specifications for these products to
met specific requirements, and these specifications were
Commissioner, Federal Supply Service, in the General
istration for use by all federal agencies. According to DOD
the Vietnam era there was no requirement for DOD to
oncerning the use of commercial herbicides on military
years. DOD officials also stated that DOD catalogued
s available for use on military installations in the federal
under federal supply classification group 68, which
cals and chemical products.

pply catalogues from that time period, DOD officials
han 35 different commercial herbicides that were listed in
ly system for use on DOD installations between 1960 and
hese commercial herbicides contained 2,4-D; 2,4,5-T; or
ney were not in the n-butyl form used in Agent Orange.
at least 4 commercial herbicides that contained some
the component that contained the contaminant 2,3,7,8-
tion, numerous commercial herbicides that were not in the
ystem but were being widely used elsewhere for
oses contained the form of n-butyl 2,4,5-T found in Agent
s its associated contaminant, 2,3,7,8-TCDD. According to
ne commercial herbicides used on installations were
el or water and sprayed by hand or truck. Tactical
ever, were formulated for aerial spraying by fixed-wing
pter without being diluted.[30]

military was employing these tactical and commercial
g the Vietnam War era, U.S. EPA had not yet been

, herbicides often did not have a commercial name in the 1960s and
ere referred to by their active ingredients, such as 2,4-D, and were
supply schedule this way. DOD also provided information from U.S.
oduct and Label System that identified various commercial herbicides
-butyl form of 2,4,5-T.

commercial form of the herbicide is the same as the dioxin in the
nt Orange. However, the toxicity of the dioxin is dependent on multiple
e route of exposure (for example, spraying by hand or aerial spraying)
administered.

established, and the U.S. Department of Agriculture had oversight of commercial herbicides. The Federal Insecticide, Fungicide, and Rodenticide Act of 1947, then administered by the U.S. Department of Agriculture, governed the marketing and use of these commercial herbicides.[31] Until amended in 1972, the Federal Insecticide, Fungicide, and Rodenticide Act review process was designed as a consumer protection measure that focused primarily on a product's effectiveness, rather than on concerns about health or the environment.[32]

Agent Orange Legislative and Regulatory History

The Agent Orange Act of 1991, as amended, requires a review of the available scientific evidence regarding the associations between certain diseases and exposure to tactical herbicides.[33] The act specifically requires the VA to enter into an agreement with the National Academy of Sciences (the Academy), or with an alternative scientific organization, to review and evaluate the scientific evidence concerning the association between exposure to an herbicide agent and each disease suspected to be associated with such exposure.[34] The Academy is required to submit periodic reports at least once every 2 years. The most recent report—the 2014 report—was issued in March 2016. The next report, which Academy officials told us would focus on inter-generational and trans-generational

[31]Federal officers acting pursuant to their authority under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 135-135k ('FIFRA'), directed defendants [chemical manufacturers working under government contracts] to supply Agent Orange without the warnings and directions which would have been used for any of defendants' commercial herbicides for civilian use. Federal officers did not register Agent Orange under FIFRA and did not comply with FIFRA requirements for warnings, relying on a statutory exception for 'public officials while engaged in the performance of their official duties.' 7 U.S.C. § 135e(a)(3). This exception extended to defendants as 'person[s] acting for' such public officials pursuant to 7 U.S.C. § 135f(d)." Isaacson v. Dow Chemical Co. (In re "Agent Orange" Prod. Liab. Litig.), 304 F. Supp. 2d 404, 430 (E.D.N.Y. 2004).

[32]See Angelo, *Embracing Uncertainty, Complexity, and Change: An Eco-Pragmatic Reinvention of a First-Generation Environmental Law*, 33 ECOLOGY L.Q. 105, 159 (2006).

[33]38 U.S.C. § 1116 note (Agreement with National Academy of Sciences). This provision applies to an herbicide used in support of the United States and allied military operations in the Republic of Vietnam during the Vietnam era, which we refer to as tactical herbicides.

[34]Reports were prepared by the Institute of Medicine Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides. The Institute of Medicine, now the National Academy of Medicine, was chartered in 1970 by the National Academy of Sciences to enlist distinguished members of the appropriate professions to advise the nation on medical and health issues.

effects of exposure to herbicides, was at the time of our report scheduled to be issued in late 2018.[35]

In its biannual reports, the Academy identifies different levels of association between exposure to 2,3,7,8-TCDD or other chemical compounds in herbicides used in Vietnam and a wide range of health effects. These levels include the following:

- sufficient evidence of an association;
- limited or suggestive evidence of an association;
- inadequate or insufficient evidence to determine an association; and
- limited or suggestive evidence of no association.

The Academy has identified that there is either sufficient evidence of an association with exposure to a tactical herbicide or limited or suggestive evidence of an association leading to certain diseases.[36] For example, the Academy has identified both chloracne and non-Hodgkin's lymphoma as having sufficient evidence of an association with exposure to a tactical herbicide, and both Parkinson's disease and diabetes mellitus (type 2) as having limited or suggestive evidence of an association. Examples of diseases for which the Academy has found inadequate or insufficient evidence to determine an association include kidney disease and pancreatic cancer.

In making determinations regarding the association between certain diseases and exposure to herbicide agents, the Secretary of Veterans Affairs is required to take into account the Academy's reports. Once the Secretary finds that such an association existed, the Secretary is then required to prescribe regulations, providing that a presumption of service connection is warranted for that disease.[37] The Agent Orange Act of

[35]According to VA officials, the upcoming report will be released before the end of 2018 and will review the literature on all potential health outcomes. VA further stated that this report will not be focused on inter-generational health outcomes, which will be covered in a separate report in the Gulf War and Health series. However, one of the four topics that VA requested the Agent Orange committee look at in its report is paternal transmission of possible inter-generational effects.

[36]In its most recent Institute of Medicine report, the committee reviewed the U.S. Agricultural Health Study, which found that individuals exposed to commercial herbicides could also suffer from adverse health effects, such as prostate cancer. NASEM, 2016.

[37]38 U.S.C. § 1116.

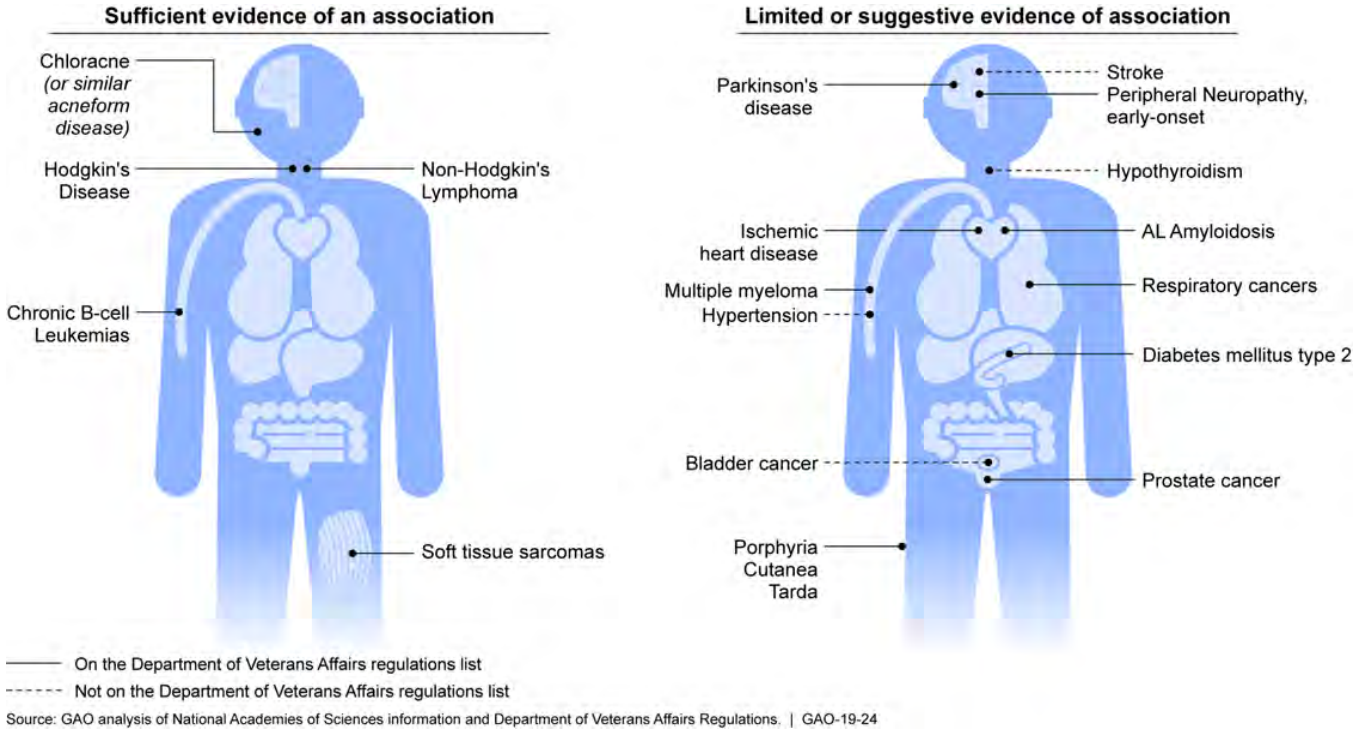
1991, as amended, also establishes a presumption of service connection, by reason of exposure to an herbicide agent, for diseases listed in the statute, to include Hodgkin's disease and diabetes mellitus (type 2).[38] This presumption applies to veterans who, during active military, naval, or air service, served in the Republic of Vietnam during the period beginning on January 9, 1962, and ending on May 7, 1975.[39] Veterans who served in Vietnam and other specific locations and time frames and who have been diagnosed with those diseases are presumed to have incurred those diseases as a result of their service and are thus eligible for presumptive service connection for disability compensation.[40] Figure 3 illustrates the diseases for which the Academy has found either sufficient, or limited or suggestive, evidence of an association. In addition, appendix II provides information on the 14 presumptive diseases that the VA currently identifies as being associated with exposure to Agent Orange or other tactical herbicides during military service for which veterans and their survivors may be able to receive disability compensation benefits.

[38]*Id.* "Herbicide agent" includes the following components: 2,4-D; 2,4,5-T and its contaminant 2,3,7,8-TCDD; cacodylic acid; and picloram. 38 C.F.R. § 3.307(a)(6) (2018).

[39]"Service in the Republic of Vietnam" includes service in the waters offshore and service in other locations if the conditions of service involved duty or visitation in the Republic of Vietnam. 38 C.F.R. § 3.307(a)(6)(iii) (2018).

[40]Title 38, section 3.307 of the Code of Federal Regulations also affords a presumption of exposure to an herbicide agent for veterans who served in active military, naval, or air service between April 1, 1968, and August 31, 1971, in a unit that operated in or near the Korean demilitarized zone in an area in which herbicides are known to have been applied during that period; and for individuals who performed service in the Air Force or Air Force Reserve under circumstances in which the individual concerned regularly and repeatedly operated, maintained, or served onboard C-123 aircraft known to have been used to spray an herbicide agent during the Vietnam era. The VA's *Adjudication Procedures Manual* also addresses exposure to herbicide agents for veterans who served in certain locations and positions in Thailand. In addition, the VA affords a presumption of herbicide exposure to veterans who served in the inland waterways of Vietnam or the waters offshore, if the conditions of service involved duty or visitation in Vietnam between January 9, 1962, and May 7, 1975. The Manual refers to service in the inland waterways and waters offshore as brown- and blue-water Navy service, respectively. We are not making a judgment about the reasons behind providing compensation for veterans who have been diagnosed with these associated diseases. As we have previously reported, it is often difficult to establish causation between an exposure and an adverse health condition, because scientific research has not always established a clear link between the contaminant and an adverse health effect. GAO, *Defense Infrastructure: DOD Can Improve Its Response to Environmental Exposures on Military Installations*, GAO-12-412 (Washington, D.C.: May 1, 2012).

Figure 3: Diseases Recognized by the National Academy of Sciences as Having Sufficient or Limited or Suggestive Association with Agent Orange Exposure



Source: GAO analysis of National Academies of Sciences information and Department of Veterans Affairs Regulations. | GAO-19-24

Veterans' Benefits

Under 38 U.S.C. § 1110, the United States will pay benefits to any veteran disabled for a disability resulting from personal injury suffered or disease contracted in line of duty, or for aggravation of a preexisting injury suffered or disease contracted in line of duty, in the active military, naval, or air service, during a period of war.[41] The VA offers health registry exams, health care, disability compensation, and other benefits to eligible veterans who were exposed to herbicides during military service. According to the VA's *Claims Adjudication Procedures Manual*, the claims evaluation process begins with the VA requesting any information missing from the veteran's claim, such as the approximate dates and location(s) of service, claimed disability, and, for certain locations, the nature of the

[41]In determining compensation, if the veteran was discharged or released from service, the discharge or release must have been under conditions other than dishonorable. *See* 38 C.F.R. § 3.4 (2018).

alleged exposure to herbicides. Generally, the veteran then has 30 days to submit the requested information. During the claims process, VA will check military records to confirm exposure to Agent Orange or other herbicides and qualifying military service. Certain diseases have already been presumed to be associated with herbicide exposure, and no further evidence of an association is needed. However, if the claimed disability is not a presumed condition, then VA will request that the veteran present scientific or medical evidence showing that the claimed condition is medically associated with herbicide exposure. If the veteran is not able to provide this information, the case is referred to DOD for verification of exposure to herbicides. Veterans' claims can either be approved or denied based on the evidence submitted by the veteran, and, if needed, by DOD.[42]

The VA tracks its claims data for Agent Orange exposure according to whether the exposure occurred inside or outside of Vietnam, which includes the Korean demilitarized zone and certain locations in Thailand. According to VA officials, as of June 30, 2018, 557,653 living veterans and 199,451 deceased veterans have been granted benefits for diseases associated with Agent Orange exposure *inside* Vietnam, with 44,925 claims pending for veterans who served in Vietnam and believe they were exposed to Agent Orange. For diseases associated with Agent Orange exposure *outside* of Vietnam, VA had granted service connection decisions to more than 10,758 veterans and denied service connection decisions to more than 58,250 veterans, as of June 30, 2018. According to VA, there are an additional 23,400 claims pending for veterans who did not serve in Vietnam but believe they were exposed to Agent Orange.

Environmental Cleanup

In 1980 Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act, which established the Superfund program—the federal government's principal program to clean up hazardous waste sites.[43] The U.S. EPA is responsible for administering the Superfund program, which places some of the most seriously contaminated sites on the National Priorities List, and has oversight for federal and non-federal sites on that list. Additionally, amendments to the

[42]VA Claims Adjudication Procedures Manual, M21-1, part IV, subpart ii, ch. 1, sec. H, *Developing Claims for Service Connection (SC) Based on Herbicide Exposure* (change date Mar. 27, 2018).

[43]Pub. L. No. 96-510, 94 Stat. 2767 (1980) (codified as amended at 42 U.S.C. §§ 9601-9675).

act in 1986 require the Secretary of Defense to carry out the Defense Environmental Restoration Program, which was specific to DOD environmental cleanup activities at active installations, formerly used defense sites, and base realignment and closure locations in the United States.[44] The cleanup process under the Environmental Response, Compensation, and Liability Act process generally includes the following phases and activities: preliminary assessment, site inspection, remedial investigation and feasibility study, remedial design and remedial action, and long-term monitoring.[45]

Through this process, DOD and U.S. EPA cleaned up some U.S. sites where Agent Orange was known to have been present after the sites were tested and confirmed to have been contaminated with 2,3,7,8-TCDD.[46] For example, U.S. EPA identified a site in Jacksonville, Arkansas, where 2,4,5-T had been manufactured, that was contaminated with 2,3,7,8-TCDD. In addition, under the Defense Environmental Restoration Program, DOD cleaned up the Naval Construction Battalion Center Gulfport, Mississippi, where Agent Orange had been stored while awaiting shipment for use in Southeast Asia. The site had also been used to store Agent Orange drums that were awaiting shipment to Johnston Island for disposal. According to a DOD report, approximately 860,000 gallons of the herbicide were stored at the site. An Agency for Toxic Substances and Disease Registry report further states that spills that occurred during storage caused 2,3,7,8-TCDD contamination around several water areas. According to a 5-year review completed by DOD in 2017, capping of the contaminated soil at the site where herbicides were stored has been completed, and long-term monitoring of the soil and groundwater began in 2012 and continues today.

[44]Pub. L. No. 99-499, § 211 (1986) (codified as amended at 10 U.S.C. § 2700 et seq.).

[45]*See* 40 C.F.R. part 300, subpart E.

[46]For some of the sites it assessed, DOD determined that the levels of contamination and associated risks did not warrant cleanup actions. For example, DOD assessed risks to human health as a result of dioxin contamination at Eglin Air Force Base in Florida, which was a testing site for aerial sprayers, to evaluate the capabilities of the equipment systems used to spray Agent Orange. Environmental assessments identified herbicides and dioxins in soils, sediments, and surface water and groundwater in a one-square mile test grid where massive quantities of herbicides were tested via repeated application, over a period of 8 years. DOD did not perform cleanup activities at the test grid, however, because the final risk assessment in 2001 concluded that the risks to human health were acceptable. However, DOD did implement remedies to control the use of the land near the herbicide testing sites to prevent future residential development. These land use controls will remain in effect indefinitely, and the site will continue to be monitored every 5 years.

DOD also cleaned up the Johnston Island site where Agent Orange was ultimately disposed of. Once drums of Agent Orange were stored at Johnston Island, environmental sea conditions caused them to corrode and leak. Initial cleanup activities assessed and monitored the area to track the chemical components remaining as a result of Agent Orange contamination. Site remediation and environmental monitoring continued throughout the 1970s until February 1989, when the Air Force, in accordance with the Defense Environmental Restoration Program, completed a final site cleanup at Johnston Island by destroying all remaining 2,3,7,8-TCDD-contaminated soil. Figure 4 shows drums of Agent Orange stored at Johnston Island.

Figure 4: May 1975 Photo of Drums of Agent Orange Stored on Johnston Island

Source: Alvin L. Young, *Agent Orange: A History of Its Use, Disposition, and Environmental Fate* (June 30, 2008). | GAO-19-24

Note: Many of the drums were no longer marked with an orange band around their center as a result of redrumming that took place from 1972 through mid-1977. According to archival sources, efforts were made to continue labeling new drums as “Herbicide Butyl Esters.”

In addition, U.S. EPA listed on its National Priorities List two former Agent Orange manufacturing sites—the Kanawha River site in West Virginia previously owned by the Monsanto Company and a site in Newark, New Jersey, owned by the Diamond Alkali Company—due to high levels of contamination from various sources and threats to human health. In 2017, U.S. EPA entered into an agreement with the Monsanto Company on a cleanup plan to address 2,3,7,8-TCDD contamination at the Kanawha River Superfund Site in Putnam and Kanawha counties, West Virginia. The cleanup effort will focus on a 14-mile stretch within the Kanawha

River. Cleanup work will include constructing a cap over more than 9 acres of contaminated river sediments. Similarly, the Diamond Alkali site in New Jersey contained 2,3,7,8-TCDD contamination at both the manufacturing site and the nearby Lower Passaic River. The site was found to contain high levels of 2,3,7,8-TCDD and was placed on the National Priorities List in 1984. As late as 2014, the site was still undergoing cleanup actions to prevent exposure to the contaminated soil and prevent further releases to the river.

It is difficult to isolate the specific costs of cleaning up Agent Orange contamination under the Comprehensive Environmental Response, Compensation, and Liability Act, according to DOD and U.S. EPA officials.[47] Moreover, cleanup plans address multiple contaminants, making it difficult to isolate the costs for cleaning up a specific contaminant, according to DOD and U.S. EPA officials. For example, the Diamond Alkali site had multiple contaminants from a number of companies that owned or operated facilities from which hazardous substances, including 2,3,7,8-TCDD and pesticides, were potentially discharged into the river and found in the soil and groundwater. Various cleanup actions were taken to address not only 2,3,7,8-TCDD contamination but the other contaminants as well. These actions included a groundwater collection and treatment system and capping to prevent exposure to contaminated soil (including contaminated soil that originated at the facility and soil that was brought to the facility from neighboring lots) and prevent further releases to the river.

[47]The national goal of the Comprehensive Environmental Response, Compensation, and Liability Act remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. 40 C.F.R. § 300.430(a)(1)(i) (2018). Cleanup alternatives providing effectiveness similar to that of another alternative but at greater cost, may be eliminated from further consideration. 40 C.F.R. § 300.430(e)(7) (2018). According to DOD officials, cost is not a primary driver for cleanup actions; such decisions are instead based on human health concerns.

The Federal Government Has Some Information on the Procurement, Use, and Destruction of Agent Orange, and Available Documentation Indicates at Least One Vessel Carrying Agent Orange Transited through Guam to Vietnam, but Information Is Not Complete

The federal government maintains information on Agent Orange, and available records indicate that DOD procured approximately 13.9 million gallons of the tactical herbicide, which was either used in U.S. military operations in Southeast Asia, used for testing, or destroyed. Our analysis of the available logbooks for 152 of the 158 shipments (approximately 96 percent) of Agent Orange to Southeast Asia that we identified indicates that the vessels carrying tactical herbicides generally stopped at foreign ports and sometimes at U.S. ports en route to Southeast Asia. Available primary source materials, such as shipment documentation, are incomplete because they were likely not maintained during and after the Vietnam era.[48] However, based on the available information, we identified at least one ship carrying Agent Orange that stopped at Port Apra (now Apra Harbor) on Guam on its way to Vietnam, although we could not locate any evidence showing that any cargo was offloaded. Further, while DOD documents identify the use of commercial herbicides on Guam, they do not identify the use of tactical herbicides there.

[48]As noted earlier, shipment documentation includes shipping and agency records, including U.S. military correspondence and logistics reports.

Available Records Indicate That All of the Agent Orange Procured Was Either Used in U.S. Military Operations, Used for Testing, Damaged, or Destroyed

Available records that the federal government maintains indicate that DOD procured approximately 13.9 million gallons of Agent Orange between 1963 and 1968, of which it used an estimated 12.1 million gallons in Southeast Asia from 1965 to 1970; used a small amount for testing; and incinerated another 2.3 million gallons in 1977.[49] Thus, the total quantity of Agent Orange that DOD procured was approximately equal to the total quantity that records indicate was tested in the United States and its territories, damaged during storage and shipment, and used during the Vietnam War, combined with the total quantity that records indicate was disposed of afterwards.[50]

Procurement and Use. Based on available records we reviewed, DOD procured approximately 13.9 million gallons of Agent Orange from nine chemical manufacturers between 1963 and 1968.[51] In 1963 DOD used small amounts of Agent Orange for testing. DOD procurement officers then advised the Military Assistance Command, Vietnam, in late 1964 that they could fulfill the supply requirements for tactical herbicides with Agent

[49]We used the best available records to identify the amounts of Agent Orange we refer to in this report, but these figures should be seen as estimates. The "amount used" is based on an estimate by the National Academy of Sciences of the amount of Agent Orange used in Vietnam during Operation Ranch Hand. This total includes quantities used in Korea and Thailand as well as quantities used for testing or lost during storage, according to DOD records. The estimated amounts used varied over the decades, but we are using the estimate of approximately 12.1 million gallons identified in the Institute of Medicine's 2014 update. See NASEM, 2016.

[50]The amounts of Agent Orange used in support of military operations plus that incinerated do not equal the amount of Agent Orange that DOD procured because we do not have complete documentation regarding the amounts used for testing or the amounts that were lost or damaged. Specifically, we were not able to obtain source documents for the procurement of Agent Orange for testing, nor were we able to determine the accuracy or completeness of records for the quantities of Agent Orange used in military operations in Vietnam. The quantities estimated to have been disposed of that include the incineration of stocks of Agent Orange in 1977 also vary, and we were not able to estimate quantities lost during storage or transit, or in redrumming operations. Therefore, we are relying on published estimates for these figures.

[51]Domestic chemical manufacturers produced 78.1 million pounds of n-butyl 2,4,5-T, one of the two components of Agent Orange, for military use beginning in 1961 and ending in 1969. DOD managed its Agent Orange procurement through 45 contracts. In 1968 DOD decided to terminate 7 of the final Agent Orange contracts due to an oversupply of Agent Orange, because fewer herbicide missions were being flown in Vietnam than had been projected.

Orange.[52] Available records further indicate that of the approximately 13.9 million gallons of Agent Orange procured, DOD used an estimated 12.1 million gallons in operations in Vietnam from 1965 to 1970.[53] In addition to the quantity used in Vietnam, Agent Orange usage also included quantities that were tested in the United States and its territories; used or tested in countries outside of Vietnam; lost during shipment and storage; or removed from the inventory and used to test different disposal options after its use was suspended.[54] With the exception of the disposal testing amounts, no archival resources we could locate and obtain provided definitive usage figures. The last known shipment of Agent Orange to Vietnam was aboard the SS *Frederick Lykes* and arrived in May 1970.

