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MTADS Demonstration at the Walker River Paiute Reservation Schurz, NV - November 1998

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EXECUTIVE SUMMARY

Over the past decade periodic Off-Range Ordnance (ORO) sweeps by the EOD Mobile Unit 3 have recovered significant live and inert ordnance from the Walker River Indian Reservation adjacent to the south border of the NAS Fallon Training Range Bravo-19. In an effort to evaluate the extent and level of contamination, the Naval Research Laboratory (NRL) conducted an *MTADS* demonstration on the site. The demonstration was supported by DoD Native American Lands Project funds through the Environmental Security Technology Certification Program which supported the development of the *MTADS*. The demonstration involved surface clearance and geophysical survey of four 50 X 2100 meter transects, two parallel to and two perpendicular to the fence. While on site, the eastern survey parallel to the fence was doubled in width to 100 meters and a significant portion of this transect was also surveyed using the *MTADS* EM array. An additional walkover and surface clearance extended the transect parallel to the fence for an additional 6,000 meters to the eastern limit of the range. The surface clearance removed several tons of OE scrap and recovered ordnance including 2.75-in war heads, BDU-33s, Luu-2 flares and about 8,000 20-mm projectiles. Following the surveys which took place between 10-20 November 1998, data was analyzed at NRL. The 500 targets chosen for digging were remediated in early July 1999. Recovered ordnance included three 2.75-in warheads, three 3-in warheads, five BDU-33s, one Mk 83 (1000-lb) and seven Mk 82 (500-lb) bombs. The HE-filled bombs were blown in place. Ordnance and OE scrap were most concentrated near the perimeter fence, the most-distant ordnance item was found more than 1,000 meters south of the Center Range Tower. Following analysis of the recovered items, NRL recommends a geophysical search and remediation approach including about 1300 acres. Recovering all ordnance from this area, we feel, will effectively clear the Reservation Lands adjacent to the Range.

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1.0 Introduction

1.1 Background Information

Unexploded ordnance (UXO) is arguably the most serious and prevalent environmental problem currently facing DOD facility managers. Mitigation and remediation activities are often hindered because UXO is co-located with other environmental threats including ordnance explosives wastes (OEW), chemical wastes, and other toxic and hazardous materials. Not limited to active sites and test ranges, these problems also occur at DOD sites that are currently dormant, and in areas adjacent to military ranges that belong to the civilian sector or are under control of other government agencies. UXO mitigation and remediation problems assume even more compelling proportions when DOD lands