Restrictions on Use. In 1969 the National Environmental Health Service of the Department of Health, Education, and Welfare conducted testing of n-butyl 2,4,5-T—the component of Agent Orange whose manufacturing process produced 2,3,7,8-TCDD as a by-product—on mice, which raised concerns about health effects of the herbicide for women of child-bearing age. These concerns led to several U.S. government decisions that ended the use of tactical herbicides. Specifically, in 1969 DOD restricted the use of Agent Orange in Vietnam to keep it away from population

[52]Military Assistance Command, Vietnam, was the command in charge of U.S. military operations in Vietnam as of February 8, 1962. It succeeded the Military Assistance Advisory Group, Vietnam. DOD procured other tactical herbicides that contained forms of n-butyl 2,4,5-T, to include thousands of gallons of Agents Green, Pink, and Purple that were disseminated in Vietnam from January 1962 through December 1964. DOD discontinued the use of Agents Green and Pink by 1965, and Agent Purple was also replaced by Agent Orange in 1964. Although Agents White and Blue were used in spraying operations in Vietnam alongside Agent Orange, neither of them contained the chemical n-butyl 2,4,5-T. DOD discontinued the use of Agent Orange in 1970 and all use of the tactical herbicides in 1971.

[53]The U.S. Air Force Logistics Command was responsible for fulfilling Air Force supply requirements for Operation Ranch Hand during the Vietnam era. According to a San Antonio Air Materiel Area historical monograph, the Middletown Air Materiel Area, located at the former Olmsted Air Force Base in Pennsylvania, initially had this responsibility, but responsibility was transferred to the San Antonio Air Materiel Area Directorate of Air Force Aerospace Fuels located at the former Kelly Air Force Base in Texas in 1966. Although herbicide management responsibility was transferred to the San Antonio Air Materiel Area, the Defense General Supply Center based in Richmond, Virginia, maintained procurement responsibility.

[54]For example, according to archival sources, about 10 out of every 10,000 drums (one-tenth of 1 percent) received at ports were damaged or defective. About 50 percent of the damaged drums leaked as a result of punctures or split seams caused by improper loading and defective drums. These sources also indicated that forklifts operated by stevedores also caused punctures of the drums.

centers. In April 1970 the federal government began restricting the use of 2,4,5-T in the United States.[55] Exceptions were made for the control of weeds and brush on range, pasture, and forests, or on rights of way and other nonagricultural land. On April 15, 1970, DOD temporarily suspended the use of Agent Orange, including new procurement, acceptance of product on terminated contracts, transfer of stocks at Gulfport, and ocean shipping operations.

Consolidation and Incineration of Remaining Stocks. After the U.S. government restricted the use of n-butyl 2,4,5-T—a component of Agent Orange—in 1970, DOD decided to consolidate the remaining 2.3 million gallons of Agent Orange stored in Vietnam and Gulfport, Mississippi, as well as any remaining amounts of n-butyl 2,4,5-T. According to an Office of Air Force History monograph, on January 16, 1971, DOD ordered the termination of all crop destruction missions by U.S. forces in Vietnam, and on September 27 of that year, the Chairman of the Joint Chiefs of Staff directed the Air Force to return all remaining stocks of Agent Orange to the United States and to dispose of them. Specifically,

- Agent Orange stocks in Vietnam were temporarily stored at U.S. Air Force bases at Da Nang, Phu Cat, and Bien Hoa until they were moved to Johnston Island in 1972. In 1972 the U.S. military moved approximately 1.36 million gallons of Agent Orange onto Johnston Island for storage. The cargo vessel SS *Transpacific* picked up this quantity at three Vietnamese ports from March 15 to April 1, traveled to Johnston Island, arrived on April 18, and completed offloading on April 28 before returning to the United States. This consolidated quantity of Agent Orange from Vietnam remained at Johnston Island until 1977.
- The Naval Construction Battalion Center Gulfport, Mississippi, was the final storage location in the continental United States for Agent Orange until the U.S. Air Force began the incineration of Agent Orange in 1977. There were approximately 860,000 gallons of Agent Orange at this location in 1977, which takes into account amounts lost in Hurricane Camille in 1969 or shipped away for testing, as described

[55]Specifically, on April 15, 1970, the Departments of Agriculture, Interior, and Health, Education and Welfare announced the suspension of the registrations of liquid formulations of 2,4,5-T for uses around the home and on lakes, ponds, and ditch banks. The agencies also announced the intent to cancel registered uses of non-liquid formulations of 2,4,5-T around the home and on all food crops intended for human consumption. USDA Press Release 1176-70 (April 15, 1970). See also USDA Pesticide Registration Notice 70-11.

previously. The 1977 figure also takes into account 14,025 gallons transferred to the Naval Construction Battalion Center Gulfport, from Eglin Air Force Base, Florida, where the Air Force had tested formulations of Agent Orange for aerial spraying. In addition, available records show that quantities of the two components of Agent Orange were stored at the former Kelly Air Force Base, Texas, until 1972 before they were transferred to the U.S. Department of Agriculture for brush control projects. These reported amounts included 106,260 gallons of n-butyl 2,4-D and 38,940 gallons of n-butyl 2,4,5-T. These records also show that 173,910 gallons of Agent Blue were stored at the installation; see figure 5.

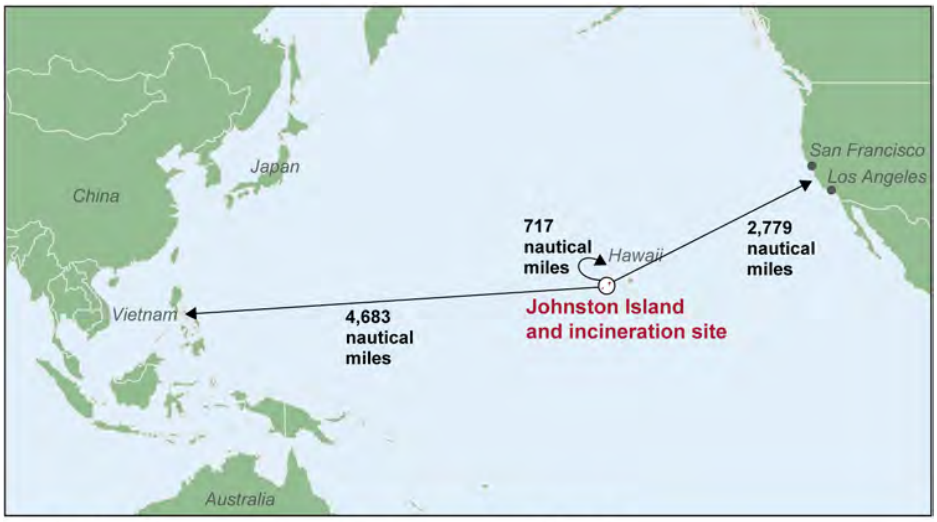
Figure 5: Photo of Drums of Agent Orange Components (n-butyl 2,4-D and n-butyl 2,4,5-T) and Agent Blue Located at San Antonio Air Materiel Area, Kelly Air Force Base, Texas

Source: National Archives and Records Administration. | GAO-19-24

Note: Photo by San Antonio Air Materiel Area, Kelly Air Force Base, Texas (October 12, 1971).

DOD chartered the incinerator ship M/T *Vulcanus* and loaded the 860,000 gallons stored at Naval Construction Battalion Center Gulfport, Mississippi, beginning in May 1977. The vessel left Gulfport, Mississippi, in June 1977, and began incinerating the Agent Orange on board in July 1977 in a research burn to test the incineration process at sea near Johnston Island. In August 1977, the M/T *Vulcanus* loaded the remaining 1.36 million gallons stored at Johnston Island and conducted two more incineration operations just southwest of Johnston Island, as shown in figure 6. By September 3, 1977, all stocks of Agent Orange had been incinerated.

Figure 6: Map of Johnston Island and M/T *Vulcanus* Burn Site



Source: GAO analysis of Department of Defense data; Map Resources (map). | GAO-19-24

Available Records Indicate That Vessels Transporting Agent Orange Stopped at Various Ports en Route to Southeast Asia, but Shipment Information Is Not Complete

Our review of documentation for the shipment of almost 12.1 million gallons of the approximately 13.9 million gallons (approximately 87 percent) of Agent Orange procured by DOD found, based on available shipment documentation, that vessels transporting Agent Orange made stops at various ports on the way to Southeast Asia. However, shipment documentation is incomplete. Manufacturers of Agent Orange blended the two components of the herbicide—the n-butyl forms of 2,4-D and 2,4,5-T—and marked 55-gallon drums for shipment to Southeast Asia. Available records indicate that manufacturers produced Agent Orange according to military specifications and marked all drums for shipment directly to the receiving U.S. military unit in Vietnam. These specifications indicated the precise herbicide formulation of Agent Orange (n-butyl esters, 50 percent 2,4-D and 50 percent 2,4,5-T) and general instructions for marking the 55-gallon drums for shipment. For example, according to a historical monograph by the San Antonio Air Materiel Area, DOD specified that each drum was to be marked with a colored band or bands around the center as well as with transportation and contract data. Figure 7 shows an example of these drum markings.

Figure 7: Drum Markings for Agent Orange with Destination and Orange Band

Source: National Archives and Records Administration. | GAO-19-24

Note: Photos of Agent Orange drums taken by San Antonio Air Materiel Area, Kelly Air Force Base, Texas. The photo on the right indicates how Agent Orange was palletized on the vessels. Precise dates of photos are unknown.

DOD then arranged for the transport of these drums, as well as drums of other tactical herbicides, by train from the manufacturers to several U.S. ports.[56] DOD transportation officials accepted the product by signing a Material Inspection and Receiving Report that indicated the destination of the rail shipment and the final destination in Vietnam. DOD primarily chartered merchant marine vessels to ship the drums to Southeast Asia, but we identified one official Navy vessel, the USNS *Lt. George W.G. Boyce*, that carried Agent Orange to Southeast Asia.[57] The first known shipment of Agent Orange left the port of New Orleans, Louisiana, on the SS *Adabelle Lykes* and arrived in Vietnam in February 1965. The last known shipment left the port of Gulfport, Mississippi, on the SS *Frederick Lykes* and arrived in Vietnam in May 1970.[58] By that time, DOD had suspended all further shipments of Agent Orange. The photos in figure 8 provide examples of drums of Agent Orange being shipped by rail and tactical herbicides being loaded onto a cargo ship.

[56]Based on available Air Force records, the known ports of embarkation for Agent Orange were Bayonne, New Jersey; Baltimore, Maryland; Gulfport, Mississippi; New Orleans, Louisiana; Mobile, Alabama; Seattle, Washington; and Oakland, California.

[57]There are limited shipment records available for herbicides shipped before 1965—Agents Pink, Green, and Purple. There are records available for Agents Blue and White for the period 1965 to 1970, but those herbicides do not contain n-butyl 2,4,5-T.

[58]Available records indicate that DOD chartered cargo ships operated by various shipping companies. Examples include the SS *American Charger* (U.S. Lines), the SS *Flower Hill* (Ocean Freighting & Brokerage Corp.), and the SS *Sir John Franklin* (American Export-Isbrandtsen Line).

Photos Showing Transportation of Agents Orange and White

h an orange band on a rail car in Mississippi.

Drums marked with a white band being loaded onto a cargo ship.

l Archives and Records Administration. | GAO-19-24

s by San Antonio Air Materiel Area, Kelly Air Force Base, Texas (March 1969).

of materiel used to support U.S. military forces in Vietnam, tactical herbicides, was transported from the continental United Vietnam via ship. The vessels carrying the tactical herbicides stopped at foreign ports and sometimes at U.S. ports on the outheast Asia. Our analyses of available shipment ntation indicate that at least 114 unique cargo vessels carried range to Southeast Asia on at least 158 different voyages from ough 1970. For each of these voyages, merchant vessel captains d logbooks to the U.S. port authorities at the end of each [59] We were able to locate and obtain logbooks for 152 of the 158 ts (approximately 96 percent) we identified. For 3 of the 6 for which we were not able to locate logbooks, we obtained f the vessels' shipping articles.[60] We were not able to obtain articles for the 3 foreign-flagged vessels because documents for ssels were not turned in at U.S. ports.

s contain information such as the ship's location, crew, and key events. hey generally do not identify specific cargo that was loaded on or offloaded . Logbooks from the Vietnam era are generally held at National Archives and dministration facilities closest to the arrival ports where the voyages ended.

articles are the articles of agreement between the captain of a ship and the ith respect to wages, length of time for which they are shipped, and related ney provide the dates and locations for different personnel actions but do not y identify every port of sailing for a voyage, and thus do not provide complete ation of the route a vessel took.

Lykes Company Ships

The Military Sea Transportation Service directly chartered merchant vessels to carry tactical herbicides during the Vietnam War. At least 28 vessels owned by the New Orleans, Louisiana-based Lykes Brothers Steamship Company transported Agent Orange between 1965 and 1970 from Gulf Coast ports to Southeast Asia. Lykes Brothers vessels were designed to handle cargo with cables that could place the cargo in a series of holds—numerous compartmented internal storage spaces. Tactical herbicides were stored vertically on pallets in these holds. The first large shipments of Agent Orange took place on the SS *Adabelle Lykes*, SS *Elizabeth Lykes*, and SS *Mayo Lykes*, traveling from the port of New Orleans, Louisiana, through the Panama Canal, and refueling in the Philippines before offloading a total of 1,782 55-gallon drums (approximately 97,000 gallons) in Saigon, Vietnam, in February and March of 1965.

Source: Photo from National Archives and Records Administration of a Lykes Line ship docked in Gulfport, Mississippi. Photo by San Antonio Air Materiel Area, Kelly Air Force Base, Texas (March 1969). | GAO-19-24

Our review of the logbooks and shipping articles for vessels carrying Agent Orange and other tactical herbicides showed that these vessels made stops at several U.S. and foreign ports, both in going to and in returning from Vietnam. For example, we identified vessels that stopped at several West Coast ports to load cargo before traveling to Vietnam, and others that made port calls to refuel in Hawaii. We also identified vessels that stopped at foreign ports such as Okinawa, Thailand, and Taiwan, as well as locations near the major U.S. Naval Supply Depots in Yokosuka, Japan, or Subic Bay, Philippines. These supply depots were major logistics hubs for U.S. military operations in East Asia, and they provided supplies to commercial ships that were chartered by DOD's Military Sea Transportation Service through contracts with shipping companies. These companies would reserve cargo space for military cargo and include Saigon, Vietnam, as a destination, but the voyages were otherwise made for normal commercial activities. From those locations, the cargo vessels traveled to one or more ports in Vietnam. However, while the logbooks we reviewed identify when vessels left the various ports as they traveled to and from Vietnam, logbooks do not provide information on whether and how much cargo was loaded and unloaded at those ports of call, nor do they indicate whether tactical herbicides were offloaded at any ports before the vessels reached Vietnam.

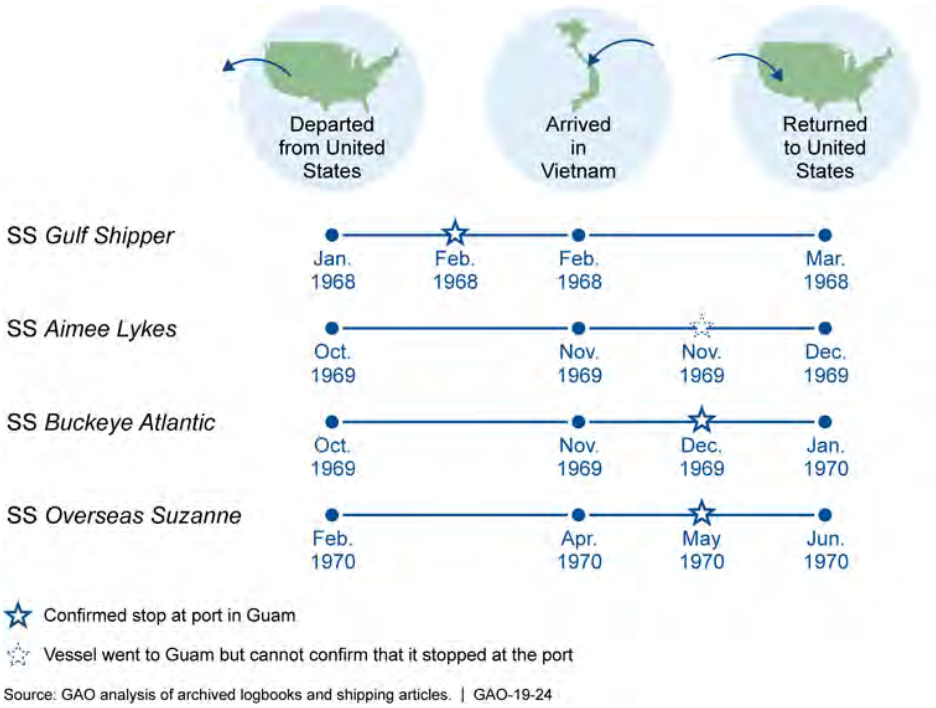
Available Shipment Documentation Indicates at Least One Vessel Carrying Agent Orange Went Through Guam en Route to Vietnam, but Archival Information Lacks Details or Is Not Complete

Based on our review of available logbooks, we identified at least one vessel carrying Agent Orange that stopped at Guam en route to Vietnam and at least three vessels that stopped at Guam on the return from Vietnam.[61] However, in our review of available shipment documentation, we found no evidence indicating that Agent Orange or any other tactical herbicides[62] were offloaded from those vessels or used in the U.S. territories of Guam or the Northern Mariana Islands. Figure 9 indicates the timelines of the four vessels known to have carried Agent Orange that stopped at Guam either on their way to or returning from Vietnam, each of which is discussed in detail below.

[61]As we discuss later, the logbook for one of the vessels does not identify a port stop on Guam, but it does include an entry indicating that the vessel pulled into Apra Harbor and offloaded an injured mariner onto a small motorboat to transport the individual for medical treatment on Guam. Therefore, we cannot confirm whether the vessel actually docked at Port Apra, Guam.

[62]Available records include limited information on Agent Purple, which was alleged to have been shipped to Guam at some time. While Agent Purple was outside of the scope of this review, earlier research that was conducted on the possible presence of Agent Purple on Guam found no records in the National Archives and Records Administration to indicate that Agent Purple was ever shipped to or stored on the Island of Guam. See Alvin Young and Kristian Young, *The Agents Orange and Purple Controversy on the Island of Guam* (Cheyenne, WY: September 2017).

Figure 9: Timelines of Vessels Carrying Agent Orange That Stopped at Guam on the Way to or from Vietnam

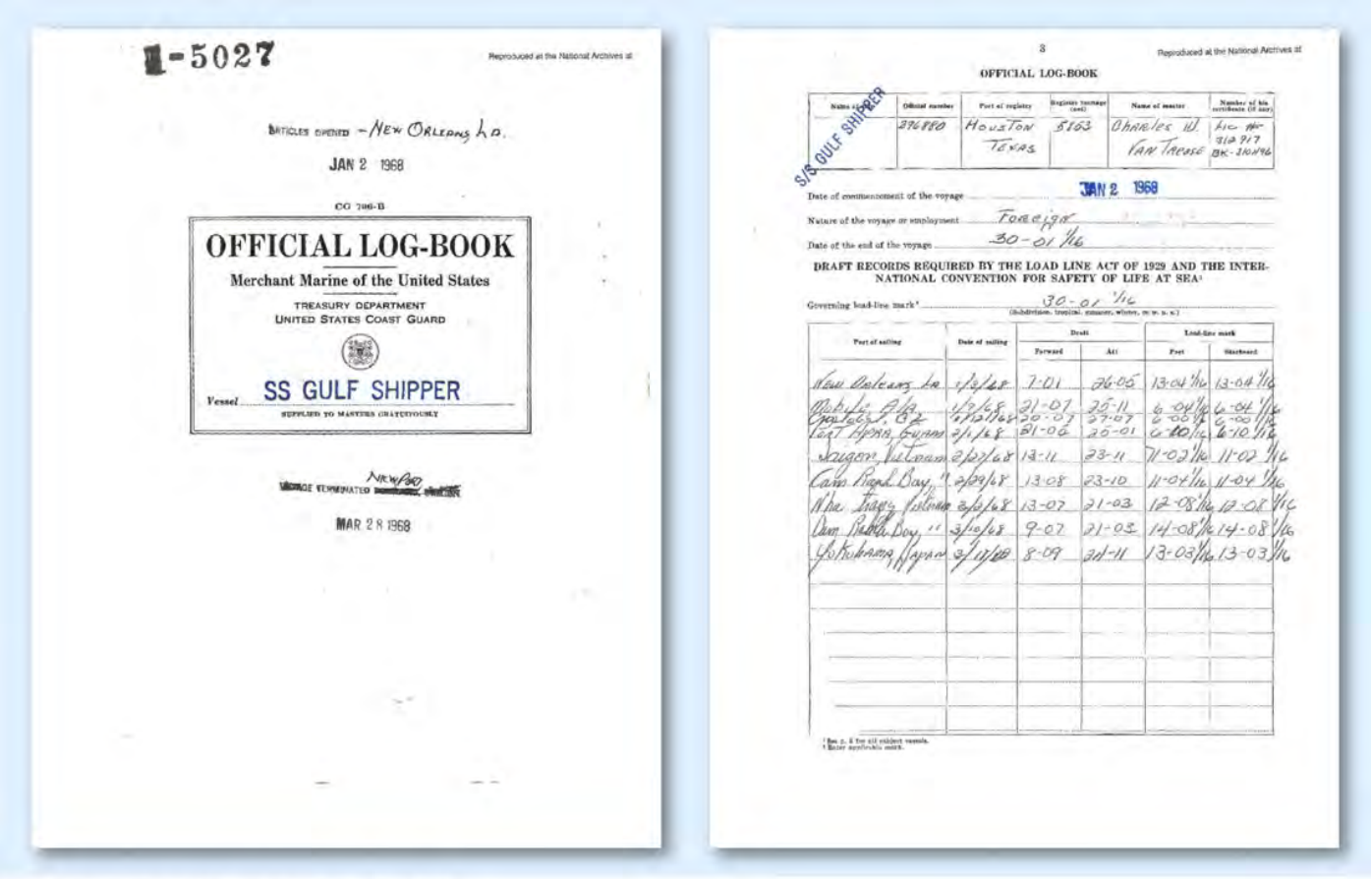


Source: GAO analysis of archived logbooks and shipping articles. | GAO-19-24

Note: While the ports of call listed in the SS *Aimee Lykes* logbook do not indicate a port of call on Guam, it does include an entry that describes pulling into Apra Harbor and offloading an injured mariner into a small motorboat so that the individual could be hospitalized on Guam. Therefore, we cannot confirm whether the vessel docked at Port Apra or stayed in the harbor.

Available shipment documentation indicates that hundreds of vessels delivered supplies to the Naval Supply Depot, including supplies bound for Andersen Air Force Base, on Guam during the Vietnam War due to both installations' strategic location in supporting the war effort. While the logbooks we were able to locate and review for vessels that transported Agent Orange to Southeast Asia between 1965 and 1970 do not show that these vessels typically stopped at Guam or the Northern Mariana Islands at any time during their voyages, we identified one ship carrying Agents Orange, Blue, and White that did stop at Guam on its way to Vietnam. Specifically, available records indicate that sometime around February 1, 1968, the SS *Gulf Shipper* stopped at Port Apra (now Apra Harbor) on Guam en route to Vietnam. Figure 10 shows a photo of the logbook from the SS *Gulf Shipper* indicating the ship's ports of call en route to Vietnam.

Figure 10: Excerpts from March 1968 SS *Gulf Shipper* Logbook



1-5027

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ARTICLES OPENED – NEW ORLEANS LA.

JAN 2 1968

CG 706-B

OFFICIAL LOG-BOOK

Merchant Marine of the United States

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

Vessel SS GULF SHIPPER

SUPPLIED TO MASTERS GRATUITOUSLY

NEW/PAD

MAR 28 1968

3

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OFFICIAL LOG-BOOK

Official number	Port of registry	Gross tonnage	Name of master	Number of his certificate
296880	HOUSTON TEXAS	5163	CHARLES W VAN TREASE	LIC NO 312 917 BK-310496

S/S GULF SHIPPER

Date of commencement of the voyage JAN 2 1968

Nature of the voyage or employment Foreign

Date of the end of the voyage 30-01 1/16

DRAFT RECORDS REQUIRED BY THE LOAD LINE ACT OF 1929 AND THE INTERNATIONAL CONVENTION FOR SAFETY OF LIFE AT SEA[1]

Governing load-line mark[2] 30-01 1/16
(Subdivision, tropical, summer, winter, or w. n. a.)

Port of sailing	Date of sailing	Draft Forward	Draft Aft	Load-line mark Port	Load-line mark Starboard
New Orleans La	1/2/68	7-01	26-05	13-04 1/16	13-04 1/16
Mobile Ala	1/3/68	21-07	25-11	6-04 1/16	6-04 1/16
Pascagoula Miss	1/5/68	20-03	23-07	6-08 1/16	6-08 1/16
East Apra Guam	2/1/68	21-06	25-01	6-10 1/16	6-10 1/16
Saigon Vietnam	2/20/68	13-11	23-11	11-02 1/16	11-02 1/16
Cam Ranh Bay "	2/29/68	13-08	23-10	11-04 1/16	11-04 1/16
Nha Trang Vietnam	3/5/68	13-07	21-03	12-08 1/16	12-08 1/16
Cam Ranh Bay "	3/10/68	9-07	21-05	14-08 1/16	14-08 1/16
Yokohama Japan	3/17/68	8-09	20-11	13-03 1/16	13-03 1/16

[1] Yes or No for all oilskin vessels.
[2] Enter applicable mark.

Source: National Archives and Records Administration. | GAO-19-24

The logbooks do not provide details about whether cargo was moved on or off the vessels during these port calls, or whether tactical herbicides were offloaded at these ports before the vessels reached Vietnam. However, the SS *Gulf Shipper's* logbook indicates that the stop at Guam could have been related at least in part to the repatriation of an injured crew member to the United States, and not to matters related to the loading or unloading of cargo. Further efforts to locate information on cargo movements for the SS *Gulf Shipper*, such as customs records, manifests, or bills of lading, were unsuccessful, because those records were not routinely retained. As such, we were not able to verify why the

SS *Gulf Shipper* stopped at Guam, what its crew did while there, or whether any cargo was loaded or unloaded.[63]

We also identified at least three vessels that stopped on Guam on their return from Vietnam, based on our review of available logbooks. Specifically, around November 30, 1969, the SS *Aimee Lykes* stopped at Port Apra on Guam and offloaded an injured crew member into a small motorboat so that he could be hospitalized on Guam. In addition, around December 23, 1969, the SS *Buckeye Atlantic* stopped at Guam and offloaded two injured crew members. Lastly, around May 5, 1970, the SS *Overseas Suzanne* stopped at Guam and offloaded an injured crew member. Based on a review of the vessels' logbooks, it is not clear whether the stops at Guam were for reasons other than offloading injured crew members—for example, reasons related to the loading or unloading of any cargo.[64] Appendix III describes information that we were able to obtain regarding the quantities of herbicides known to have been shipped to Southeast Asia on the four vessels that we identified as having stopped at Guam (either on the way to or from Vietnam) between February 1968 and May 1970.

As noted earlier, based on our review of available shipment documentation, we were able to identify approximately 87 percent of the shipments of Agent Orange to Southeast Asia, and to obtain logbooks for about 96 percent of the vessels known to have transported Agent Orange from U.S. ports to Vietnam. Because we were unable to obtain logbooks for every shipment of Agent Orange, we cannot conclude with certainty whether any ships other than the SS *Gulf Shipper* that were transporting the tactical herbicide to Vietnam, or the three ships returning to the United States from Vietnam—the SS *Aimee Lykes*, the SS *Buckeye Atlantic*, and the SS *Overseas Suzanne*—made port calls either at Guam or the Northern Mariana Islands. Additionally, we found and U.S Air Force officials agreed that it is unlikely that Agent Orange was shipped by air to or from Guam. The U.S. Air Force transported small quantities of tactical herbicides by air to Vietnam in 1961. However, we did not identify any documentation showing the transport of tactical herbicides by air to

[63]See appendix I for more information on the steps GAO took to attempt to locate information on the cargo movements for this SS *Gulf Shipper* voyage.

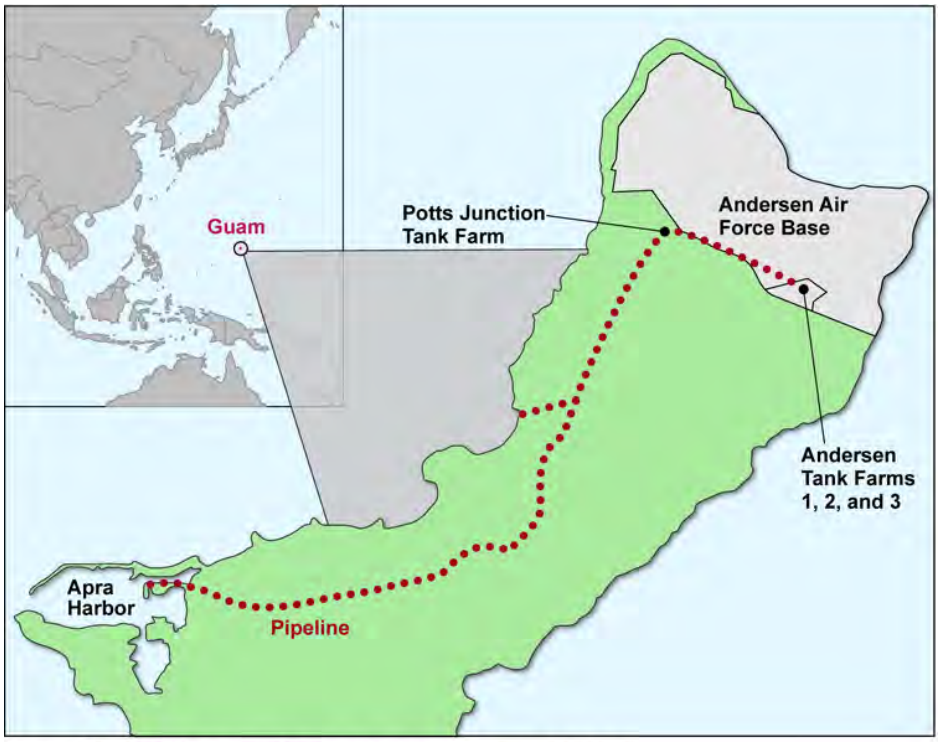
[64]Archival sources we reviewed did not provide information on the cargo that was loaded on these vessels after they arrived in Southeast Asia and began their return voyages to domestic U.S. ports. Additionally, logbooks do not provide information about whether cargo was moved onto or off of vessels at any port calls during these voyages.

Vietnam after 1961. During our visit, officials at Andersen Air Force Base stated that it would have been possible to fly 55-gallon drums from Guam to supply operations in Vietnam, but that such an action would have been an inefficient method of transporting large quantities of herbicides. Agent Orange weighed approximately 600 pounds per drum, or about 11 pounds per gallon, a weight that, according to a 1966 memorandum from the Military Assistance Command, Vietnam, would have precluded large-scale transport of the herbicide by aircraft.

DOD Documents Identify the Use of Commercial but Not Tactical Herbicides on Guam

Available records show that DOD stored and used commercial herbicides on Guam, possibly including those containing n-butyl 2,4,5-T, during the 1960s and 1970s, but documents do not indicate the use of tactical herbicides on Guam. Commercial herbicides were available through the federal supply system for use on U.S. military installations worldwide. For example, the fuel supply for Andersen Air Force Base was delivered by ship to the port at Naval Base Guam and was then delivered to the Air Force base by a cross-island fuel pipeline—see figure 11. A detailed 1968 report by the Naval Supply Depot states that the Public Works Center sprayed herbicides semi-annually to control the vegetation along fuel pipelines between the depot and Andersen Air Force Base.

Figure 11: Fuel Pipeline from Naval Base Guam to Andersen Air Force Base in 1968



Source: GAO analysis of Department of Defense data; Map Resources (map). | GAO-19-24

Note: Document entitled, “Condition of Naval Supply Depot” (June 1968).

Additionally, draft environmental assessments written in 1999 and 2009 by Naval Facilities Engineering Command, Pacific, indicate that commercial herbicides containing 2,4-D were present on Guam, and that commercial herbicides containing 2,4,5-T, which included the contaminant 2,3,7,8-TCDD, had been used for weed control along power lines and substations through 1980. Further, a 1969 master storage plan for the Naval Supply Depot includes sketches of storage facilities that specify the location of weed killers. Commercial herbicides approved for DOD procurement for use on installations were issued in 55-gallon drums and 5-gallon containers during the Vietnam War era, as were a range of other products, such as fuel oil and diesel. According to DOD officials, records for such purchases were not typically retained due to short record retention policies related to such routine supply transactions.

During the course of our review, we received photographs and written statements from veterans alleging the presence of Agent Orange on Guam. However, based on our discussion sessions with veterans and civilians and our review of this documentation, we could not substantiate the presence or use of Agent Orange or other tactical herbicides on Guam. We asked veterans in our six discussion sessions about their potential for exposure to Agent Orange and where, if, and how they believe they were exposed. In their responses, some veterans in each of the six discussion sessions stated that they believe they were exposed to Agent Orange while deployed in Vietnam or other areas where a presumption of service for benefits has already been granted, while some veterans in three of the six discussion sessions stated that they believe they were exposed to Agent Orange while stationed on Guam. Specifically, some veterans in our discussion sessions described using herbicides or witnessing the spraying of herbicides at locations on Andersen Air Force Base and along the pipeline, as well as the burning of contaminated fuel as part of firefighting training on the installation. As we previously stated, according to DOD officials and archived military specifications, tactical herbicides were not authorized or available for use on lands owned by, or otherwise managed as military installations. However, commercial herbicides were widely available worldwide for use in vegetation management at military installations, to include controlling vegetation adjacent to flightlines or along perimeter fencing.

Selected Comments by Veterans at Discussion Sessions Moderated by GAO Regarding Where They Believe They Were Exposed to Agent Orange or Its Components

- I feel like I was exposed on Guam. I was [on] temporary duty there during the conflict and my duties were as a squadron controller that worked the schedules for the B-52 Bombers on Guam. I did venture into the loading area because I was with the aircrew on the Navy field at Andersen Air Force Base.
- I thought I was in contact with Agent Orange in Guam loading bombs in sites. We would move from one site to another and they would spray those areas before we got there. I never saw spraying but could smell it. One time I was near that and I broke out in boils and blisters on my face and arms.
- I was a fuel specialist [and] I witnessed spraying going on at the barracks at Marbo Annex, 2 to 3 miles off the main Air Force base. It was sprayed all around the barracks. As my job, I worked at POL [fuels]—where they stored all of the 55-gallon drums—fuels, pesticides, herbicides—in bulk storage. Those were constantly sprayed around—for maintenance and fire safety. Also, I would work on the flightline and at the pump houses—these were about 20 yards from the security fence. As I was working there, I witnessed spraying.

Source: Comments from veterans during GAO's facilitated discussions at moderated discussion sessions. | GAO-19-24.

Note: We documented, as closely as possible, the actual comments made by veterans and civilians at the six moderated discussion sessions held from December 2017 to March 2018. We did not edit their comments to further clarify the information provided. The views of these veterans are not generalizable to all veterans, but they provide illustrative examples of comments that we heard. The veterans' comments also do not necessarily reflect GAO conclusions contained in this report.

DOD's List of Herbicide Testing and Storage Locations Is Incomplete, and Veterans Have Expressed Confusion about How to Obtain Information on Potential Exposure

DOD's official compilation of herbicide testing and storage locations outside of Vietnam, which is posted on the VA's website, is inaccurate and incomplete, and DOD does not have a process for managing the list. Further, while DOD and VA each have methods for communicating information to veterans and the public about Agent Orange, they do not have a formal process for communicating the most accurate available information to veterans about potential locations where they could have been exposed to Agent Orange or other tactical herbicides.

DOD's List of Locations Where Herbicides Were Tested and Stored Is Inaccurate and Incomplete

DOD developed a list that identifies locations and dates where herbicides, including Agent Orange, are thought to have been tested and stored outside of Vietnam, which VA has made publicly available on its website, but this list is neither accurate nor complete. DOD's list includes information on testing and storage locations, applicable dates, the herbicide or herbicide components tested, a description of the project, and DOD's involvement. See appendix IV for the list that was posted on the VA website as of September 2018. When we began this review, DOD and VA officials were unable to identify the origin of the DOD list that is posted on the VA website, which does not have a date. A DOD official subsequently informed us that the list was initially created in 2003 by an individual in the Office of the Secretary of Defense in response to a congressional inquiry about the use of Vietnam-era herbicides at specific locations in the United States and overseas. DOD subsequently provided this list to VA, which in turn posted the information on its website. *VA's Claims Adjudication Procedures Manual* related to Agent Orange directs VA officials to review the DOD list to determine whether herbicides were used as claimed as part of verifying potential herbicide exposure when a veteran alleges exposure at locations other than the Republic of Vietnam, the Korean demilitarized zone, or Thailand.[65] However, in our review of

[65]VA Claims Adjudication Procedures Manual, M21-1, part IV, subpart ii, ch. 1, sec. H, *Developing Claims for Service Connection (SC) Based on Herbicide Exposure* (change date Mar. 27, 2018).

several sources provided by DOD and VA officials,[66] we identified multiple examples of inaccurate and incomplete information in DOD's list, to include the following:[67]

- **Omission of specific testing and storage locations:** We identified additional testing and storage locations in the United States and its territories that were not included on DOD's list.[68] For instance, we identified additional testing locations at Belle Glade, Florida, and Stuttgart, Arkansas, where researchers reported small-plot field tests of the components of Agent Orange on rice. In addition, we found examples of shipments of herbicides to Kelly Air Force Base, Texas, where Agent Orange components were stored following the cancellation of tactical herbicide contracts. None of these locations are included on DOD's list.
- **Lack of clarity in descriptive information:** DOD's list lacks clarity in descriptive information, making it difficult to identify which specific herbicides or components were tested and stored, as well as when and where. For example, the size and scope of some testing activities are unclear from the descriptions provided in DOD's list, making it difficult to differentiate between small-scale and large-scale testing. Some testing events on DOD's list are described in detail, including the amount of herbicide or components tested, while descriptions of other testing activities contain little information about what took place. Furthermore, we could not identify the chemical components of some of the agents on DOD's list. We asked DOD and VA officials to identify those specific agents for us, and they were unable to do so. Specifically, neither DOD nor VA officials could identify the chemical

[66]We reviewed, for example, the proceedings of three defoliation conferences; archives search reports and other environmental studies for several Army, Air Force, and Navy installations; contractor studies; and other historical documents related to the development and testing of tactical herbicides, including Agent Orange.

[67]We did not attempt to recreate the DOD list or perform a comprehensive update of its contents; therefore, there may be other locations and testing events that are not reflected above.

[68]While we did not work to identify every location, in our research we found at least 30 testing and storage locations that were not included. Of these locations, 20 were identified in a report prepared for DOD in 2006, and we identified an additional 9 locations that were neither in the 2006 report nor on the list on VA's website. Our research also indicated that this list did not include, among the storage locations, the manufacturing sites, nor did it include all of the ports from which Agent Orange was shipped to Southeast Asia.

composition of 26 different agents on the DOD list, making it difficult to determine whether these agents should be included on the list.[69]

- **Omission of additional time periods for identified locations:** We identified additional testing events of Agent Orange or its components at locations that are on the DOD list but that cover additional time periods not reflected on the list. For instance, the DOD list identified testing that took place at Aberdeen Proving Grounds, Maryland, in July 1969. However, our review uncovered additional testing events that took place at Aberdeen Proving Grounds in 1963, 1965, and 1966.[70]

In addition to the lack of clarity and omissions that we identified, reports commissioned by DOD and VA since 2003 have also identified omissions in the list. For example, a report prepared for DOD in 2006 identified 40 different locations where Agent Orange was tested or stored outside of Vietnam.[71] However, during our review, we found several examples of locations in the United States and its territories that were included in that 2006 report but are not included on the DOD list that is currently posted on the VA website. These include locations in Arkansas, California, New Jersey, New York, Maryland, Ohio, Oregon, Puerto Rico, Texas, and Utah.[72] Similarly, a report prepared for VA in May 2013 described

[69]The DOD list also included a biological agent called stem rust of wheat that is not an herbicide. Amiendo and V-C 3-173 are two examples of agents on the list that neither DOD nor VA officials could identify.

[70]We did not work to identify every instance where there were additional testing events at every location on DOD's list. We refer to the testing at Aberdeen Proving Grounds as an illustration of incomplete information in DOD's list. In addition to the testing events at Aberdeen Proving Grounds, archival sources show that there was application of 2,4,5-T; 2,4-D; and other commercial herbicides continuing into the 1970s as part of the installation's vegetation management.

[71]Alvin Young, *The History of the US Department of Defense Programs for the Testing, Evaluation, and Storage of Tactical Herbicides* (Cheyenne, WY: December 2006). This report was prepared for DOD and, according to a DOD official, has not been publicly released. We did not perform an independent assessment of the information on site locations and dates in this report, using archival sources, nor did we evaluate the potential that a veteran could have been exposed at those locations.

[72]Locations that were included in the 2006 report but are not included on the list on the VA website include: Dugway, Utah; Middleport, New York; Preston, Maryland; Llano, Texas; Refugio, Texas; Victoria, Texas; Carlos, Texas; Livingston, Texas; Maricao, Puerto Rico; Guajataca, Puerto Rico; Toro Negro, Puerto Rico; El Verde, Puerto Rico; Jimenez, Puerto Rico; Garden City, Kansas; Corvallis, Oregon; Pullman, Washington; Bound-Brook, New Jersey; Painesville, Ohio; Jacksonville, Arkansas; and Van Nuys, California. Note that the list in the 2006 report contained additional time periods for some locations that also were not included on DOD's list on the VA website.

locations where Agent Orange exposure to Vietnam-era veterans has been alleged.[73] This report summarized additional sites where veterans alleged Agent Orange was used, stored, or destroyed. It also included an assessment of the DOD information posted on the VA's website—and indicated, notably, that information had not changed since the 2006 report to DOD. In the assessment, the report identified that the list contained many errors of dates, chemicals, locations, and the governmental agencies or institutions responsible for conducting the tests or military operations. The report suggested specific criteria for validating the presence of a tactical herbicide at a site, including evidence that a veteran actually came into contact with a tactical herbicide at that site.[74]

Even though they have received reports dating back more than a decade that identified issues with the accuracy and completeness of the list, neither DOD nor VA has taken steps to validate or correct the list, or to develop the criteria they would use to determine which locations and dates to include on the list. As previously stated, this list is posted on the VA's Agent Orange website as a primary source for veterans seeking information on Agent Orange. Despite its inconsistencies, the list can be accessed from multiple places on the VA website, and we found that some veterans service organizations and other groups also post this incomplete and inaccurate list of testing and storage sites on their websites, as well as communicate this information to their members. *Standards for Internal Control in the Federal Government* state that agencies should use quality information to achieve their objectives.[75] We found and DOD officials agreed that DOD's list was not as accurate or complete as available records would allow because (1) there are not clearly identified responsibilities for validating the information on this list, (2) there is no process for updating the list as needed, and (3) criteria

[73]Alvin Young, *Investigations into Sites Where Agent Orange Exposure to Vietnam-Era Veterans Has Been Alleged* (Cheyenne, WY: May 2013). This report was prepared for VA and, according to VA officials, has not been publicly released.

[74]We did not perform an independent assessment of the information on site locations and dates in this report, using archival sources, nor did we evaluate the criteria that the report proposes DOD and VA use in determining the presence of Agent Orange, or the potential that a veteran could have been exposed at those locations. We mention the 2006 and 2013 reports to illustrate that both DOD and VA were aware that the list on the VA website was inaccurate and incomplete, but have not taken steps to update the list.

[75]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

have not been developed and used to determine which locations and dates to include on the list.

Until recently, neither DOD nor VA has taken responsibility for ensuring the accuracy and completeness of the list, which is being provided to veterans and the public on the VA website. Federal internal control standards state that management should establish an organizational structure, assign responsibility, and delegate authority to achieve the entity's objectives.[76] As noted earlier, DOD and VA officials were initially unable to identify the source or date of this list, and neither agency took action to respond to reports about the problems with it. During the course of our review, DOD took some initial steps to begin validating the accuracy and completeness of information on its list by reviewing primary source records for additional locations and events of herbicide testing and storage. However, thus far in its efforts, DOD has not identified responsibilities for completing the validation of the information included on the list, nor has it established a process for updating the list as any new information becomes available.

Moreover, it remains unclear whether DOD's review will cover all locations, including non-DOD sites, where testing and storage of Agent Orange or its components were thought to have occurred, or if it will focus only on U.S. military installations. Private companies, academic institutions, and other federal agencies were involved in the testing of herbicides at some of the non-DOD sites on the list, and, in some of those cases, Army personnel were involved in the testing at the non-DOD locations. For instance, testing was performed by DOD personnel at non-DOD locations in Georgia and Tennessee in the 1960s. Some non-DOD storage locations included various U.S. commercial ports, such as Mobile, Alabama, where Agent Orange was transferred by rail from the manufacturers to be stored until it was loaded onto vessels for shipment to Vietnam. According to a DOD official, DOD's priority in its review of testing and storage locations is to focus on DOD installations. Although this official told us that the department expects to eventually identify non-DOD locations where the department was involved in herbicide testing and/ or storage through collaboration or funding, the official was not able to provide information on the time frames for conducting this review. Finally, DOD has not established a process for how this list will be updated once it has been validated and revised, when and if new

[76]GAO-14-704G.

information about Agent Orange testing and storage locations is identified.

In our analysis of the DOD list, we were also unable to determine the criteria that DOD initially used to select which locations and time periods to include—particularly given that the testing varied in intensity and duration, and that the likelihood that personnel at a particular location could have been exposed to the herbicides or components was unclear. For example, some tests on the list included small laboratory experiments on a couple of plants using a very small amount of chemical agents, as in bench tests of various compounds at Forts Detrick and Ritchie, Maryland, in the 1950s, while other tests included gallons of Agent Orange or other chemical agent components that were used in field testing trials or to test aerial spraying, as in a defoliation effort in which 13 drums were sprayed by helicopter over an area covering 4 square miles. Similarly, the duration of testing events could have been over a total of 3 days, as with spray testing in Marathon, Florida, or over several months or even years, as with spray testing of several tactical herbicides at Eglin Air Force Base, Florida. Because of the variance in the size and duration of testing events; the specific areas where the testing events took place at the locations; and the number of personnel who actually came into contact with the chemical agents during the testing, the presence of a location on this list does not clearly indicate the likelihood or extent of potential exposure that individuals not involved would have had if they were simply present at the locations on the list at the times indicated.

In May 2018, during the course of our review, a DOD official noted that DOD and VA formed a joint Herbicide Orange Working Group to address the issues with the DOD list and identify criteria for including information on this list. This group held its first meeting on May 31, 2018. As of July 2018, a DOD official noted that the group was working to identify appropriate steps to take, but that it was too soon to report specific actions that were being implemented, and that no documentation on the group's efforts was available.

Without assigned responsibility for ensuring an accurate and complete list of locations where Agent Orange or its components were tested and stored; a process for updating the list as needed; and clearly defined and transparent criteria for what to include on this list, DOD will not have reasonable assurance that it has identified the most complete information possible for VA to use when informing veterans and the public of the full extent of locations where Agent Orange exposure could potentially have occurred. As a result, veterans may not have complete information about

the risk that they could have been exposed to Agent Orange during their military service, and VA may not have quality information when making important decisions on claims for veterans who may not be eligible for benefits.

DOD and VA Have Communicated with Veterans and Others about Potential Exposure to Agent Orange, but Veterans Have Expressed Confusion Regarding How to Obtain Needed Information

Both DOD and VA have communicated with veterans in response to inquiries about Agent Orange, but veterans have expressed confusion regarding how to obtain information to determine their potential exposure to Agent Orange. Further adding to this confusion are inconsistencies in the list of testing and storage locations, as discussed above. As the agency responsible for reviewing and validating veterans' disability compensation claims for possible Agent Orange exposure, VA communicates with veterans largely through the agency's website, which contains information on Agent Orange regarding related diseases, benefits, exposure locations, and resources. The VA also communicates through other means, including an annual newsletter and forums with veterans service organizations. DOD also receives inquiries from veterans about the potential that they could have been exposed to Agent Orange at DOD installations outside of Vietnam. In addition, DOD receives Freedom of Information Act inquiries and congressional requests for information on where Agent Orange was present. A DOD official stated that while they will respond to veterans' inquiries, they typically direct veterans with Agent Orange inquiries to VA.

In responding to these inquiries, both DOD and VA officials stated that they rely on the expertise of staff at the Armed Forces Pest Management Board to provide details to answer questions related to locations where exposure might have occurred. According to a DOD official, the board received 109 inquiries in 2017 alone. In addition, DOD's Joint Services Records Research Center provides information to VA regional liaisons electronically in response to their questions about where and when specific units were stationed or on temporary duty. The center extracts operational records from various record repositories and, if the information is available, corroborates the descriptions of incidents described by veterans in their claims. According to DOD officials, unless an herbicide-related incident was documented in some sort of unit record, the center would not have information on where Agent Orange was present.

Despite these various approaches for communicating information to veterans and the public, veterans we spoke with expressed confusion as to where to obtain information on their potential exposure to Agent

Orange. Specifically, we asked veterans in our six discussion sessions about what they had heard from DOD, VA, or other federal agencies about the potential that they could have been exposed to Agent Orange or its components at locations where Agent Orange was manufactured, transported, stored, used, or destroyed. Veterans in each of the six sessions stated that, generally, the federal government has not reached out to them regarding Agent Orange, but that they instead have relied on their own research to learn more about their potential for having been exposed, adding to the confusion about where to obtain information on Agent Orange exposure. Other veterans, however, stated that they have received information from VA regarding potential exposure. DOD officials acknowledged that there is confusion among veterans about a variety of issues related to their potential for exposure to Agent Orange, including where to go for information. U.S. EPA and DOD officials stated that veterans are contacting multiple agencies to get information on herbicide exposure.

Selected Comments by Veterans at Discussion Sessions Moderated by GAO Regarding What They Had Heard from the Federal Government about Negative Health Effects Associated with Exposure to Herbicides, Including Agent Orange or Its Components

- I've heard things from multiple sources—media, newspaper, television, people themselves. It has mainly been from my own research, not from a federal agency.
- Just based on the fact that I have heart disease and going through the VA process means I receive updates from VA on just about everything going on, including Agent Orange and all of the research they have done. I do know the Secretary is authorized by law from Congress late last year to add additional presumptive diseases associated with Agent Orange and how one would contract that.
- I had to do the research myself. It seems to be a secret with information coming out in spurts. When you have things happen to your body, they [the Department of Veterans Affairs] say it is not service connected. Sometimes when the government tries to explain something, they don't give the whole thing and they give it piecemeal. It does not carry any essence of importance.
- I am not hearing anything from the federal government. Most of the information I get is from a USveterans.com website and I subscribe to a daily newsletter from the Vietnam Veterans of America and the Veterans of Foreign Wars.
- There is information on the VA website about conditions attributed to Agent Orange In that context, I went to the VA website and found that there are 21 states where Agent Orange was used, including on Hawaii in Kauai. It is because of this list that I became aware that people in Hawaii may have been exposed to Agent Orange. I learned that such exposure might increase the likelihood of having diabetes or cancer. I believe the list is still on the VA website and that there is also a list of units that were possibly exposed to Agent Orange.
- I have not been contacted by any government agency with regard to Agent Orange exposure or ill health. I first heard about Agent Orange and dioxin and cancer related issues/illnesses in late 1980s or early 1990s and later on after doing own research.

Source: Comments from veterans during GAO's facilitated discussions at moderated discussion sessions. | GAO-19-24.

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Working Group has the potential for being an effective forum for communicating this information; however, a DOD official noted that this is an ad hoc group, and as we discussed earlier, it has not yet determined the direction it will be taking for communicating with veterans regarding exposure to Agent Orange. By coordinating on how best to communicate this information, VA would be better positioned to provide veterans with information regarding their potential exposure to Agent Orange at locations where Agent Orange was known to have been present outside of Vietnam.

Challenges Exist with Testing for Agent Orange Today Due to Degradation and Multiple Sources of Potential Contamination

Testing to determine whether Agent Orange was present in a particular location is challenging because, for example, derivatives of Agent Orange—including the two components of Agent Orange (n-butyl 2,4-D and n-butyl 2,4,5-T) and the contaminant from the 2,4,5-T manufacturing process (2,3,7,8-TCDD)—degrade over time, and because derivatives of 2,4-D and 2,4,5-T can come from multiple sources. Regardless of these challenges, in response to a request by the Government of Guam, DOD developed a testing plan that was reviewed and accepted by U.S. EPA and Guam EPA to conduct a limited investigation into alleged Agent Orange use at three sites on Guam.

Testing for Agent Orange Presents Challenges Due to Degradation and Multiple Sources of Potential Contamination

Challenges Due to Degradation

Testing to identify locations where Agent Orange may have been present is challenging because the components of Agent Orange degrade over time. It has been nearly 50 years since Agent Orange was last transported and used in support of military operations in Vietnam. According to scientific research, it is difficult to find traces of the two components of Agent Orange—n-butyl 2,4-D and n-butyl 2,4,5-T—because, under normal environmental conditions, the n-butyl forms break

down rapidly into the acid forms.[79] Scientific research indicates that the half-lives of the acid forms of the chemical components 2,4-D and 2,4,5-T in soil can range from several days to many months, depending on conditions.[80] The World Health Organization has stated that the half-life of 2,4-D in soil is reported to range from 4 to 7 days in most soil types. According to the Centers for Disease Control and Prevention, the half-life of 2,4,5-T in soil varies with conditions, ranging from several weeks to many months.[81] In addition, when Agent Orange is sprayed for defoliation, there are several things that can happen to it. For example, it can be washed out by rain, degrade in the presence of sunlight (photodegradation), or slowly turn into a vapor (volatize) from surfaces such as foliage. These factors reduce the chances of finding traces of Agent Orange components after 50 years.

The amount of time it takes for the contaminant 2,3,7,8-TCDD to degrade is longer than that for the components of Agent Orange, although estimates vary. For example, according to the research cited by the Agency for Toxic Substances and Disease Registry, the half-life of 2,3,7,8-TCDD is approximately 9 to 15 years in surface soil and 25 to 100 years in subsurface soil.[82] Further, 2,3,7,8-TCDD breaks down quickly when exposed to sunlight, providing one explanation for the shorter half-life in surface soil.[83] Any 2,3,7,8-TCDD contamination from herbicide

[79]U.S. Department of Agriculture, Forest Service, *2,4-D Human Health and Ecological Risk Assessment Final Report*, (Arlington, Va., Sept. 30, 2006); National Library of Medicine Toxicology Data Network, *2,4,5-T, N-Butyl Ester*, accessed November 1, 2018, https://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+4494. The EPA method used for testing samples includes a step that converts herbicide esters into the acid forms of 2,4-D and 2,4,5-T prior to analysis.

[80]A half-life is the time it takes for a certain amount of an herbicide to be reduced by half, which occurs as it dissipates or breaks down in the environment.

[81]World Health Organization, *2,4-D in Drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality* (Geneva, Switzerland: 2003); Centers for Disease Control and Prevention, *Biomonitoring Summary: 2,4,5-Trichlorophenoxyacetic Acid*, CAS No. 93-76-5, 2016.

[82]Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Chlorinated Dibenzo-p-dioxins* (Atlanta, G.A.: December 1998), citing D.J. Paustenbach, R.J. Wenning, V. Lau, et al., 1992. Recent developments on the hazards posed by 2,3,7,8-tetrachlorodibenzo-p-dioxin in soil: Implications for setting risk-based cleanup levels at residential and industrial sites. J Toxicol Environ Health 36(2):103-150.

[83]D. G. Crosby and A. S. Wong, "Environmental Degradation of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)," *Science*, New Series, vol. 195, no. 4284 (Mar. 25, 1977).

spraying—as opposed to being spilled onto the soil—would generally be expected to be found in surface soil, where it would be exposed to degradation due to sunlight. This reduces the likelihood of detecting this compound 50 years later. However, as discussed below, there are multiple sources of dioxins, including 2,3,7,8-TCDD, and the specific source of dioxin contamination is difficult to identify.

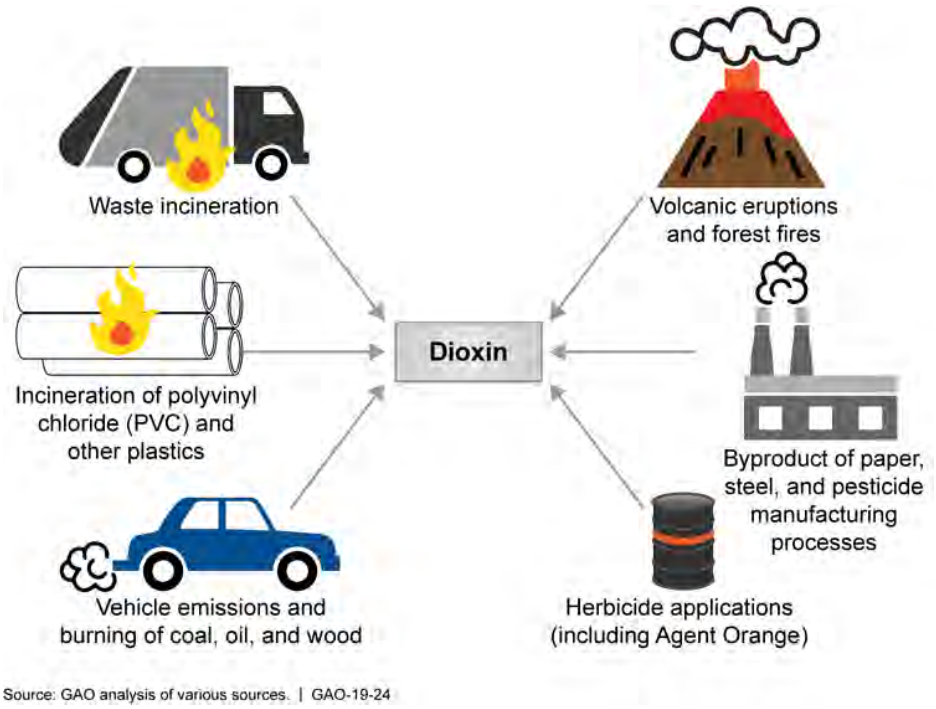
Challenges Due to Multiple Sources of Potential Contamination

Testing to identify locations where Agent Orange may have been present is challenging because there are multiple sources of 2,4-D and 2,4,5-T derivatives as well as multiple sources of the contaminant, 2,3,7,8-TCDD. Specifically, many commercial herbicides that were available at the time Agent Orange was used contained derivatives of 2,4-D; 2,4,5-T; or both. Additionally, 2,4-D derivatives are still used in commercial herbicides today. Therefore, even if testing were to show the presence of one of the two components of Agent Orange, it would be difficult to distinguish whether the chemicals were present from the use of commercial herbicides or the use of tactical herbicides. Further, because 2,4-D is still used in many commonly used herbicides sold today, the presence of this component could be due to a recent use of a commercial herbicide rather than a tactical herbicide used decades ago.

Moreover, multiple sources of the contaminant 2,3,7,8-TCDD can be found in the environment today. DOD and U.S. EPA officials told us that if 2,3,7,8-TCDD is found in soil today, the source of the dioxin contamination could be a result of other sources besides Agent Orange. For example, according to the World Health Organization, dioxins—including 2,3,7,8-TCDD—are primarily released to the environment with the burning of materials such as wood and waste (see figure 12).[84]

[84]World Health Organization, *Dioxins and Their Effects on Human Health Fact Sheet* (Updated October 2016).

Figure 12: Examples of Sources That Contribute to the Presence of Dioxins in the Environment



Source: GAO analysis of various sources. | GAO-19-24

Testing for the Components of Agent Orange on Guam Is Challenging

In 2017 the Government of Guam coordinated with DOD to test for Agent Orange and other tactical herbicides at Andersen Air Force Base due to claims from veterans that they were exposed to Agent Orange while stationed on Guam during the 1960s and 1970s. In December 2017 DOD developed a draft testing plan in collaboration with U.S. EPA and Guam EPA to test for the acid form of the components 2,4-D and 2,4,5-T at three different sites on Andersen Air Force Base. The draft testing plan did not include testing for the presence of 2,3,7,8-TCDD. According to DOD and U.S. EPA officials, they are not testing for 2,3,7,8-TCDD because the test would not be able to conclusively link any positive results to the use of tactical herbicides, given that dioxins are also produced by, among other things, burning fossil fuels. These officials noted that, over time, large quantities of fuel have been burned at Andersen Air Force Base, and they stated their belief that if 2,3,7,8-TCDD were found, the likely source would be from combustion. The areas identified for testing included the fuel pipeline, a perimeter fenceline, and an area near some fuel storage tanks. See figure 13 for a photograph of

the fenceline testing site near the fuel storage tanks on Andersen Air Force Base.

Figure 13: Fenceline Testing Site Near the Fuel Storage Tanks at Andersen Air Force Base, Guam

Source: GAO. | GAO-19-24

Based on our initial review of the draft testing plan and a review of the scientific literature, we identified and discussed with DOD and U.S. EPA officials some challenges the two agencies would face in detecting the presence of Agent Orange on Guam due to two factors: (1) the short amount of time that it takes for 2,4-D and 2,4,5-T to degrade; and (2) the inability of testing to determine whether the presence of 2,4-D and 2,4,5-T is attributable to the use of Agent Orange or to some other source.

- Degradation of 2,4-D and 2,4,5-T: DOD officials and the jointly developed draft testing plan acknowledged that the planned testing would not be able to confirm the presence of Agent Orange, given that the components degrade over time. The draft testing plan indicates that the maximum half-lives of 2,4-D and 2,4,5-T are 14 days and 24 days, respectively, in soil and groundwater. Even given the possible variation in half-lives discussed above, it is likely that no detectable concentrations remain in soil today, given that the alleged period of use on Guam was in the 1960s and 1970s.
- Inability to distinguish whether the presence of 2,4-D and 2,4,5-T is attributable to the use of Agent Orange or some other source: Even if the results were to confirm the presence of either 2,4-D or 2,4,5-T in

any form, it would be difficult to distinguish the source of the chemical, and whether its presence was attributable to the use of Agent Orange or some other source. For example, 2,4-D is still in use today, and 2,4,5-T was used in both tactical and commercial herbicides during the 1960s. In addition, if the components were found, the interpretation of those results could be complicated by, for example, natural variability in the potential half-lives and the possibility of more recent use of banned products. Further, the testing protocol will convert all forms of 2,4-D and 2,4,5-T, including the ester forms, to the acid forms, further complicating any attempt to identify the source of the compounds.[85]

We discussed with cognizant officials the challenges that we identified in the draft testing plan to determine how the information from the testing would be used to inform U.S. EPA, DOD, veterans, and the public about whether Agent Orange was present on Andersen Air Force Base. DOD officials subsequently stated that the questions raised by us and internally within DOD led them to reconsider the approach for testing for Agent Orange on Guam. For example, in December 2017, DOD officials told us that they would begin testing for Agent Orange and other tactical herbicides in March 2018. In late March 2018, a DOD official noted that the department had placed the testing on hold until they were certain that the methodology to be employed would meet scientific rigor and could be replicated in future testing efforts at other locations. In April 2018, DOD officials told us that the contract execution took longer than anticipated, and that soil sample testing would commence that month.

In April 2018, DOD provided us with a copy of the final plan that was reviewed and approved by U.S. EPA and Guam EPA and was used to test for Agent Orange and other tactical herbicides at Andersen Air Force Base. When we reviewed the final testing plan and compared it with the draft previously provided, we found that some of the challenges we had initially identified in the draft testing plan, as described above, were still present. For example, based on our review of the final testing plan, with

[85]The original version of Agent Orange consisted of the n-butyl ester forms of 2,4-D and 2,4,5-T. As noted earlier, a later version of Agent Orange (II) consisted of the n-butyl ester form of 2,4-D and the isooctyl ester form of 2,4,5-T. The ester form of the chemicals breaks down into 2,4-D and 2,4,5-T when it undergoes a reaction with water. Herbicide esters generally have a half-life of less than one week in soil. The draft testing plan called for testing for the acid forms of 2,4-D and 2,4,5-T rather than the ester forms that were present in Agent Orange. According to DOD officials, sampling parameters and methodology address all of the tactical or non-tactical forms or mixtures and will return a single value for 2,4-D and for 2,4,5-T without regard to the form.

the proposed testing methodology, it would be difficult to determine if 2,4-D and 2,4,5-T came from Agent Orange or another source, and there were inconsistencies in the reported half-lives of the components of Agent Orange. At the same time, both DOD and U.S. EPA officials questioned the ability of any testing for 2,4-D or 2,4,5-T on Andersen Air Force Base to either confirm or deny the presence of Agent Orange on Guam. Specifically, the final testing plan states that more than 50 years have passed since the period of alleged use, and that a lack of detection provides no evidence that herbicides were not used historically. Moreover, U.S. EPA officials noted that the testing on Guam would not provide definitive proof of Agent Orange use on the island. Although DOD officials recognized these challenges and acknowledged the low probability of conclusively identifying the components of Agent Orange, they decided to move forward with testing to address veterans' and the public's concerns.

In April 2018, samples were collected from the three areas at Andersen Air Force Base, according to DOD officials. Each sample was divided following procedures outlined in the final testing plan, resulting in two identical sample sets. A sample set was sent to two independent laboratories for analysis. According to officials from DOD and U.S. EPA, test results and associated quality control reports from both laboratories agreed on the results from two of the area samples, but did not agree on the third area sample. The jointly developed decision rules for the sampling and analysis plan required the results from both laboratories to agree in order to draw a conclusion on the presence or absence of Agent Orange. As a result, according to the officials, the DOD, U.S. EPA, and Guam EPA project team agreed in July 2018 to resample the one area where the two labs reported differing results. The project team is updating the sampling and analysis plan to address the various possible reasons for the differing laboratory results in order to provide a conclusive final testing result. DOD officials told us they do not anticipate completing the updates for the sampling and analysis plan, field sampling, analysis, and reporting until early 2019. As such, we were not able to comment on the results of the final testing in this report. Moreover, DOD officials said that, provided the final resampling results are negative, DOD does not have plans to conduct additional testing, because the testing was conducted in areas alleged to be the likeliest locations for the application of Agent Orange. However, an official from U.S. EPA said that the challenges associated with testing on Guam are not insurmountable and that the agency would like to continue this investigation. Given that (1) DOD, working with U.S. EPA and Guam EPA, made a decision to test for Agent Orange and other tactical herbicides; (2) DOD, U.S. EPA, and Guam EPA

recognize the limitations associated with the testing; (3) the testing and analysis of results are still on-going; and (4) there is currently uncertainty regarding whether any additional testing will take place on Guam, we are not making any recommendations with respect to the testing plan or its execution.

Conclusions

DOD suspended the use of Agent Orange in Vietnam in 1970 and incinerated remaining stockpiles at sea in 1977, but concerns about the effects of exposure in U.S. locations have persisted. DOD developed a list that identifies locations and dates where herbicides, including Agent Orange, are thought to have been tested and stored outside of Vietnam, which VA has made publicly available on its website, but this list is neither accurate nor complete. Without assigning responsibilities for verifying the accuracy of the information included on the list; a process for ensuring that the list is updated, as new information is found; and clear and transparent criteria, indicating which locations should be included on the list, DOD and VA will not have assurance that they have the most complete information possible when informing veterans and the public of the full extent of locations where Agent Orange exposure could potentially have occurred. By relying on an inaccurate list, VA may not have quality information when making important decisions on claims for veterans who might or might not be eligible for benefits. Further, while DOD and VA both communicate with veterans in response to their Agent Orange inquiries, the two agencies do not have a formal process for coordinating on how best to communicate this information. Until DOD and VA develop a process for how best to coordinate to ensure that they are communicating information, veterans and the public may not have the information needed regarding their potential exposure to Agent Orange.

Recommendations for Executive Action

We are making six recommendations: four to the Secretary of Defense and two to the Secretary of Veterans Affairs.

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment assigns responsibility for ensuring that DOD's list of locations where Agent Orange or its components were tested and stored is as complete and accurate as available records allow. (Recommendation 1)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment develops a process for updating

the revised list as new information becomes available. (Recommendation 2)

The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations. (Recommendation 3)

The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations. (Recommendation 4)

The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam. (Recommendation 5)

The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam. (Recommendation 6)

Agency Comments and Our Evaluation

We provided a draft of this report for review and comment to DOD, VA, U.S. EPA, the U.S. Department of Agriculture, and the U.S. Department of Health and Human Services. In its written comments, DOD concurred with each of our four recommendations directed to the Secretary of Defense and identified actions it plans to take to implement them. In its written comments, VA concurred with one recommendation directed to the Secretary of VA and described actions it would take to implement the recommendation. VA also non-concurred with one recommendation. In its written comments, the U.S. Department of Agriculture agreed with the report's findings related to matters under the purview of agricultural research and programs, though we did not make any recommendations to the department. Comments from DOD, VA, and the U.S. Department of Agriculture are reprinted in their entirety in appendixes V through VII. We also received technical comments from DOD, VA, U.S. EPA, and the U.S. Department of Health and Human Services, which we incorporated as appropriate.

Based on oral comments we received from DOD, we revised our recommendation regarding the development of clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations to clarify that DOD and VA should collaborate on this effort. VA non-concurred with this recommendation, noting that DOD chairs the Herbicide Orange Working Group that will be responsible for developing the criteria (Recommendation 4). However, VA stated that as a member of the working group, it would work collaboratively with DOD as the lead. Doing so would meet the intent of our recommendation.

In its overall written comments, VA stated that it was concerned that the report conflates the terms “commercial herbicides” with “tactical herbicides,” which the department noted were distinctive from one another. While VA stated that it does not dispute that some chemicals found in the VA regulation may be included in certain commercial herbicides, VA noted that exposure to tactical herbicides intended for military operations in Vietnam is required for VA to grant disability benefits on a presumptive basis. We recognize that the presumption for service-connection applies to exposure to tactical herbicides and nothing in our report states otherwise. VA also stated in its letter that the focus on commercial herbicides is not relevant for determining the list of locations where tactical herbicides were tested or stored. We agree and as we noted in this report, the U.S. military managed tactical herbicides used during the Vietnam War era differently from commercial herbicides in the federal supply system, which were widely available worldwide for use in vegetation management at military installations. To avoid conflating tactical and commercial herbicides, the report further notes that while some of these commercial herbicides contained 2,4-D; 2,4,5-T; or both, these commercial herbicides were not in the n-butyl form used in Agent Orange. However, commercial herbicides with 2,4,5-T likely contained some level of 2,3,7,8-TCDD. Moreover, we believe it is important to reiterate that numerous commercial herbicides that were being widely used elsewhere for agriculture purposes contained the form of 2,4,5-T found in Agent Orange and thus its associated dioxin contaminant, 2,3,7,8-TCDD.

In its overall written comments, VA also recommended that GAO analyze its list to ensure that only locations where the presence of tactical herbicides has been confirmed are included on the list of locations. It is important to note that we do not maintain a list of herbicide testing and storage locations. As we noted in this report, DOD developed a list that identifies locations and dates where herbicides, including Agent Orange

and its components, are thought to have been tested and stored outside of Vietnam, which VA has made publicly available on its website.

We are sending copies of this report to the appropriate congressional addressees; the Secretaries of Defense, VA, Agriculture, and Health and Human Services; and the Administrator of U.S. EPA. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact Brian Lepore at (202) 512-4523 or leporeb@gao.gov or J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix VIII.

Brian J. Lepore
Director, Defense Capabilities and Management

J. Alfredo Gómez
Director, Natural Resources and Environment

List of Addressees

The Honorable Mac Thornberry
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Madeleine Z. Bordallo
Ranking Member
Subcommittee on Readiness
Committee on Armed Services
House of Representatives

The Honorable Tim Walz
Ranking Member
Committee on Veterans' Affairs
House of Representatives

The Honorable Gregorio Kilili Camacho Sablan
House of Representatives

Appendix I: Objectives, Scope, and Methodology

House Report 115–200 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that we review the government's handling of Agent Orange on Guam. In response to both this provision and a separate request letter, this report examines (1) the extent to which the federal government has information about the procurement, distribution, use, and disposition of Agent Orange or its components at locations in the United States and its territories, including Guam; (2) the extent to which the Department of Defense (DOD) and the Department of Veterans Affairs (VA) have complete and accurate information about where Agent Orange and its components were tested and stored and communicated this information to veterans and the public; and (3) challenges associated with testing for Agent Orange.

For objective one, we collected and reviewed available agency records and shipping documents on Agent Orange from the following sources:

- the U.S. National Archives and Records Administration;
- the U.S. National Agricultural Library;
- the U.S. Air Force Historical Research Agency at Maxwell Air Force Base, Alabama;
- staff historians at the Air Force Materiel Command at Wright-Patterson Air Force Base, Ohio, and Pacific Air Forces at Joint Base Pearl Harbor–Hickam, Hawaii;
- the Armed Forces Pest Management Board in Silver Spring, Maryland;
- the Defense Logistics Agency;
- the U.S. Army Corps of Engineers; and
- the Naval History and Heritage Command.

The records we researched and collected include published and unpublished materials on the procurement, shipment, and disposition of Agent Orange, including U.S. military correspondence, logistics reports, and Navy and merchant vessel logbooks. We reviewed DOD documents related to Agent Orange contracts to determine the total quantity of Agent Orange that was produced by the nine manufacturers. To show how much Agent Orange was used in Vietnam, we used estimates from the National Academy of Sciences analysis of Operation Ranch Hand data. Details about the estimated quantity of Agent Orange that was destroyed

in 1977 are available in public reports from DOD and the U.S. Environmental Protection Agency (U.S. EPA).[1]

We used a variety of archival sources to identify the shipping routes for Agent Orange, to include a database prepared for VA that lists records held in National Archives and Records Administration Record Group 341, which contains more than 200 boxes of unclassified records relating to tactical herbicides used in Vietnam. During our review of this record group, we identified and summarized the correspondence between and reports submitted by the U.S. military commands that managed the tactical herbicides, to identify details of tactical herbicide shipments and, to the extent that the data were available, to develop a consolidated list of shipments of Agent Orange, including vessel names, ports of embarkation and debarkation, time frames, and quantities. In some cases, individual source documents did not identify which specific tactical herbicides were being shipped. To the extent we were able, we used multiple sources to identify which shipments carried Agent Orange. For the purposes of this report, we refer to these records collectively as shipment documentation.

Using this shipment documentation, we located and obtained from several regional facilities of the National Archives and Records Administration logbooks for the vessels that we had identified as having shipped Agent Orange—hereinafter referred to as logbooks—which accounted for approximately 83 percent of the shipments we found. Logbooks that were submitted to port authorities upon the vessels' returns to the United States were consolidated at National Archives and Records Administration facilities including Fort Worth, Texas; Seattle, Washington; San Francisco and Riverside, California; New York, New York; Philadelphia, Pennsylvania; Boston, Massachusetts; Chicago, Illinois; and Atlanta, Georgia, as well as at Archives I in Washington, D.C., and Archives II in College Park, Maryland.[2] These logbooks recorded basic details about each ship's operation and route, which we analyzed to identify any shipments that stopped at locations in the United States or its

[1]We used the best available records to identify the amounts of Agent Orange we refer to in this report, but these figures should be seen as estimates.

[2]We also contacted archivists at the regional archives in Denver, Colorado, and St. Louis, Missouri, to confirm that there were no merchant vessel logbooks from the Vietnam War era archived at their locations. The regional archives facility in Kansas City, Missouri, does not maintain logbooks prior to the 1970s but does store logbooks for some other archives facilities that have run out of room at their locations.

territories before arriving in Vietnam. Because none of the logbooks we reviewed provided detail about the specific types of cargo that were loaded onto or unloaded from the vessels, we relied on available military correspondence and reports about those vessels to identify whether the ships carried Agent Orange.

We attempted to locate the remaining 17 percent of the logbooks, or 27 shipments. Of those shipments, 3 were by foreign-flagged merchant vessels, which did not submit logbooks to U.S. ports. Working with officials from the U.S. Coast Guard, the agency that oversees the retention and archiving of logbooks, we coordinated with archivists at the Federal Records Centers to determine whether there were any unprocessed boxes of logbooks that had not yet been archived. When that effort did not turn up additional logbooks, we worked with archivists at Archives I to obtain copies of shipping articles—the articles of agreement between the captain of a ship and the seamen with respect to wages, length of time for which they are shipped, and related matters—for the remaining 24 shipments. While these documents focus on employment issues, the annotations include the locations where different personnel actions took place. We reviewed these documents to identify the locations and approximate dates of the ports of call during those voyages. We were able to obtain the shipping articles for the 24 remaining voyages, as well as for the one vessel that stopped in Guam on the way to Vietnam (SS *Gulf Shipper*) and the three that stopped in Guam on the way back (SS *Aimee Lykes*, SS *Buckeye Atlantic*, and SS *Overseas Suzanne*).[3] Using the information on voyage ending dates and ports that we obtained from the shipping articles, we were able to work with the regional archives to obtain another 21 logbooks, bringing the total number of logbooks obtained to 152, or 96 percent of the shipments we identified.[4] We relied on the shipping article information for the remaining three voyages (excluding the shipments on the three foreign-flagged vessels) to provide some information on the routes taken by those vessels. However, one limitation of relying on shipping articles for port information and dates is that locations are mentioned only if a personnel action—such as an injury, hospitalization, or desertion—took place. If no personnel action took place

[3]We had previously obtained logbooks for three of these vessels and voyages—SS *Aimee Lykes*, SS *Buckeye Atlantic*, and SS *Gulf Shipper*. We obtained the logbook for the SS *Overseas Suzanne* after obtaining additional information from its shipping articles.

[4]The ports of call in 1 of the 21 logbooks matched the dates in the shipment documentation, but the vessel did not travel to Vietnam. For this reason, we removed this particular voyage from our list of Agent Orange shipments.

at a location on a vessel's route, that port would not be listed in the shipping articles.

To obtain specific information about the SS *Gulf Shipper* voyage that stopped in Guam en route to Vietnam, to include documentation on its cargo and whether or not cargo was loaded or unloaded at the ports on the way to Vietnam, we contacted officials at several agencies.

- In Guam, we contacted the Customs and Quarantine Service, the University of Guam's Micronesian Research Center, and officials at Naval Base Guam for information on vessels that stopped in Guam during the Vietnam War era, and any cargo they carried.
- We also contacted archivists at the Federal Records Center in Seattle, Washington, where the SS *Gulf Shipper* logbook is archived, and the regional archives in Fort Worth, Texas, for additional information on the vessel itself and guidance on retaining and archiving cargo information. The National Archives had some information on the SS *Gulf Shipper*, such as sales documents and company correspondence records. However, the National Archives did not have records for the manifest or bills of lading, which may have documented any cargo offloaded from the ship.
- We contacted U.S. Customs and Border Protection for information on movements of vessels engaged in foreign trade in and out of ports, which is found in customs forms that are required to be archived after 30 years. We were unsuccessful in locating the customs forms for the SS *Gulf Shipper's* voyage to Vietnam through Guam; however, an official noted that although these records provide manifest numbers and ports of sailing, the manifests themselves are not archived.
- An online search on the SS *Gulf Shipper* through the U.S. Maritime Administration's website identified the transfer of vessel ownership over the years. We contacted the latest company that owned the vessel to see whether the company had retained any cargo manifests or other historical records as the ownership changed hands. However, we could not obtain this information because, according to a company official we contacted, the vessel's records, along with other historical documents, were stored in an off-site storage facility in New Jersey, and were subsequently destroyed in a fire in 1996.

We also looked at articles from Guam newspapers and news sources such as the Military Sea Transportation Service Vietnam Chronicles for any information about vessel comings and goings in Guam in early 1968 to see if they mentioned the SS *Gulf Shipper* or specific cargo being offloaded in Guam. None of these contacts or written sources provided

information specific to any cargo that was being moved through Guam, or about this particular vessel.

We also obtained original DOD reports and command histories that provided additional operational details about the procurement, distribution, use, and disposition of Agent Orange and its components. According to an Office of History, Air Force Logistics Command, monograph, the command directly responsible for managing Agent Orange was the Directorate of Aerospace Fuels at the San Antonio Air Materiel Area at the former Kelly Air Force Base, Texas, which was a sub-component of the U.S. Air Force Logistics Command during the Vietnam War. The unclassified San Antonio Air Materiel Area command histories for the years 1966 through 1973 include chapters with extensive documentation on “herbicide management.” We obtained copies of command histories from the Air Force Historical Research Agency at Maxwell Air Force Base, Alabama, and the Air Force Materiel Command at Wright-Patterson Air Force Base, Ohio.

To obtain information regarding herbicide use on Guam, we obtained command histories for Naval Base Guam and an analysis and summary of the available documentation by the historian at Andersen Air Force Base. We also spoke with Navy and Air Force officials on Hawaii and Guam to identify any relevant records pertaining to such use. In addition, we met with and obtained information from officials representing the Office of the Governor of Guam and senior members and staff from the Guam Legislature. We also met with officials representing a veterans service organization. Finally, as discussed below, we spoke directly with veterans about their recollections of herbicide use on Guam, and any documentation they might have pertaining to such use.

For objective two, we analyzed the archival search records provided by DOD to identify additional locations where Agent Orange or its components were tested and stored in the United States and its territories. We reviewed Army archives search reports of herbicide testing at Aberdeen Proving Grounds (including Edgewood Arsenal), Maryland; Dugway Proving Ground, Utah; Fort Chaffee, Arkansas; Fort Gordon, Georgia; Fort Meade, Fort Ritchie, and Fort Detrick, Maryland; and two Air Force studies related to herbicide equipment testing at Eglin Air Force Base, Florida, to determine whether there were additional sites and testing events that were not included on the DOD list found on the VA

website.[5] We also reviewed the proceedings of the First, Second, and Third Defoliation Conferences, technical and special reports, and published papers provided by the Armed Forces Pest Management Board to determine whether there were additional sites and testing events that were not included on the list. We compared the information about testing locations and dates on the DOD list found on the VA website with information found in a 2006 report on locations where Agent Orange was tested and stored.[6]

To determine the locations where Agent Orange or its components were tested and stored, we attempted to identify the chemical composition of all the agents on DOD's list found on the VA website. We located information on the chemical composition of agents on the list in archives search reports for Forts Detrick, Meade, and Gordon; a glossary of pesticide chemicals from the Food and Drug Administration; journal articles; and the defoliation conference proceedings.[7] We also interviewed DOD and VA officials about the chemical composition of agents on the list, the origins of the list, how the list is used, and the role of each agency in managing the list. We compared the results with information that DOD and VA provided publicly on testing and storage locations of tactical herbicides in the United States and its territories, and with DOD policies for conducting record research and responding to inquiries related to past environmental exposures. We also compared the accuracy and completeness of the list with *Standards for Internal Control in the Federal Government*, which state that management should

[5]The Army undertook the compilation of its 7 archives search reports to provide research and analysis regarding herbicide testing that occurred at these locations. In addition to studies on Eglin Air Force Base, the Air Force also provided summary information on current and former Air Force installations where Agent Orange or its components were known to be present.

[6]Alvin Young, *The History of the US Department of Defense Programs for the Testing, Evaluation, and Storage of Tactical Herbicides* (Cheyenne, WY: December 2006).

[7]U.S. Army Corps of Engineers, *Archives Search Report Findings for Field Testing of 2,4,5-T and Other Herbicides Fort Detrick* (Frederick, Maryland: Apr. 4, 2012); *Archives Search Report Herbicide Testing at Fort George G. Meade* (Fort Meade, Maryland: Mar. 17, 2015); *Archives Search Report Findings for Field Testing of 2,4,5-T and Other Herbicides Fort Gordon* (Fort Gordon, Georgia: Sept. 20, 2013); Food and Drug Administration, *Glossary of Pesticide Chemicals* (College Park, Maryland: June 2005).

internally and externally communicate the necessary quality information to achieve the entity's objectives.[8]

We also reviewed the extent to which DOD and VA have communicated health information to DOD personnel and veterans. We compared the communication process that both DOD and VA use with DOD's guidance on assessing long-term health risks, and with VA's process for determining benefits based on veterans' claims. We also compared DOD and VA actions with *Standards for Internal Control in the Federal Government*, which state that management should internally and externally communicate the necessary quality information to achieve the entity's objectives.[9] The standard further states that management should evaluate the entity's methods of communication so that the organization has the appropriate tools to communicate quality information throughout the entity on a timely basis. We also reviewed documents from DOD and VA on communication with veterans, including the VA's website on Agent Orange. Further, we interviewed cognizant agency officials from DOD and VA, including officials from the Armed Forces Pest Management Board and DOD's Joint Services Records Research Center.

For objectives one and two, to better understand veterans' experiences with Agent Orange and other herbicides and the health effects of exposure to them, we conducted six small discussion sessions with a non-generalizable sample of veterans.[10] Four of the discussion sessions were conducted in person in the following locations: two discussion sessions in Guam, and two discussion sessions in Hawaii.[11] We conducted two additional discussion sessions that were moderated via telephone from Washington, D.C.: one of those had individuals participate both in person and by telephone, while the other was held solely by

[8]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

[9]GAO-14-704G.

[10]Participants in the discussion sessions were self-selected. In addition to veterans, a few civilians, including spouses, were present at some discussion sessions. We handled any comments these individuals provided separately from the veterans' comments. Specifically, we documented whether speakers were veterans or not, and we included comments only from participants who identified themselves as Vietnam era veterans.

[11]DOD, VA, and Guam Environmental Protection Agency officials worked to schedule three discussion sessions for participants to attend in Guam, but only two of the sessions had attendees present. Thus, for the purposes of this report, we are counting only the two discussion sessions with attendees present.

telephone. We selected Guam because of the provision in House Report 115–200 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 for GAO to review the government's handling of Agent Orange on Guam. We selected Hawaii because of its strategic location during the Vietnam War and because of the VA presence in the region. A total of 38 individuals attended the sessions, which ranged from 1 to 10 participants per session and lasted approximately 1 to 2 hours.[12] These discussion sessions were consistently moderated by the same team member using a prepared script and documented by several other team members.

To select candidates for participating in our discussion sessions, we worked with the Veterans Health Administration as well as veteran clinics and veteran centers at the selected locations to identify non-combat veterans who had served during the Vietnam era. In Guam, we also worked with the Guam Environmental Protection Agency to coordinate a discussion session. Attendees included Vietnam-era veterans who self-reported that they were in active service between 1961 and 1977 in Vietnam, the United States, and its territories, including Guam. As we became aware of other veterans who might be interested in these discussion sessions, including Vietnam combat veterans, we reached out to offer them the opportunity to participate in one of our discussion sessions. Our six discussion sessions included questions to individuals regarding what, if anything, they had heard from DOD, VA, or other federal agencies about links between exposure to herbicides and negative health effects, and whether attendees believed that they had been exposed to Agent Orange or its components at locations where Agent Orange was manufactured, transported, stored, used, or destroyed. We also asked individuals if they believed they had been exposed to Agent Orange in Guam, Vietnam, or another location, and if so, to describe the situation.[13] At the start of the discussion sessions, the moderator told participants that their responses would be kept confidential

[12]Although the session with one participant was not technically a discussion session because only one person participated, for simplicity and fairness we combined that person's responses with those from the discussion sessions and describe them all as discussion sessions.

[13]These results are not generalizable to the population of Vietnam era veterans, and we present this information from participants as a way to report the perspectives of people who believe they were or may have been in contact with or affected by Agent Orange. We used the veterans' input to provide individual examples of their experiences but not as direct support for any findings in this report. We did not obtain documentation that would enable us to verify any comments made by participants.

and that we were not recording their statements. The moderator noted that we would be taking notes to make sure we accurately captured the conversations, but that we would not attribute statements directly to individuals.

For those discussion sessions held in person in Guam and Hawaii, we also administered a brief, written questionnaire about individuals' experiences during the Vietnam era (for example, duty locations, military occupation, rank), and what they had heard and experienced related to Agent Orange and other herbicides. Due to logistical obstacles, we were not able to administer the questionnaire to participants in sessions held via telephone. However, the information requested in the questionnaire was also covered in the discussion sessions themselves. Therefore, we did not analyze the information from the completed questionnaires. We also solicited from the veterans any documentation they might have that could support their allegations of the use of Agent Orange on Guam, but we did not receive documentation that corroborated the use of Agent Orange on Guam. In addition, we met with officers from the Vietnam Veterans of America to discuss how, if at all, veterans could have been exposed to Agent Orange beyond serving directly in Vietnam as part of Operation Ranch Hand, and how the organization disseminates information, especially on Agent Orange, to veterans.

For objective three, we reviewed scientific literature and agency documents regarding the degradation and sources of the components of Agent Orange and an associated dioxin contaminant, 2,3,7,8-TCDD, as well as other sources of dioxins. This review included documents from the Agency for Toxic Substances and Disease Registry and reports and protocols from U.S. EPA, the World Health Organization, the Centers for Disease Control and Prevention, and the American Industrial Hygiene Association. We also reviewed the draft and final plans for testing for the presence of the acid forms of the components of Agent Orange—2,4-D and 2,4,5-T—on Guam. We compared the information outlined in the testing plan with scientific literature on the environmental fate of the components of Agent Orange and other Agent Orange testing methodologies. We interviewed officials from DOD, U.S. EPA, and Guam EPA about the testing plan for Guam and the science surrounding Agent Orange testing. We also conducted a site visit to Naval Base Guam and Andersen Air Force Base on Guam and interviewed DOD and Government of Guam officials involved in the planning for the testing for Agent Orange on Andersen Air Force Base. We visited the three selected sites where the initial testing took place and took photographs of those sites.

We conducted this performance audit from May 2017 through November 2018, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comparison of the Department of Veterans Affairs (VA) List of Diseases Associated with Agent Orange against Those Identified by the National Academy of Sciences

The VA recognizes 14 presumptive diseases associated with exposure to Agent Orange or other herbicides during military service for which veterans and their survivors may be eligible to receive disability compensation benefits. The list of diseases provided by the VA has generally incorporated the findings of reviews performed by the National Academy of Sciences (the Academy). The list includes 5 diseases that have been identified as having sufficient evidence of association and 9 that have been identified as having limited or suggestive evidence of association. In the Academy's biannual reports, for a disease identified as having sufficient evidence of association, the evidence is sufficient to conclude that there is a positive association—that is, a positive association has been observed between herbicides and the outcome in studies for which chance, bias, and confounding could be ruled out with reasonable confidence. For a disease identified as having limited or suggestive evidence of association, the evidence is suggestive of an association between herbicides and the outcome but is limited, because chance, bias, and confounding could not be ruled out with confidence. Table 1 describes those 14 diseases and the extent of association identified by the Academy.

Table 1: Presumptive Diseases Associated with Exposure to Agent Orange and Certain Other Herbicides by the Department of Veterans Affairs (VA), by Level of Association

Disease	Description
Sufficient Evidence of Association	
Chronic B-cell Leukemias	A type of cancer which affects white blood cells.
Chloracne (or similar acneform disease)	A skin condition that occurs soon after exposure to chemicals and looks like common forms of acne seen in teenagers. Per VA's rating regulation, it must be at least 10 percent disabling within 1 year of exposure to an herbicide.
Hodgkin's Disease	A malignant lymphoma (cancer) characterized by progressive enlargement of the lymph nodes, liver, and spleen, and by progressive anemia.
Non-Hodgkin's Lymphoma	A group of cancers that affect the lymph glands and other lymphatic tissue.
Soft Tissue Sarcomas (other than osteosarcoma, chondrosarcoma, Kaposi's sarcoma, or mesothelioma)	A group of different types of cancers in body tissues such as muscle, fat, blood and lymph vessels, and connective tissues.
Limited or Suggestive Evidence of Association	
AL Amyloidosis	A rare disease caused when an abnormal protein, amyloid, enters tissues or organs.
Diabetes Mellitus (Type 2)	A disease characterized by high blood sugar levels resulting from the body's inability to respond properly to the hormone insulin.
Ischemic Heart Disease[a]	A disease characterized by a reduced supply of blood to the heart that leads to chest pain.
Multiple Myeloma	A cancer of plasma cells, a type of white blood cell in bone marrow.

Disease	Description
Parkinson's Disease	A progressive disorder of the nervous system that affects muscle movement.
Peripheral Neuropathy, Early-Onset	A nervous system condition that causes numbness, tingling, and motor weakness. Per VA's rating regulation, it must be at least 10 percent disabling within 1 year of exposure to an herbicide.
Porphyria Cutanea Tarda	A disorder characterized by liver dysfunction and by thinning and blistering of the skin in sun-exposed areas. Per VA's rating regulation, it must be at least 10 percent disabling within 1 year of exposure to an herbicide.
Prostate Cancer	Cancer of the prostate; one of the most common cancers among men.
Respiratory Cancers (includes lung cancer) [b]	Cancers of the lung, larynx, trachea, and bronchus.

Source: GAO analysis of VA regulations and National Academy of Sciences studies. | GAO-19-24

[a]Per VA's rating regulation, ischemic heart disease does not include hypertension or peripheral manifestations of arteriosclerosis such as peripheral vascular disease or stroke, or any other condition that does not qualify within the generally accepted definition of ischemic heart disease. 38 CFR 3.309(e) (2018).

[b]The Academy breaks the respiratory cancers into two separate categories—laryngeal cancer and cancers of the lung, trachea, and bronchus.

The 2014 Academy biannual report, issued in 2016, listed four more diseases it categorized as having limited or suggestive evidence of association, as described in table 2.[1]

Table 2: Diseases Identified by the National Academy of Sciences as Having Limited or Suggestive Evidence of Associations, but Not Included on the Department of Veterans Affairs (VA) List of Presumptive Diseases

Disease	Description
Cancer of the urinary bladder	Cancer that forms in tissues of the bladder. Most bladder cancers are transitional cell carcinomas (cancer that begins in cells that normally make up the inner lining of the bladder). Other types include squamous cell carcinoma (cancer that begins in thin, flat cells) and adenocarcinoma (cancer that begins in cells that make and release mucus and other fluids). The cells that form squamous cell carcinoma and adenocarcinoma develop in the inner lining of the bladder as a result of chronic irritation and inflammation.
Hypertension, also called high blood pressure	A blood pressure of 140/90 or higher. Hypertension usually has no symptoms. It can harm the arteries and cause an increase in the risk of stroke, heart attack, kidney failure, and blindness.

[1]The 2014 report also broadened the definition for Parkinson's disease to include Parkinson-like symptoms. In this report, the Academy clarified that the finding for Parkinson's disease should be interpreted by VA to include all diseases with Parkinson-like symptoms unless those symptoms can be definitively attributed to be secondary to an external agent other than the herbicides sprayed in Vietnam.

Disease	Description
Stroke, also called cerebrovascular accident or CVA	A loss of blood flow to part of the brain, which damages brain tissue. Strokes are caused by blood clots and broken blood vessels in the brain. Symptoms include dizziness, numbness, weakness on one side of the body, and problems with talking, writing, or understanding language. The risk of stroke is increased by high blood pressure, older age, smoking, diabetes, high cholesterol, heart disease, atherosclerosis (a buildup of fatty material and plaque inside the coronary arteries), and a family history of stroke.
Hypothyroidism, also called underactive thyroid	Too little thyroid hormone. Symptoms include weight gain, constipation, dry skin, and sensitivity to the cold.

Source: GAO analysis of VA regulations and National Academy of Sciences studies. | GAO-19-24

VA officials told us that these diseases are not included on the VA's current list of presumptive diseases associated with exposure to Agent Orange or other herbicides because, as of October 25, 2018, the Secretary of Veterans Affairs had yet to make the determination based on the most recent biannual review (the 2014 report). According to the officials, the Secretary is also considering the inclusion of parkinsonism and Parkinson-like syndromes.

Finally, according to the VA website, VA has recognized that certain birth defects among veterans' children are associated with veterans' qualifying service in Vietnam or Korea. For example, spina bifida (except spina bifida occulta) is associated with veterans' exposure to Agent Orange or other herbicides during qualifying service in Vietnam or Korea.[2] The affected child must have been conceived after the veteran entered Vietnam or the Korean demilitarized zone during the qualifying service period, and a child with spina bifida or covered birth defects who is a biological child of a veteran with qualifying service may be eligible for a monetary allowance, health care, and vocational training. The 2014 report moved spina bifida to the lower category of "inadequate or insufficient evidence to determine an association," as studies that have been released since the 1996 update do not support a link between the condition and exposure to herbicides. According to VA officials, VA does not currently plan to change its regulations based on this conclusion.

[2]Spina bifida is a defect in the developing fetus that results in incomplete closing of the spine.

Appendix III: Quantities of Herbicides Known to Have Been Shipped to Southeast Asia on Ships Identified as Having Stopped in Guam between February 1968 and May 1970

Based on available shipment documentation and logbooks, we identified one vessel—the SS *Gulf Shipper*—carrying Agents Orange, Blue, and White that stopped at Port Apra (now Apra Harbor) on Guam on its way to Southeast Asia. Additionally, we identified three vessels—the SS *Aimee Lykes*, the SS *Buckeye Atlantic*, and the SS *Overseas Suzanne*—that stopped in Guam on the return routes after having made various port calls in Southeast Asia.[1] For each of these voyages, we obtained shipment documentation that outlined the quantities of herbicides that records indicate had been loaded onto the vessels while at port in the United States, and to the extent available, quantities of herbicides that were discharged in Southeast Asia. We also obtained logbooks that identified the routes the vessels took from U.S. ports to Vietnam and back, and identified any port calls en route. While we are unable to confirm the reliability of the information available in shipment documentation and logbooks, details on the quantities of herbicides that were documented to have been transported on these vessels during their routes are outlined below.

SS *Gulf Shipper*: According to shipment documentation and the vessel's logbook, the SS *Gulf Shipper* left the port of Mobile, Alabama, on January 9, 1968, and stopped at Port Apra (now Apra Harbor) on Guam and offloaded a mariner for repatriation to the United States on February 2, 1968.[2] We are unable to state with certainty whether there were reasons why this vessel stopped in Guam beyond what was reported in available shipment documentation and the vessel's logbook. The logbook further indicates that the SS *Gulf Shipper* then arrived in Saigon, Vietnam, approximately February 27, 1968, with subsequent stops in Cam Rahn Bay, Vietnam, approximately February 29, 1968, and Nha Trang,

[1]Through archival research, we obtained available shipping and agency records, including U.S. military correspondence and logistics reports, and reviewed these documents to trace the federal government's procurement, distribution, use, and disposition of Agent Orange and its components. We analyzed this available documentation, referred to as shipment documentation, to prepare summary information on the quantities of Agent Orange and the vessels that carried the shipments. We used this information to obtain official Navy and merchant vessel logbooks—referred to as logbooks—to the extent they were available. While logbooks contain information such as the vessel's location, crew, and key events, they generally do not identify specific cargo that was loaded onto or offloaded from a vessel. Logbooks from the Vietnam era are generally held at National Archives and Records Administration facilities closest to the arrival ports where the voyages ended.

[2]In addition to the stop in Guam, the SS *Gulf Shipper* also stopped in Panama on the way to Vietnam.

Vietnam, approximately March 2, 1968.[3] According to available documentation, there is some discrepancy with regard to the amount of herbicides that records indicate were loaded onto the SS *Gulf Shipper* when it left the port of Mobile, Alabama. Specifically, shipment documentation indicates that 62,570 gallons of Agent Orange, 31,735 gallons of Agent White, and 4,620 gallons of Agent Blue—a total of 98,925 gallons of herbicides—were loaded onto the SS *Gulf Shipper* before it departed for Saigon, Vietnam.[4] On the contrary, according to the available shipping documentation, the vessel's manifest indicates that the vessel was carrying 86,270 gallons of herbicides, but does not break the total down by individual herbicide. The vessel's manifest further indicates that the SS *Gulf Shipper* discharged 93,150 gallons of herbicide in Saigon, Vietnam, on March 1, 1968, which does not align with reported dates in the vessel's logbook. However, we are unable to determine discharge quantities by specific herbicide—for example, the quantities of Agents Orange, Blue, or White discharged—because available documentation states that the breakdown of the herbicides would not be determined until arrival at the depot. Moreover, we are unable to account for the difference between the number of gallons of herbicides reported to have been loaded onto the vessel and the number of gallons reported to have been discharged in Saigon, Vietnam, or potentially any other location.

SS *Aimee Lykes*: According to shipment documentation and the vessel's logbook, the SS *Aimee Lykes* left the port of Beaumont, Texas, on October 4, 1969. The vessel arrived in Saigon, Vietnam, approximately November 9, 1969.[5] The vessel made a subsequent stop at Da Nang, Vietnam, approximately November 23, 1969. Following its departure from Vietnam, the SS *Aimee Lykes* stopped in Apra Harbor on Guam approximately November 30, 1969, and offloaded an injured crew member. However, the logbook does not include Guam on its list of ports of call. Rather, there is a separate entry within the logbook that describes

[3]For purposes of this report, we are using the last documented port from which the vessel left the United States.

[4]Herbicide manufacturers marked 55-gallon drums for shipment to Vietnam. DOD then arranged for the transport of these drums by train from the manufacturers to several U.S. ports. From the U.S. ports, the herbicides were shipped to Southeast Asia. The quantity of Agent Orange reported to have been loaded onto the SS *Gulf Shipper* is not divisible by 55, raising questions about the reliability of some of the numbers in the records we were able to obtain.

[5]Prior to arriving in Vietnam, the SS *Aimee Lykes* also stopped in Panama and Taiwan.

the vessel pulling into Apra Harbor and offloading the injured mariner into a small motorboat so that he could be hospitalized in Guam. Therefore, we cannot confirm whether the vessel docked at Port Apra during this voyage. According to available documentation, the SS *Aimee Lykes* left the port of Beaumont, Texas, with 880 gallons of Agent Orange on board—documentation does not indicate that there were any amounts of Agents White or Blue on this voyage. Based on the available documentation, we are unable to determine the quantity of Agent Orange that was discharged in Saigon, Vietnam, or potentially any other location.

SS *Buckeye Atlantic*: According to shipment documentation and the vessel's logbook, the SS *Buckeye Atlantic* left the port of New Orleans, Louisiana, on October 1, 1969. The vessel arrived in Saigon, Vietnam, approximately November 20, 1969. The vessel made a subsequent stop at Qui Nhon, Vietnam, approximately November 29, 1969.[6] Following its departure from Vietnam, the SS *Buckeye Atlantic* stopped at various ports in Japan before stopping in Guam approximately December 23, 1969, and offloading two injured crew members, one who returned to duty and another who was repatriated to the United States. While on Guam, the SS *Buckeye Atlantic* also performed a fire and boat drill on December 26, 1969, before departing. According to available documentation, the SS *Buckeye Atlantic* left the port of New Orleans, Louisiana, with 17,105 gallons of Agent Orange on board. Based on the available documentation, we are unable to determine the quantity of Agent Orange that was discharged in Saigon, Vietnam, or potentially any other location.

SS *Overseas Suzanne:* According to shipment documentation and the vessel's logbook, the SS *Overseas Suzanne* left the port of New Orleans, Louisiana, on February 28, 1970. The vessel arrived in Saigon, Vietnam, approximately April 9, 1970.[7] The vessel made a subsequent stop at Da Nang, Vietnam, approximately April 17, 1970, and at Cam Rahn Bay, Vietnam, approximately April 22, 1970. Following its departure from Vietnam, the SS *Overseas Suzanne* stopped in Taiwan and Japan before stopping in Guam approximately May 5, 1970, and offloading an injured crew member. The vessel then departed Guam on May 9, 1970. According to available documentation, the SS *Overseas Suzanne* left the

[6]Prior to arriving in Vietnam, the SS *Buckeye Atlantic* also stopped in Panama, Hawaii, and the Philippines.

[7]Prior to arriving in Vietnam, the SS *Overseas Suzanne* also stopped in Panama, Hawaii, and the Philippines.

port of New Orleans, Louisiana, with 80,795 gallons of Agent Orange and 48,537 gallons of Agent Blue on board. Based on the available documentation, we are unable to determine the quantity of Agent Orange that was discharged in Saigon, Vietnam, or potentially any other location.

Appendix IV: The Department of Defense's (DOD) List of Testing and Storage Locations Posted on the Department of Veterans Affairs (VA) Website

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Location	Dates	Agents	Project Description	DoD Involvement
Fort Chaffee, AR	5/16/1967-5/18/1967, 7/22/1967-7/23/1967, 8/23/1967 - 8/24/1967	basic, in-house, improved desiccants and Orange, Blue	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Derrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI.	Yes
Pinal Mountains near Globe, AZ	1965, 1966, 1968, and 1969	2,4-D isooctyl-ester, 2,4,5-t isooctyl-ester, silvex, propyleneglycolbutylether ester, 2,4,5-T butyl ester, 2,4,5-T 2-e-h e	In 1965, the USFS began a land improvement program in the Pinal Mountains. The program called for spraying an area of chaparral with herbicides to accomplish the objectives of multiple land use.	No
Brawley, CA	1950-51	2,4-D	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent.Here, irrigation water studies were done with the agent. H.F. Arle worked here.	Undetermined
Orlando, FL at Army Grove Air Force's Tactical Center	3/14/1944, 4/12/1944	ammonium thiocynate, zinc chloride, sodium nitrate, sodium arsenate, sodium fluoride	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent.	Yes
Marathon, FL	3/21/1944-3/23/1944	zinc chloride, ammonium sulphamate, ammonium thiocynate	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent. Spraying was done here.	Yes
Near Lake George, FL	Spring 1944	zinc chloride	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent. Spraying here.	Yes
Orlando, FL, Cocoa, FL	1944	ammonium thiocyanate and zinc chloride	Tests were conducted in 1944 by the Army in Orlando and Cocoa areas of Florida to determine the value of ammonium thiocyanate and chloride as marking and defoliation agents.. They were conducted initially at ground level and later from aircraft.	Yes

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Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Bushnell Army Air Field, FL	2/1945	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was aerial spray experiments on potted plants	Yes
Bushnell Army Air Field, Bushnell, FL	2/1945-4/1945	2,4-D and its ammonium salt	Trials, performed by C.W.S. personnel from Camp Detrick, MD tested the practicability of severely injuring or destroying crop plants sprayed from smoke tanks mounted on tactical aircraft.	Yes
Avon Air Force Base, FL	2/1951-4/1951	butyl 2,4 D	Trials were conducted at Avon Air Force Base, FL by Chemical Corps with personnel of the Air Force and Navy to determine the practical effectiveness of spraying pure anticrop agents from at low volume from aircraft. C-47 and Navy XBT2D-1 aircraft with various nozzles were used.	Yes
Englin Air Force Base, FL	11/1952-12/1952	2,4-D, 2,4,5-T: 143 and 974, respectively	Two trials: Chemical Corps- concerned with basic fundamental work, using 2,4-D, Air Force-concerned with evaluating prototype large capacity spray system for aircraft installation using 2,4,5-T, primarily. Used 3 atomizing nozzles: Bete Fog Nozzles, Whirljet Spray Nozzles, and Fogjet 1.5F50	Yes
Avon Park Air Force Base, FL	Spring 1954	butyl 2,4-D, butyl 2,4,5-T, Isopropyl 2,4-D	Series of tests were conducted at Avon Park AFB during the spring of 1954 to study the behavior of chemical anticrop aerial sprays when released from high-speed jet aircraft. The Navy F3D jet fighter was used with Aero 14A Airborne Spray Tanks to disperse the anticrop agents.	Yes
Jacksonville,FL	7/18/1962-7/21/1962	Purple, Fuel Oil, Mix	The HIDAL was used successfully on an H-34 helicopter to spray herbicidal materials. Therefore, it had not been calibrated previously. Spray tests were performed to do so. This was done under order by OSD/ARPA.	Yes
Eglin AFB, FL, C-52A test area	1962-70	Orange (1962-68), Purple (1962-68), White (1967-70), Blue (1968-70)	CPT John Hunter discussed vegetation changes and ecological studies of the 2 square mile test area which had been sprayed with herbicides over the period 1962-70.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Apalachicola National Forest near Sophoppy, FL	5/3/1967-5/8/1967	basic desiccants and Orange/Blue	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes
Eglin AFB, FL	6/11/1968-9/12/1968	orange, Bifluid #1, Bifluid#2, Stull Bifluid	A spread factor study was performed by the Army to correlate the spherical drop sizes of both Orange and Stull Bifluid defoliants. It involved development of new techniques to determine spread factors over an extended range of drop sizes. A spinning cup drop generator was used.	Yes
2 areas in FL, 2 areas in GA, and 1 in TN	1968	bromacil, Tandex, monuron, diuron, and fenuron	In 1968, emphasis was given to soil applied herbicides for grass control. Applications were made by a jeep-mounted sprayer on small plots or by helicopter on larger plots.	Undetermined
GA and TN	1964	diquat and Tordon 101, various	In 1964, helicopter spray tests were conducted on transmission line rights-of-way by the Georgia Power Company and Tennessee Valley Authority in collaboration with Fort Detrick to evaluate effectiveness of several commercially available herbicides.	Yes
Fort Gordon, GA	7/15/1967-7/17/1967	in-house desiccants mixtures and formulations, Orange and Blue	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes
Kauai Branch Station near Kapaa, Kawai, HI	6/1967, 10/1967, 2/1968, 12/1967	Blue,diquat,paraquat, Orange, PCP, Picloram, White, HCA, 2,4,5-T, Endothall	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes
State Forest area, 3500 ft.elevation on slope of Mauna Loa, near Hilo, HI	12/2/1966, 12/4/1966, 1/12/1967	Orange, M-3140, TORDON ester, 2,4-D ester, 2,4,5-T ester	The purpose of this project was to evaluate iso-octyl ester of picloram (TORDON) in mixtures with ORANGE, as a candidate defoliant agent, using ORANGE as standard. There were personnel from Fort Detrick there.	Undetermined

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Hilo, HI	12/1966	Orange	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables. There were Fort Detrick personnel there.	Yes
Kauai,HI	1967	Orange	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables.	Yes
Vigo Plant CWS, Terre Haute, IN	5/1945-9/1945	LN (see attached) *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was aerial trials spraying field grown plants.	Yes
Jefferson Proving Grounds, Madison, IN	Summer 1945	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was dropping trials.	Yes
Hays, KS, Langdon, ND	1960	stem rust of	Two studies on the stem rust of wheat were conducted during 1960 to obtain data on the establishment, development, and destructiveness of artificially induced stem rust epiphytotics.	Undetermined
Fort Knox, KY	1945	various	In 1945, a special project known as Sphinx was conducted jointly by CWS and the ARML to investigate the use of chemical agents for increasing the flammability of vegetation prior to flame attack.	Yes
Area B, Camp Detrick, MD	Spring/Summer 1953	3:1 mixture 2,4-D and 2,4,5-T	Personnel at Camp Detrick tested the feasibility of using an experimental spray tower for applying a mixture of chemical anticrop agents to broad-leaf crops.	Yes
Fort Ritchie, MD	1963	Tordon, 2,4-D, Orange, diquat, endothal, and combinations of each with Tordon	Various studies were done to explore the effectiveness of different herbicides. They were all field trials. These studies were done by personnel from the US Army Biological Laboratories.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Fort Meade, MD	1963	cacodylic acid, Dowco 173, butyediol	Various studies were done to explore the effectiveness of different herbicides. They were all field trials. These studies were done by personnel from the US Army Biological Laboratories.	Yes
Camp Detrick, MD-Fields A,B, and C	1946-1947	2,4,5-T, 2,4,5-T triethanolamine, tributylphosphate, ethyl 2,4-D, butyl 2,4,5-Ttriet 2,4-D,	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots.	Yes
Camp Detrick, MD- Fields C,D, and E	1948	2,4,5-T, isopropyl phenol carbamate, LN-2426, 2,4-D	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots.	Yes
Camp Detrick, MD-Fields C,D,E	1949	triethelyne. 2,4,5-T, carbamates	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were done by Ennis, DeRose, Newman, Williamson, DeRigo, and Thomas.	Yes
Camp Detrick, MD-Fields A,B,D,E	1950	2464, butyl 2,4-D, 974, butyl 2,4,5-T, q:q 143 and 974	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were done by Ennis, DeRose, Acker, Newman, Williamson, and Zimmerly.	Yes
Camp Detrick, MD-Field F	1950-51	2464, carbamate, butyl 2,4-D, 143 and 974 (orange?),2,4,5-T, 2,4-D, Orange	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were done by Acker, DeRose, McLane, Newman, Williamson, Baker, Dean, Johnson, Taylor, Walker, and Zimmerly.	Yes
Fort Detrick, MD; Fort Ritchie, MD	1956-1957	various, 577 compounds	In 1956 And 1957, defoliation and desiccation were carried out at Fort Detrick and Fort Ritchie, Maryland by the Chemical Corps and Biological Warfare Research. These were bench tests.	Yes
Poole's Island, Aberdeen Proving Ground, MD	7/14/1969-	Orange, Orange plus foam, Orange plus foam Orange, Foam	During the week of 7/14/1969, personnel from Naval Applied Science Laboratory in conjunction with personnel from Limited War Laboratory conducted a defoliation test along the shoreline.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Fort Detrick, MD	8/1961-6/1963	1410 compounds	From 8/1961 to 6/1963, compounds were spray-tested in the greenhouse to evaluate them as effective defoliants, desiccants, and herbicides.	Yes
Near Wayside, Miss., Wilcox Road, Greenville, Miss.	9/19/1967	picloram, bromacil, pyriclor, and terbacil, Orange, cacodylic acid	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Fulcher Ranch, Greenville, Mississippi	4/15/1968	picloram and bromicil	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Gulfport, Miss.	1968-1970	Orange	While discussing the mandatory disposal of Orange, it was mentioned that 15,161 drums were being stored at Gulfport, Mississippi.	Yes
Galatin Valley near Bozeman, Montana	7/3/1953, 7/6/1953, 7/14/1953	4- fluorophenoxy-acetic acid and 2 of its esters, 3:1 butyl 2,4-D and butyl 2,4,5-T	A preliminary series of field evaluations of chemical agents for attacking wheat using a miniature spraying system mounted on light aircraft were performed by USDA.	No
Fort Drum, NY	1959	Orange	The Commanding General, 1st US Army, requested that Ft Detrick assist with defoliation efforts at Ft Drum. Thirteen drums were sprayed there on 4 square miles from a helicopter spray device.	Yes
Stone Valley Experimental Forest in Huntington County and near State College in Centre County, PA	3/1969-10/1970	bromacil, diuron, tandex, fenuron, picloram	Soil- applied herbicides were studied by the U of Pa with Ft Detrick for 18 months for their effectiveness, rapidity of action, and duration of response in native stands of central PA grasses, broadleaf weeds and woody plants. These herbicides were spread or sprayed.	Undetermined
Kingston, RI	7/26/1949, 1950-51	trieth.2,4,5-T, butyl 2,4,5-T,974	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were carried out under supervision of T.E. Odland if RI State College. H.T. DeRigo was also there.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Beaumont, TX	6/1944	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, they were testing on rice crops.	No
Marinette, WI, Weslaco, TX	5/1967-1/1969	arsenic compounds, Orange, cacodylic acid, sodium cacodylate	71 new arsenic compounds were tested in primary screening against 6 plant species in greenhouse tests. Then, 5 of the most active compounds were tested in field trials against Red Maple and compared to formulations of cacodylic acid and a 50:50 blend of orange and sodium cacodylate. The Ansul Co. for DoD.	Yes
Beaumont, TX	1950-51	2,4-D	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent. Here, irrigation water studies were done with the agent. Coghill, Hasse, and Yeatner worked here.	Undetermined
Granite Peak, UT	Summer 1945	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was dropping trials.	Yes
Prosser,WA	1950-51	2,4-D	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent.Here, irrigation water studies were done with the agent. V.F. Burns worked here.	Undetermined
southeastern part of Kompong Cham Province and Dar and Prek Clong plantations, Cambodia	6/1969	Orange	In 6/1969, the US government received notice of charge by Cambodian government that major defoliation damage to the Cambodian rubber plantation near the RVN border had occurred as a result of US defoliation activity. This was confirmed by a team of experts.	Yes
Base Gagetown near Fredericton, New Brunswick, Canada	6/20/1967-6/24/1967	basic desiccants and Orange, Blue, various	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Kumbla, South India	1945-1946	LN compounds *phenoxy	The main objective of the experiments was to determine the feasibility of accomplishing severe injury or destruction of tropical food crops by the application of growth-inhibiting (LN*) compounds in static trials. Field plantings were treated with various agents at different rates in different forms.	Yes
Korea, third Brigade, 2nd Division area	7/23/1968-7/24/1968	Hyvar XWS, tandex, Urox B, Urox Oil concentrate (liquids) bromacil, tandex, Urox 22 (solids)	In 1968, chemicals were sent from the Plant Sciences Lab, Ft Detrick, MD, to the Republic of Korea for the purpose of testing their effectiveness in the control of vegetation.	Yes
Korea,2nd and 4th Brigades, 2nd Division area	8/1968	Hyvar XWS, tandex, Urox B, Urox Oil concentrate (liquids) bromacil, tandex, Urox 22 (solids)	In 1968, chemicals were sent from the Plant Sciences Lab, Ft Detrick, MD, to the Republic of Korea for the purpose of testing their effectiveness in the control of vegetation.	Yes
Korea, third Brigade, 2nd Division area	10/3/1968	Hyvar XWS, tandex, Urox B, Urox Oil concentrate (liquids) bromacil, tandex, Urox 22 (solids)	In 1968, chemicals were sent from the Plant Sciences Lab, Ft Detrick, MD, to the Republic of Korea for the purpose of testing their effectiveness in the control of vegetation.	Yes
Laos	12/1965- 1967	Orange	In December 1965, herbicide operations were begun in Laos, with sorties being flown from Tan Son Nhut and Da Nang. The purpose was the exposure of foot trails, dirt roads and other LOCs that crossed into SVN. This network leads from NVN, through the eastern panhandle, to Combodian border.	Yes
Las Marias, Puerto Rico	2/1967-12/1967	various, including Orange	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

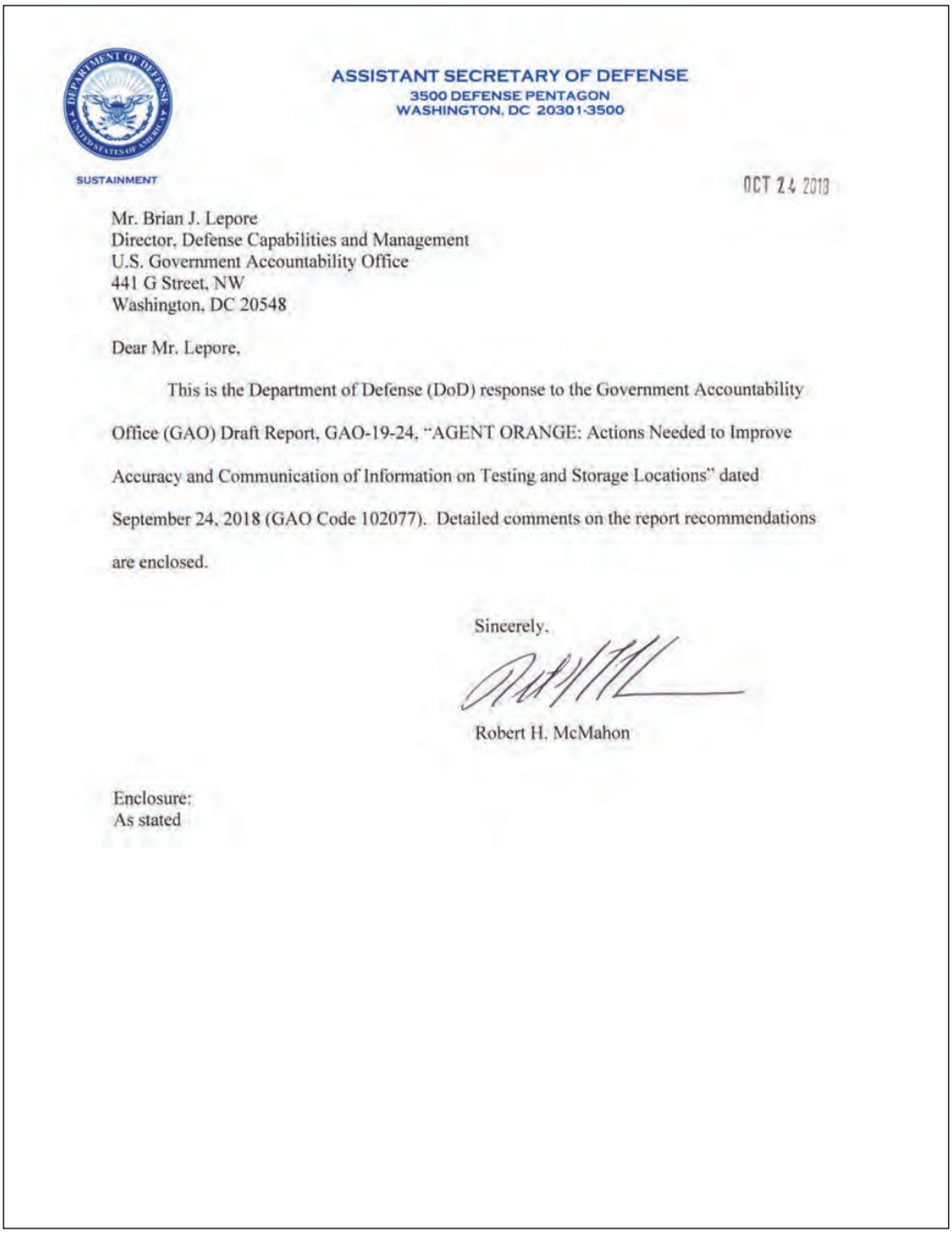
Las Mesas Cerros, Mayaguez, Puerto Rico	5/24/1968, 5/26/1968, 5/27/1968	picloram, bromacil, pyriclor	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Las Mesas and La Jagua experimental areas at Mayaguez, Puerto Rico	2/1956-6/1956	2,4,5-T, 2,4-D, pentachlorophenol, ammate, weedazol, endothal Harvestaid, Butyne -1,4-diol	During February to June, 9 chemicals were evaluated in PR on 16 genera tropical woody plants. The chemicals were applied in highly concentrated solutions with a microsprayer to the leaves.	Yes
Guanica and Joyuda, Puerto Rico	6/1956-9/1956	2,4,5-T, potassium cyanate, amiendo, F-2, 6-Ca-4, Y-F Tree and Brush Kiler, ACP M-118, Shed-A-Leaf	9 chemicals were evaluated on 16 genera of tropical woody between June and September. The chemicals were sprayed to duplicate small branches, using a microsprayer.	Yes
Las Mesas and La Jagua, Mayaguez, Joyuda at Cabo Rojo, and Guanica Insular Forest at Guanica, Puerto Rico	9/1956-12/1956	6-Ca-4,Liojn Oil,2,4,5-T, B-1613, B-1638, Ammate, V-C1-186, endothal, shed-a-leaf, M-118, Y-F,esteron 2,4-D,F3,F4,F5,F6	16 compounds with defoliating properties were evaluated using 28 different tropical woody plants, each representing a separate genus. The chemicals were applied to duplicate small branches with a microsprayer and to single larger branches or whole trees with a 2-gallon knapsack sprayer.	Yes
Las Mesas and La Jagua, Mayaguez, Guanica Beach, Puerto Rico	1/1957-3/1957	V-C 3-105, V-C 1-21, V-C 1-443, F-7, TBP, Phillips 713, V-C 3-173	7 compounds were evaluated on 29 different woody plants to determine their effectiveness as defoliants, desiccants, and as killing agents. They were applied with a microsprayer to the upper leaf surfaces of duplicate small branches.	Yes
Las Mesas and La Jagua, Mayaguez, Guanica Beach, Puerto Rico	4/1957-6/1957	B-1676, B-1638, NP 1098, SD 1369, Ammate, Shed-a-leaf	7 compounds were sprayed on 25 different plants in order to evaluate their effectiveness as defoliants, desiccants, and killing agents. The compounds were applied with a microsprayer to the upper and lower leaf surfaces of duplicate small branches.	Yes
Las Mesas and La Jagua, Mayaguez, Puerto Rico	7/1957-12/1957	MgClO3, Golden Harvest Defoliant, Dow-M562, F-8, F-9, F-10, F-11, F-12	8 different spray formulations were applied to 16 different tropical trees and shrubs in order to evaluate their effectiveness as defoliants, desiccants, and killing agents.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Near Rio Grande, on the northeast coast of Puerto Rico	8/23/1967, 10/18/1967, 12/21/1967-12/26/1967	picloram, bromacil, pyriclor, and terbacil	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Loquillo, Puerto Rico	4/1966, 10/1966	Orange	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables.	Yes
At Sea	Summer 1977	Orange	In 1977, the USAF incinerated 2.22 million gallons of Herbicide Orange at sea in an operation entitled PACER HO. Extensive industrial hygiene sampling efforts supporting the transfer operations at Gulfport, MS and Johnston Island indicated all exposures were inconsequential (2-3 orders of magnitude below the TLVs for 2,4-D and 2,4,5-T).	Yes, Gulfport No, JI
Thailand	1964-1965	Purple, Orange, Others	Sponsored by ARPA; ARPA Order 423, Between the mentioned dates, there was a large-scale test program to determine effectiveness of mentioned agents in defoliation of upland forest or jungle vegetation representative of SEA.	Yes
Thailand	1964-65	Orange, Blue	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables.	Yes
Replacement raining Center of the Royal Thai Army near Pranburi, Thailand	1964 and 1965	Orange, Purple	An extensive series of tests were conducted by Fort Detrick during 1964 and 1965 in collaboration with the Military Research and Development Center of Thailand. The objective was to perform onsite evaluation of phytotoxic chemicals on vegetation in SE Asia.	Yes

Source: DOD's list of testing and storage locations posted on VA's website [accessed on September 18, 2018]. | GAO-19-24.

Appendix V: Comments from the Department of Defense



ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

SUSTAINMENT

OCT 24 2018

Mr. Brian J. Lepore
Director, Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Lepore,

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-19-24, "AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations" dated September 24, 2018 (GAO Code 102077). Detailed comments on the report recommendations are enclosed.

Sincerely,

Robert H. McMahon

Enclosure:
As stated

GAO DRAFT REPORT DATED SEPTEMBER 24, 2018
GAO-19-24 (GAO CODE 102077)

"AGENT ORANGE: ACTIONS NEEDED TO IMPROVE ACCURACY AND COMMUNICATIONS OF INFORMATION ON TESTING AND STORAGE LOCATIONS"

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment assigns responsibility for ensuring that DoD's list of locations where Agent Orange or its components were tested or stored is as complete and accurate as available records allow.

DoD RESPONSE: *Concur. The Under Secretary of Defense for Acquisition and Sustainment will assign responsibility for DoD's list of locations where Herbicide Orange, or its components, were tested or stored.*

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment develops a process for updating the revised list as new information becomes available.

DoD RESPONSE: *Concur. The Under Secretary of Defense for Acquisition and Sustainment will develop a process to update the DoD list based on clear and transparent criteria developed with Veterans Affairs in recommendations #3 and 4.*

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should ensure that the Under Secretary of Defense for Acquisition and Sustainment develop clear and transparent criteria for what constitutes a location that should be on the list of testing and storage locations.

DoD RESPONSE: *Concur. DoD will be the lead agency for searching, reviewing, and validating documentation to identify DoD locations where the development of chemicals for military use in controlling vegetation and crops in tactical situations were developed, tested, used or stored. DoD, in collaboration with the VA, will develop clear and transparent criteria for what constitutes a location for the list to be provided to the VA.*

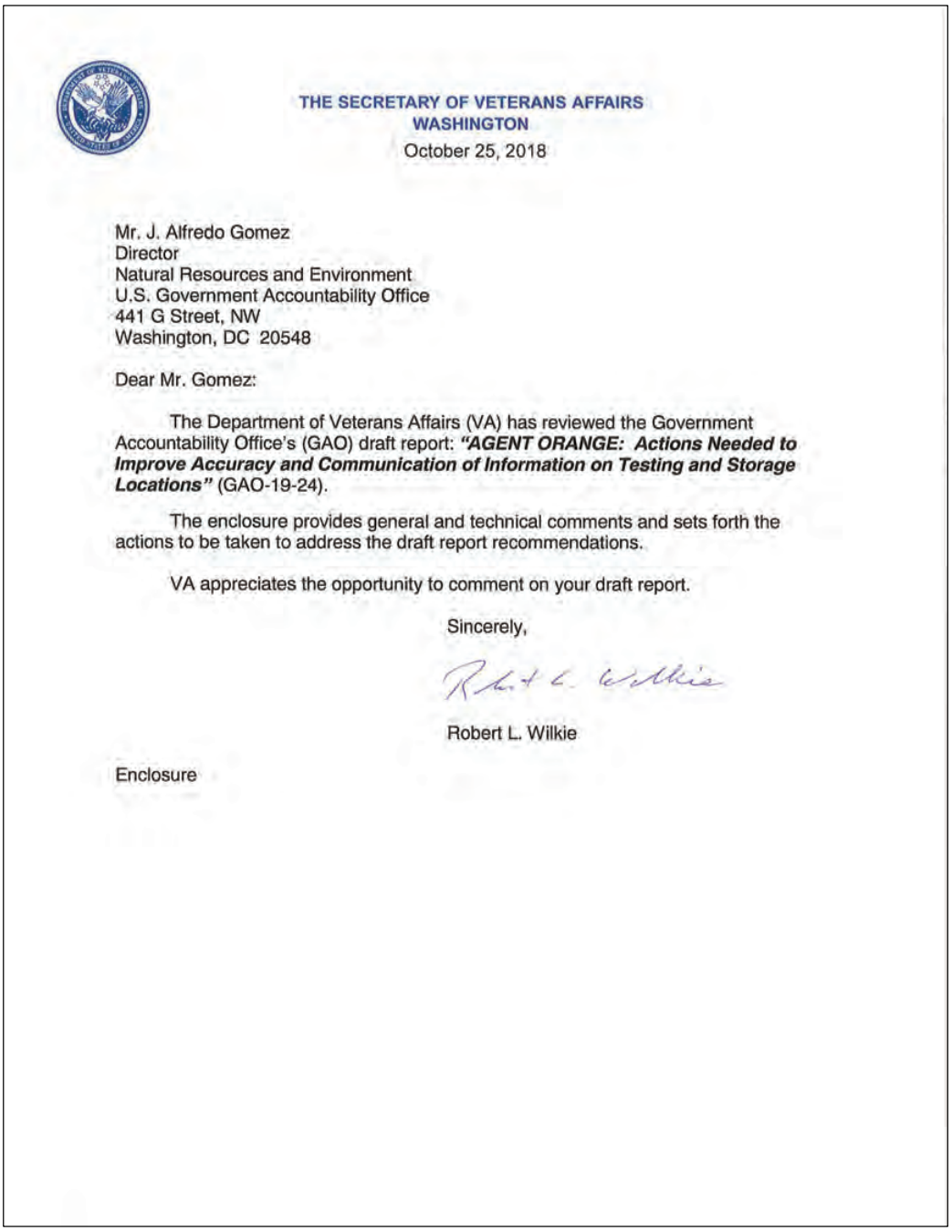
Status: DoD has engaged in thorough searches of DoD and other Federal agency records relating to Herbicide Orange and other tactical herbicides. The records discovered thus far are extensive and very useful in evaluating whether a location stored or used Herbicide Orange. DoD continues to seek and review records on these subjects as part of the process that will be developed per recommendation #2.

The DoD and VA subject matter experts (SMEs) are working collaboratively to develop clear and transparent criteria and guidance for what constitutes a location that should be on the VA list.

RECOMMENDATION 5: The GAO recommends that the Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam.

DoD RESPONSE: *Concur. DoD will be the lead agency for producing and updating the list. VA, however, will be the lead agency in providing information to Veterans regarding Herbicide Orange. VA will provide information and coordinate with DoD on the development of a communication plan. The DoD will develop guidance for DoD on directing inquiries regarding Herbicide Orange from Veterans or Veterans families back to the VA.*
DoD SMEs are currently serving on a DoD/VA Herbicide Orange Working Group (HOWG) that is advising the DoD/VA Deployment Health Working Group (DHWG). The HOWG has developed criteria for a location to be included on the list. The DoD has engaged in thorough searches of its and other Federal agencies' records relating to Herbicide Orange and other tactical herbicides to identify locations where Herbicide Orange and other tactical herbicides or their components were tested at, disposed of, transported through, or stored at DoD installations or DoD operational locations. DoD has continuously inter-faced closely with VA subject matter experts in this process.

Appendix VI: Comments from the Department of Veterans Affairs



THE SECRETARY OF VETERANS AFFAIRS
WASHINGTON

October 25, 2018

Mr. J. Alfredo Gomez
Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Gomez:

The Department of Veterans Affairs (VA) has reviewed the Government Accountability Office's (GAO) draft report: ***"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"*** (GAO-19-24).

The enclosure provides general and technical comments and sets forth the actions to be taken to address the draft report recommendations.

VA appreciates the opportunity to comment on your draft report.

Sincerely,

Robert L. Wilkie

Enclosure

THE SECRETARY OF VETERANS AFFAIRS
WASHINGTON

October 25, 2018

Mr. Brian J. Lepore
Director
Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Lepore:

The Department of Veterans Affairs (VA) has reviewed the Government Accountability Office's (GAO) draft report: ***"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"*** (GAO-19-24).

The enclosure provides general and technical comments and sets forth the actions to be taken to address the draft report recommendations.

VA appreciates the opportunity to comment on your draft report.

Sincerely,

Robert L. Wilkie

Robert L. Wilkie

Enclosure

Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

General Comments:

The Veterans Health Administration (VHA) is strongly committed to developing long-term solutions that mitigate risks to the timeliness, cost-effectiveness, quality, and safety of the Department of Veterans Affairs (VA) health care system. As such, VHA will use the findings of this report to continue to make improvements and fulfill our mission of honoring America's Veterans by providing exceptional health care that improves their health and well-being.

VA has a robust Agent Orange program centered in the Post-Deployment Health Services (PDHS) that coordinates efforts with the Veterans Benefits Administration (VBA) and will be able to respond to the recommendations of this report. Current Agent Orange efforts include the following:

1. PDHS provides oversight for an Agent Orange Registry (AOR), which currently contains more than 710,000 individuals, including more than 16,000 who were enrolled during Fiscal Year 2018. Participation in the AOR includes a comprehensive exam and history. Although the exam is not used specifically to apply for benefits, the information gained can be used as background for that process. PDHS is currently reviewing the data in the AOR to report on possible health effects associated with service during the Vietnam War in the registry participants and to generate ideas for future studies.
2. PDHS provides oversight for and management of a Web site (https://www.publichealth.va.gov/exposures/agentorange/) that covers a range of topics, such as the AOR and its eligibility, 14 conditions that have presumptive status, locations where Agent Orange was stored, used, tested, etc., (currently being revised by the Herbicide Orange Working Group), and links to VBA sites that cover eligibility for benefits and a ships list for Navy and other Veterans that provides information on specific service on ships that qualifies for Agent Orange-related service connection.
3. PDHS produces a newsletter on Agent Orange-related topics annually and sends it to the AOR population and some other Veterans and providers. The most recent newsletter is posted at: https://www.publichealth.va.gov/exposures/publications/agent-orange/agent-orange-2018/index.asp.
4. PDHS has also trained providers and other interested VA staff on Agent Orange in the last year via two webinars and a large, interactive conference in St. Louis, MO. PDHS is continually interfacing with Environmental Health Coordinators and Clinicians on topics related to possible Agent Orange exposure in Veterans.
5. PDHS has contracted with the National Academies of Science, Engineering, and Medicine to produce biennial reports on the evidence supporting associations

between exposure to tactical herbicides and a number of disease conditions. The findings of these reports are considered when making determinations on the potential addition of new conditions to the list of those presumed to be caused by exposure to Agent Orange.

6. PDHS has provided advise and materials on Agent Orange to Veterans Service Organizations and/or VA staff to use when providing educational sessions for Veterans.
7. PDHS has created a mobile application, Exposure Ed, that provides real-time information on Agent Orange and other potential exposures encountered during military service.

VA is concerned that the report conflates the terms "commercial herbicides" with "tactical herbicides," which are distinctive from one another. In this regard, VA is concerned that certain testing and storage locations, (e.g., Kelly Air Force Base) added to the list are based on the presence of commercial herbicides or mere components of Agent Orange or other rainbow agents.

It should be noted that exposure to tactical herbicides (those herbicides intended for military operations in Vietnam) is required for VA to grant disability benefits on a presumptive basis for Agent Orange conditions outside of Vietnam. The focus on commercial herbicides, which may include certain Agent Orange components, is not relevant for purposes of determining the list of locations where tactical herbicides were tested, stored, etc. unless such commercial agents were in fact the same form and mixture as the tactical agents used in Vietnam.

According to VA regulations, for purposes of determining diseases associated with exposure to certain herbicide agents, the term herbicide agent means a chemical in an herbicide used in support of the United States and allied military operations in the Republic of Vietnam during the period beginning on January 9, 1962, and ending on May 7, 1975, specifically: 2,4-D, 2,4,5-T, and its contaminant tetrachlorodibenzo-p-dioxin (TCDD); cacodylic acid; and picloram. See 38 Code of Federal Regulations §3.307(a)(6).

VA does not dispute that some of the above-mentioned chemicals found in the VA regulation may be included in certain commercial herbicides listed in the federal supply chain; however, of primary importance, the impetus for the creation of the list of testing and storage is to carry out the administration of providing disability benefits in accordance with the applicable Agent Orange statute and regulations. Thus, unless such commercial herbicides were in fact the same composition, forms, and mixtures as the estimated 77 million liters, or 20 million gallons, of rainbow agents (i.e., tactical herbicides) that were specifically produced for the United States and allied military

operations in Vietnam, then such discussion is misleading and not relevant for the purposes described above. See table below for estimated amounts and chemical compositions of rainbow agents used in Vietnam.

An example of this occurs in the draft report on page ten, paragraph one, where GAO mentions that some of the commercial herbicides in the federal supply system contained one or both of some form of the components of Agent Orange, including at least four that contained some form of 2,4,5-T, the component which contained the contaminant 2,3,7,8-TCDD. It should be noted, however, that such commercial forms do not, for example, equate to the mixtures of the n-butyl forms of 2,4-D (50 percent) and 2,4,5-T (50 percent), which make up herbicide orange. This is further illustrated in the last bullet on page 20, where it is noted that two components of Agent Orange were stored at the former Kelly Air Force Base.

VA recommends GAO analyze its list to ensure that only locations where the presence of tactical herbicides, as contemplated by law in 38 United States Code § 1116 and prescribed in VA regulations, has been confirmed, are included on the list of locations.

TABLE
Herbicides in Vietnam (1961 – 1971)
(National Academies of Sciences, 2014, p. 67)

Code Name	Chemical Constituents	Years Used	Veterans Agent Orange Series Estimate	Revised Estimate
Pink	60% n-butyl ester, 40% isobutyl ester of 2,4,5-T	1961, 1965	464,817 L (122,792 gal)	50,312 L sprayed; 413,852 L additional on procurement records
Green	n-butyl ester of 2,4,5-T	1961, 1965	31,071 L (8,208 gal)	31,026 L on procurement records

Purple	50% n-butyl ester of 2,4-D, 30% n-butyl ester of 2,4,5-T, 20% isobutyl ester of 2,4,5-T	1962-1965	548,883 L (145,000 gal)	1,892,733 L
Orange	50% n-butyl ester of 2,4-D, 50% n-butyl ester of 2,4,5-T	1965-1970	42,629,013 L (11,261,429 gal)	45,677,937 L (could include Agent Orange II)
Orange II	50% n-butyl ester of 2,4-D, 50% isooctyl ester of 2,4,5-T	After 1968	--	Unknown; at least 3,591,000 L shipped
White	Acid weight basis: 21.2% triisopropanolamine salts of 2,4-D, 5.7% picloram	1966-1971	19,860,108 L (5,246,502 gal	20,556,525 L
Blue Powder	Cacodylic acid (dimethylarsinic acid) sodium cacodylate	1962-1964	--	25,650 L
Blue aqueous solution	21% sodium cacodylate + cacodylic acid to yield at least 26% total acid equivalent by weight	1964-1971	4,255,952 L (1,124,307 gal)	4,715,731 L
Total, all formulations	**--**	**--**	**67,789,844 L (17,908,238 gal)**	**76,954,766 L (including procured)**

Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

Recommendation 3: The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop clear and transparent criteria for what constitutes a location that should be included on the listing of testing and storage locations.

VA Comment: The Department of Defense (DoD) is the lead on this recommendation. The Department of Veterans Affairs (VA) agrees to support DoD as the lead.

Recommendation 4: The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations.

VA Comment: Non-Concur. VA does not agree to take the lead on this recommendation. Rather, VA agrees to support DoD as the lead (highlighted in recommendation 3). DoD chairs the Herbicide Orange Working Group (HOWG) and has sole access to the information on storage, transport, and usage of Agent Orange.

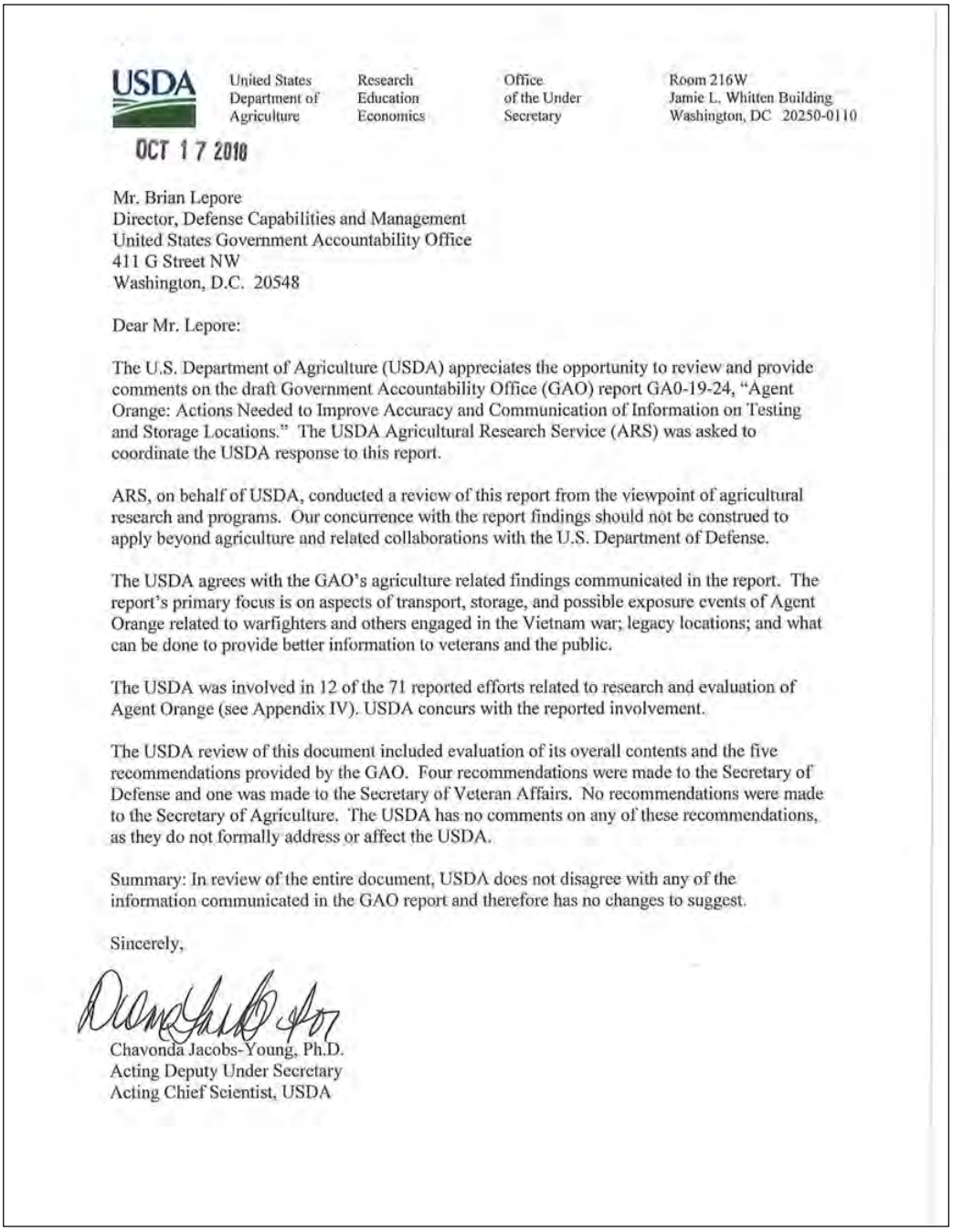
Recommendation 6: The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam.

VA Comment: Concur. VA's subject matter experts (SMEs) are currently serving on a DoD/VA HOWG, which is advising the DoD/VA Deployment Health Work Group (DHWG). The HOWG developed criteria for a location to be included on the list. DoD has engaged in thorough searches of its, and other federal agencies', records to identify locations where Herbicide Orange and other tactical herbicides or their components were used or tested at, disposed of, transported through, or stored at installations or other DoD operational locations. DoD has continuously interfaced with VA SMEs during this process.

While DoD will be the lead agency to produce and update the list, VA will be the lead agency to provide information to Veterans regarding Herbicide Orange. VA will provide information and coordinate with DoD on the development of a communication plan. VA will convene a workgroup comprised of SMEs from the Veterans Health Administration and the Veterans Benefits Administration, as well as Agency communication and public affairs experts, to develop and implement the formal process to communicate where Agent Orange and other tactical herbicides were known to have been present outside of Vietnam. This effort will be closely coordinated with the designated leads at DoD tasked with updating the list. VA's workgroup tasks will also include updating VA Web

sites, producing articles for social media/newsletters, and engaging in communications with Veterans Service Organizations. The working group will brief the HOWG, and then the DHWG, on its progress, and ultimately brief appropriate senior VA leadership before the target completion date. The target completion date is August 2019.

Appendix VII: Comments from the U.S. Department of Agriculture



USDA United States Department of Agriculture | Research Education Economics | Office of the Under Secretary | Room 216W Jamie L. Whitten Building Washington, DC 20250-0110

OCT 17 2018

Mr. Brian Lepore
Director, Defense Capabilities and Management
United States Government Accountability Office
411 G Street NW
Washington, D.C. 20548

Dear Mr. Lepore:

The U.S. Department of Agriculture (USDA) appreciates the opportunity to review and provide comments on the draft Government Accountability Office (GAO) report GA0-19-24, "Agent Orange: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations." The USDA Agricultural Research Service (ARS) was asked to coordinate the USDA response to this report.

ARS, on behalf of USDA, conducted a review of this report from the viewpoint of agricultural research and programs. Our concurrence with the report findings should not be construed to apply beyond agriculture and related collaborations with the U.S. Department of Defense.

The USDA agrees with the GAO's agriculture related findings communicated in the report. The report's primary focus is on aspects of transport, storage, and possible exposure events of Agent Orange related to warfighters and others engaged in the Vietnam war; legacy locations; and what can be done to provide better information to veterans and the public.

The USDA was involved in 12 of the 71 reported efforts related to research and evaluation of Agent Orange (see Appendix IV). USDA concurs with the reported involvement.

The USDA review of this document included evaluation of its overall contents and the five recommendations provided by the GAO. Four recommendations were made to the Secretary of Defense and one was made to the Secretary of Veteran Affairs. No recommendations were made to the Secretary of Agriculture. The USDA has no comments on any of these recommendations, as they do not formally address or affect the USDA.

Summary: In review of the entire document, USDA does not disagree with any of the information communicated in the GAO report and therefore has no changes to suggest.

Sincerely,

Chavonda Jacobs-Young, Ph.D.
Acting Deputy Under Secretary
Acting Chief Scientist, USDA

Appendix VIII: GAO Contacts and Staff Acknowledgments

GAO Contacts

Brian J. Lepore, (202) 512-4523 or leporeb@gao.gov
J. Alfredo Gómez, (202) 512-3841 or gomezj@gao.gov

Staff Acknowledgments

In addition to the contacts named above, Kristy Williams and Barbara Patterson (Assistant Directors), Karyn Angulo, Emil Friberg, Ashley Grant, Karen Howard, Kelly Husted, Richard Johnson, Amie Lesser, Keegan Maguigan, Jeff Mayhew, Dennis Mayo, Parke Nicholson, Shahrzad Nikoo, Josie Ostrander, Rebecca Parkhurst, Michael Silver, Anne Stevens, Rachel Stoiko, Roger Stoltz, and Cheryl Weissman made key contributions to this report.

Related GAO Products

Agent Orange: Limited Information Is Available on the Number of Civilians Exposed in Vietnam and Their Workers' Compensation Claims. GAO-05-371. Washington, D.C.: Apr. 22, 2005.

Agent Orange: Persisting Problems with Communication of Ranch Hand Study Data and Results. GAO/T-NSIAD-00-117. Washington, D.C.: Mar. 15, 2000.

Agent Orange: Actions Needed to Improve Communications of Air Force Ranch Hand Study Data and Results. GAO/NSIAD-00-31. Washington, D.C.: Dec. 17, 1999.

Agent Orange Studies: Poor Contracting Practices at Centers for Disease Control Increased Costs. GAO/GGD-90-122BR. Washington, D.C.: Sept. 28, 1990.

Agent Orange: VA Needs To Further Improve Its Examination and Registry Program. GAO/HRD-86-7. Washington, D.C.: Jan. 14, 1986.

VA's Agent Orange Examination Program: Actions Needed To More Effectively Address Veterans' Health Concerns. GAO/HRD-83-6. Washington, D.C.: Oct. 25, 1982.

(102077)

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Congressional Relations	Orice Williams Brown, Managing Director, WilliamsO@gao.gov, (202) 512-4400, U.S. Government Accountability Office, 441 G Street NW, Room 7125, Washington, DC 20548
Public Affairs	Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800 U.S. Government Accountability Office, 441 G Street NW, Room 7149 Washington, DC 20548
Strategic Planning and External Liaison	James-Christian Blockwood, Managing Director, spel@gao.gov, (202) 512-4707 U.S. Government Accountability Office, 441 G Street NW, Room 7814, Washington, DC 20548

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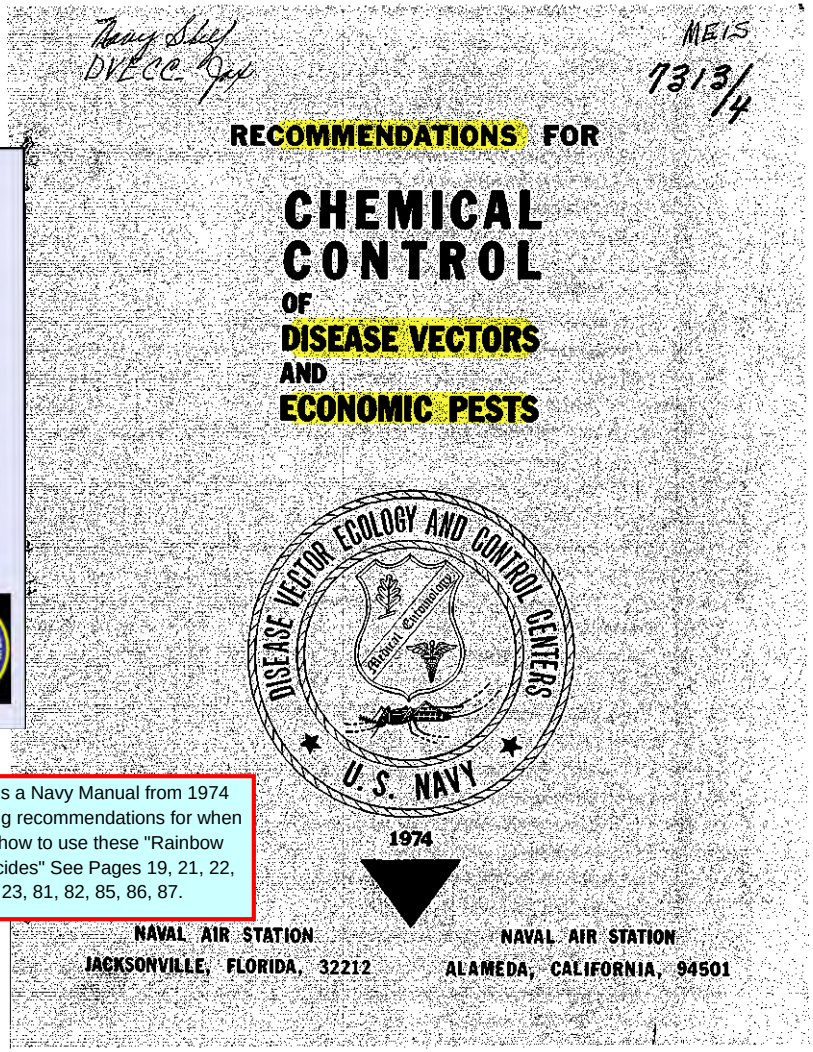
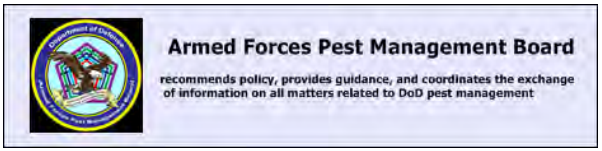


This is a Navy Manual from 1974 showing recommendations for when and how to use these "Rainbow Herbicides" See Pages 19, 21, 22, 23, 81, 82, 85, 86, 87.



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INTRODUCTION

Subj: Recommendations for Chemical Control of Disease Vectors and Economic Pests

1. Purpose. This publication has been prepared primarily for distribution to Armed Forces Pest Control Program personnel, military and civilian. Post engineers, public works officers and installation engineers of the respective services may also find the publication helpful. It may also be useful to individuals, householders and property owners among military personnel and their dependents.

2. Cancellation. DVECC Recommendations for Chemical Control of Disease Vectors and Economic Pests, issued 1 January 1972, is hereby cancelled and superseded.

3. Background. Since the first use of kerosene for scale insect control in 1865 and later in the century as a mosquito larvicide, numerous chemicals and other substances have been tried, some proven, but most discarded as chemical control agents. The discovery in 1939 of the insecticidal properties of DDT opened up a new and fruitful era of chemical pesticides. Since then, through synthesis, testing and laboratory and field evaluation, many new chemicals have emerged as the pesticides of today.

Some modern pesticides are more or less specific for certain animal or plant pests and have limited specialized use. Others are effective against a wide range of a certain type or group of pests. Thus, we have the insecticides, the acaricides, the rodenticides, the fungicides, the herbicides, etc. A substance found to be effective against a wide variety of insect pests may be called a broad-spectrum insecticide. An attempt has been made in this publication to give the pesticide of choice first under each pest heading and then to list one or more alternate materials. The listing of a particular pesticide as first choice is a precarious if not arbitrary business since there is no standard yardstick by which one pesticide may be compared with another for a given purpose.

The recommendation of one pesticide over another should not be taken as an endorsement of one product or material over another. Neither should it be inferred that the others are less valuable under certain conditions and locations.

4. Precautions - Reading the Label. The use of pesticides is regulated by the Environmental Protection Agency. That agency is responsible for enforcement of the Federal Pesticide Act of 1972. PESTICIDES ARE REGISTERED FOR USE AGAINST SPECIFIC PESTS AND CERTAIN TYPES OF APPLICATION. TO USE THEM OTHERWISE IS UNLAWFUL AND MAY RESULT IN RATHER SEVERE PUNISHMENT. IT IS THE RESPONSIBILITY OF THE USER TO ENSURE THAT A PESTICIDE IS USED IN STRICT COMPLIANCE WITH THE LABEL. It is also the responsibility of the user to make sure the label is current and contains the latest instructions and restrictions. Recommendations contained in this publication are intended as a guide only and must not be substituted for

HERBICIDES

FSN No.	ITEM
6840-833-1217	Amitrol, ATA*, Cytrol*, Weedazol* Must be procured from the Army. A non-selective systemic herbicide. For control of annual grasses and broadleaf weeds, perennial broadleaf weeds and grasses, cattails, poison ivy, and certain aquatic weeds in marshes and drainage ditches. 90% water soluble. $46.50/Pail (24 lbs)
6840-781-8195	Atrazine, AAtrex*, Fenamine*, Fenatrol*, Gesaprim* Primatol A* Principal use by military is as soil sterilant. 80% wettable powder. $2.20/Bag (50 lb)
6840-027-6467	Borate-Bromacil Mixture This granular mixture contains 71.2% disodium tetraborate pentahydrate, 22.8% disodium tetraborate decahydrate, 4.0% bromacil, 2.0% inert. $21.50/Bag (50 lbs)
6840-890-2146	Bromacil, Hyvar-X*, Hyvar-P*, Hyvar X-L* For general weed control in non-crop areas; particularly useful against perennial grasses. Wettable powder contains 80% bromacil. $248.00/Drum (50 lbs)
6840-926-9094	Cacodylic acid, Silvisar 510*, Phytar 560G* Difficult to procure Non-selective herbicide. The 16 gauge drum shall have a three inch wide blue band at the center line. This item is for tactical purposes only and is not for base type pest control. $271.00/Drum (55 gallons)
6840-063-3981	Copper Sulfate This water soluble crystalline herbicide contains 80.16% cupric sulfate. Used for control of algae in impoundments. $14.00/Bag (50 pounds)

This is a Synonym for Agent Blue herbicide

* Trade Name

HERBICIDES (Continued)

FSN No.	Item
6840-577-4204	Dalapon-Na, Dowpon*, Ded-Weed*, Gramevin*, Radapon*, Unipon* Selective herbicide. Effective against quackgrass, Bermuda grass, Johnson grass and other perennial grasses as well as cattails and rushes. 85% water soluble powder. $39.00/Drum (50 lbs)
6840-681-9475	DCPA, DAC 893*, Dacthal* Selective pre-emergence herbicide controls crabgrass, witchgrass, foxtails, fall panicum and other annual grasses. Also useful against certain broadleaf weeds such as carpet weed, dodder, purslane and common chickweed. This wettable powder contains 75% active ingredient. $118.00/Box (48 lbs)
6840-905-4304	Dicamba, Banvel D*, Banex*, Mediben* Very effective on many hard to kill broadleaf species of weeds and brush which may not be controlled efficiently with 2,4-D or amitrol. Effective as soil or foliar treatment. 49% dicamba, liquid form. $29.90/Bottle (1 gallon)
6840-815-2799	Diquat, Aquacide*, Dextrone*, Reglone* Non-selective herbicide and desiccant. For aquatic weeds in still and slow flowing ponds, lakes and canals. For floating weeds. 35.3% diquat dibromide, liquid. $120.00/Drum (5 gallon)
6840-825-7790	Diuron, Karmex*, Marmer*, Di-on* Used in the military as a non-selective weed killer on sites where bare ground is desired. As a soil sterilant it is more persistent and is often recommended in light sandy soils in areas of moderate to heavy rainfall. This water dispersible powder contains 80% active ingredient. $127.00/Drum (50 lbs)

* Trade Name

HERBICIDES (Continued)

FSN No.	Item
6840-965-2071	DSMA, Ansar 184*, Ansar 8100*, Arrhenal*, DMA*, Weed-E-Rad* and others Selective post-emergence contact herbicide controls crabgrass, Johnson grass, Dallis grass, nutgrass, foxtail, watergrass, witchgrass, velvetgrass, chickweed, goosegrass, knotweed and others. Thorough coverage essential. This water soluble powder contains 63% disodium methylarsonate. $38.20/Drum (100 lbs)
6840-929-7951	Fenac, Tri-Fen*, Effective for Johnson grass seedlings, Russian thistle, morning glory, Russian knapweed, Canada thistle, perennial sow thistle and puncture vine. $228.00/Drum (30 gallons)
6840-514-0644	Monuron, Telvar* Used by the military as a soil sterilant on medium to heavy soils and under intermediate rainfall. At sterilant dosages it controls a wide range of annual and perennial plants, both grasses and broadleaf types. Water dispersible powder. $119.00/Drum (50 lbs)
6840-629-1368	Picloram, Tordon*, Borolin* Effective against a wide variety of deep rooted herbaceous weeds and woody plants. Most grasses are resistant. For noncrop use in brush control along utility rights-of-way. Since it is compatible with 2,4-D, dalapon and certain other herbicides, it is mixed occasionally with another herbicide to produce desired results. $57.00/Drum (5 gallon)
6840-926-9093	Picloram Difficult to procure. Same as preceding. The 16 gauge drum shall have a three inch wide white band at the center line. This item is for tactical purposes only and not for base type pest control operations. $390.00/Drum (55 gallon)

This is a synonym for Agent White herbicide

Rainbow Herbicide

* Trade Name

HERBICIDES (Continued)

FSN No.	Item
6840-990-1464	Picloram Same chemical as preceding. This formulation is pelletized and contains 11.6% picloram potassium salt. $69.00/Drum (50 lbs)
6840-882-4810	Silvex Ester, 2,4,5-TP*, Garlon*, Kurosal*, Kuron* Hormone type herbicide that is absorbed by leaves and translocated. Tests have indicated that silvex is more effective than 2,4,5-T for control of certain woody plants, especially oak species. Very effective on many turf weeds such as chickweed, clover, henbit and yarrow. This emulsifiable concentrate contains 58.9% to 65.1% of any suitable low volatile ester derivative of 2-(2,4,5-trichlorophenoxy) propionic acid (4 lb minimum acid equivalent per gallon). $38.70/Drum (5 gallons)
6840-814-7334	Simazine, Princep*, Gesatop*, Primatol* Soil sterilant. Tightly held by soil. Little lateral movement. Micro-organisms break it down in about a year. Persists longer in dry, cold or low fertility soils. Can be combined with 2,4-D, 2,4,5-T, silvex, dalapon, amitrol and others. Broadleaf plants are the most susceptible. 80% water dispersible powder. $12.10/Bag or Can (5 lbs)
6840-781-8195	Simazine Same as preceding $110.00/Drum (50 lbs)
6840-664-7060	2,4-D, Weed-B-Gone*, Weedone*, Weedar 64*, Formula 40* and others. Post emergence herbicide for broadleaf control. Sometimes for aquatic weed control. Effective against morning glory, Canada thistle, chickweed, cocklebur, golden rod, ivy, hoary cress, jimsonweed, lambsquarter, locoweed, mustards, pigweed, plaintain, Russian thistle, purslane, sagebrush, sunflower, willows and others. Avoid drift. Very susceptible desirable plants include cotton, tomatoes, grapes, fruit, trees, and ornamentals. Amine form. $14.00/Can (5 gallons)

Silvex is another rainbow herbicide

* Trade Name

HERBICIDES (Cont.)

FSN No.		
6840-825-7792	2,4-D - 2,4,5-T Mixture, Ded-Weed LV33*	Restricted procurement. This solution contains 33.5% low volatile ester of 2,4-D (2.0 lb 2,4-D acid equivalent/ gallon). 31.9% low volatile ester of 2,4,5-T (2.0 lb 2,4,5-T/gallon) and 34.6% inert ingredients. $297.00 Drum (55 gallons)
6840-926-9095	2,4-D - 2,4,5-T High volatile ester	Difficult to procure. This solution contains 50% N-butyl 2,4-dichlorophenoxyacetate, 50% N-butyl, 2,4,5-T trichlorophenoxyacetate. The drum shall have an orange band 3 inches wide at the center line of the drum body. This item is for tactical purposes only and is not for base type pest control operations. $430.00 Drum (55 gallon)
6840-582-5440	2,4,5-T, Dacamine 4T*, Reddon*, Weedone 2,4,5-T*	Selective hormone type herbicide. Effective against woody plants. Treat when plants are actively growing. Four pounds acid equivalent per gallon. $33.50/Can (5 gallons)
6840-577-4201	2,4,5-T	Same as preceding. $348.00 Drum (55 gallons)

Rainbow Herbicicde

Agent Orange

Rainbow Herbicide

Rainbow Herbicide

* Trade

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ESTIMATED RELATIVE ACUTE TOXIC HAZARDS OF PESTICIDES TO SPRAYMEN*

The estimates of hazards in this table are based primarily on the *observed acute dermal* and to a less extent oral toxicity of these compounds to experimental animals. *Where it is available, use experience has also been considered.* It should be noted that the classification into *toxicity groups is both approximate and relative.* These toxicity categories are not related to specific categories spelled out for label requirements.

Most Dangerous	*Dangerous*	*Less Dangerous†*	*Least Dangerous*
carbanolate, Temik (M)‡	aldrin (CH)	azinphosmethyl, Guthion® (OP)	Aramite® (M)
demeton, Systox® (OP)	Bidrin® (OP)	BHC (CH)	captan (M)
disulfoton, Di-Syston® (OP)	carbophenothion, Trithion® (OP)	binapacryl, Morocide® (N)	carbaryl, Sevin® (C)
mevinphos, Phosdrin® (OP)	DDVP, dichlorvos (OP)	chlordane (CH)	chlorobenzilate (CH)
parathion (OP)	dieldrin (CH)	coumaphos, Co-Ral® (OP)	2,4-D (CH)
phorate, Thimet® (OP)	dioxathion, Delnav® (OP)	diazinon (OP)	DDD, TDE (CH)
schradan, OMPA (OP)	DNOC (N)	dicapthon (OP)	DDT (CH)
tepp (OP)	DNOSBP (N)	dichloroethyl ether (M)	dicofol, Kelthane® (CH)
thionazin, Zinophos® (OP)	endrin (CH)	dimethoate, Cygon® (OP)	Dilan® (CH,N)
	EPN (OP)	endosulfan, Thiodan® (CH)	dinocap, Karathane® (N)
	ethion, Nialate® (OP)	fenthion, Baytex® (OP)	diquat (M)
	methyl parathion (OP)	heptachlor (CH)	IPC, propham (M)
	nicotine (M)	lead arsenate (M)	malathion (OP)
	pentachlorophenol (M)	lindane (CH)	maneb (M)
	phosphamidon, Dimecron® (OP)	naled, Dibrom® (OP)	methoxychlor (CH)
	sodium arsenite (M)	oxydemetonmethyl, Meta-Systox®-R (OP)	mirex (CH)
	Zectran® (C)	Ruelene® (OP)	Morestan® (M)
		SMDC, Vapam® (M)	NAA (M)
		trichlorfon, Dipterex®, Dylox® (OP)	Perthane® (CH)
		toxaphene (CH)	piperonyl butoxide (M)
		VC-13 (OP)	ronnel, Korlan® (OP)
			rotenone (M)
			simazine (M)
			2,4,5-T (CH)
			tetradifon, Tedion® (CH)
			thiram (M)
			zineb (M)
			ziram (M)

* SOURCE OF DATA: *Safety In the Use of Pesticides*, Homer R. Wolfe, William F. Durham. Proc. 2nd Eastern Wash. Fertilizer and Pesticide Conf. Pullman: Washington State University, pp. 16-21, 1966.

‡ The fumigant compounds acrylonitrile, D-D®, and Telone® have systemic toxicities which would indicate their placement under the "Less Dangerous" category. However, special note should be taken of the fact that the volatility of these compounds and their capacity to produce irritation of skin, eyes and other tissues indicate that appropriate caution should be exercised in their use.

† The chemical class to which the pesticide belongs is designated as follows: C, carbamate; CH, chlorinated hydrocarbon; M, miscellaneous; N, nitro; and OP, organic phosphorus.

WEED CONTROL RECOMMENDATIONS: THESE RECOMMENDATIONS ARE FOR GUIDELINES ONLY. USER MUST ENSURE THAT PESTICIDE IS APPLIED IN STRICT COMPLIANCE WITH THE LABEL

HERBICIDES

TYPE OF APPLICATION	PESTICIDE	TIME OF APPLICATION	ORGANISMS CONTROLLED	REMARKS
Lawns and Ornamental Turf	DSMA	Any time target weeds are growing actively and air temperature is over 70°F	dallisgrass, sandbur, bahiagrass, nutsedge, crabgrass, chickweed and wood sorrel	Do not treat new lawns until after 3 mowings. Tolerant grasses may be temporarily affected, especially in hot weather. Rain or waterings will revive them. Bent and fescue grasses are generally more sensitive, and may be temporarily discolored. Zoysia, bluegrass and bermuda are tolerant. Do NOT use on St. Augustine and centipede grasses. Spray thoroughly. Repeat as necessary at 10-14 day intervals. Keep children and pets off treated areas until material has been washed into the soil. Do NOT contaminate waters used for domestic consumption, or by animals, wildlife and aquatic life, or for irrigation purposes.
Aquatic Weeds emerged from still water such as ponds, lakes and ditches	silvex	When foliage is above water and well developed	waterlily, spatterdock, pickerelweed, alligator weed, arrowhead	Thorough coverage is essential. Special Precautions: See remarks under "Aquatic Weeds Submerged" for silvex. General Precautions: See remarks for silvex for "Brush Vines and Trees"
	diquat	When foliage is above water but before flowering	pennywort, salvinia, water hyacinth, water-lettuce, cattails, duckweed	Care should be taken to thoroughly cover all plants on water and on damp marginal areas. Reinfestation of duckweed occurs readily from untreated areas. Retreatment with diquat may be necessary to obtain season long control. See remark under "Aquatic Weeds Submerged" for diquat.

Rainbow Herbicide

WEED CONTROL RECOMMENDATIONS: THESE RECOMMENDATIONS ARE FOR GUIDELINES ONLY. USER MUST ENSURE THAT PESTICIDE IS APPLIED IN STRICT COMPLIANCE WITH THE LABEL

HERBICIDES

TYPE OF APPLICATION	PESTICIDE	TIME OF APPLICATION	ORGANISMS CONTROLLED	REMARKS
Aquatic weeds submerged in still water such as ponds, lakes and ditches	silvex	Early summer when water is above 50°F and weeds are nearing water surface	Milfoil, fanwort, bladderwort, waterweed	Uniform distribution over the water surface is necessary. Do not treat flowing water. A pond with a slight current can be treated after the water level is lowered if there will be no overflow for at least three days following treatment. Apply only in accordance with state and local laws governing chemical treatment of bodies of water for control of weeds. Special Precautions: Do not use where pond water is being used for irrigation, agricultural sprays, for domestic water supply or for livestock watering. Do not apply to water containing valuable fish unless some fish kill can be tolerated. Kill may occur in shallow coves if application is not uniform or in shallow areas not diluted by fresh water. Treatment of aquatic weeds can result in oxygen loss from decomposition of dead weeds. This loss can cause fish suffocation. Therefore, treat 1/3 to 1/2 of the water area in a single operation and wait 10 to 14 days between treatments. It is recommended that edges of pond or lake be treated first so that fish will not be trapped in shallow pockets or inlets. Apply silvex when water level is low to minimize exposure of desirable vegetation along shorelines. Do not apply algacides such as copper sulfate for 3 days before or after applying silvex since they may interfere with the action of silvex. See remarks for silvex for "Brush, Vines and Trees".

Rainbow Herbicide

WEED CONTROL RECOMMENDATIONS: THESE RECOMMENDATIONS ARE FOR GUIDELINES ONLY. USER MUST ENSURE THAT PESTICIDE IS APPLIED IN STRICT COMPLIANCE WITH THE LABEL

HERBICIDES

TYPE OF APPLICATION	PESTICIDE	TIME OF APPLICATION	ORGANISMS CONTROLLED	REMARKS
Unwanted annual and perennial broadleaved weeds and woody plants and vines on non-crop areas including industrial sites, right-of-ways of power lines, pipelines, communication lines, highways and railroads	tordon-2,4-D mixture	Any time target plants are actively growing	Perennial Broadleaved Weeds: Field bindweed, wild carrot, bouncingbet, chicory, sweet clover, wild clover, dandelion, dock, fleabane, goldenrod, horsenettle, knapweed, Russian milkweed, bur ragweed, plantain, common ragweed, sowthistle, snakeweed, spurge, Canada thistle toadflax and vetch	Do not permit these herbicides to contact susceptible crop, ornamental, vegetable, flower or other desirable plantings. Use coarse sprays under low pressure to minimize drift. Do not spray when wind velocity exceeds 5 mph. At high temperature (above 90°F), vapors from this product may injure susceptible nearby plants. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. Do not store near other pesticides. To avoid injury to desirable plants, do not handle or apply other pesticides with the same equipment used for these herbicides except as specified on the label. Rinse equipment and containers and dispose of waste by burying in non-crop lands away from water supplies. May cause skin irritation. Avoid contact with eyes, skin and clothing.

Agent White

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WEED CONTROL RECOMMENDATIONS: THESE RECOMMENDATIONS ARE FOR GUIDELINES ONLY. USER MUST ENSURE THAT PESTICIDE IS APPLIED IN STRICT COMPLIANCE WITH THE LABEL

HERBICIDES

TYPE OF APPLICATION	PESTICIDE	TIME OF APPLICATION	ORGANISMS CONTROLLED	REMARKS
Unwanted annual and perennial broadleaved weeds and woody plants and vines on non-crop areas including industrial sites, right-of-ways of power lines, pipelines, communication lines, highways and railroads	Tordon-2,4-D mixture	Any time target plants are actively growing	Woody Plants: Ailanthus, alder, aspen, birch, blackberry, bracken fern, buttonbush, cedar, cherry, douglas fir, elm, balsam fir, gorse, gum, hemlock, hickory, honeysuckle, kudzu, locust, maple, oak, persimmon, pine, poison oak, sassafras, sourwood, spruce, sumac, tulip poplar, wild rose, willow	Do not permit these herbicides to contact susceptible crop, ornamental, vegetable, flower or other desirable plantings. Use coarse sprays under low pressure to minimize drift. Do not spray when wind velocity exceeds 5 mph. At high temperature (above 90°F), vapors from this product may injure susceptible nearby plants. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. Do not store near other pesticides. To avoid injury to desirable plants, do not handle or apply other pesticides with the same equipment used for these herbicides except as specified on the label. Rinse equipment and containers and dispose of waste by burying in non-crop lands away from water supplies. May cause skin irritation. Avoid contact with eyes, skin and clothing.

Agent White

WEED CONTROL RECOMMENDATIONS: THESE RECOMMENDATIONS ARE FOR GUIDELINES ONLY. USER MUST ENSURE THAT PESTICIDE IS APPLIED IN STRICT COMPLIANCE WITH THE LABEL

HERBICIDES

TYPE OF APPLICATION	PESTICIDE	TIME OF APPLICATION	ORGANISMS CONTROLLED	REMARKS
Brush, vines and trees in industrial sites, forests, right-of-ways of power lines, pipelines, highways, railroads, and along drainage ditch banks, fuel breaks, fence rows, golf courses, parks and athletic fields	silvex	Any time target plants are actively growing	Most unwanted woody plants such as alder, bramble, dogwood, buttonbush, maple, honeysuckle, locust, mesquite, poison ivy, persimmon, poison oak, pricklypear, cactus, sagebrush, willow, salmonberry, salt cedar, wild rose, oak, yucca, plus many species of broadleaf weeds	Do not permit these herbicides to contact susceptible crop, ornamental, vegetable, flower or other desirable plantings. Use coarse sprays under low pressure to minimize drift. Do not spray when wind velocity exceeds 5 mph. At high temperature (above 90°F), vapors from this product may injure susceptible nearby plants. Do not contaminate irrigation ditches or water used for irrigation or domestic purposes. Do not store near other pesticides. To avoid injury to desirable plants, do not handle or apply other pesticides with the same equipment used for these herbicides except as specified on the label. Rinse equipment and containers and dispose of waste by burying in non-crop lands away from water supplies. May cause skin irritation. Avoid contact with eyes, skin and clothing.
Algae in still water such as ponds, lakes and ditches	diquat	At first appearance	Algae of Spirogyra spp. and Pithophora spp.	Apply 0.5 to 1.5 ppm of water. Application methods as for submerged weeds.

Rainbow Herbicide

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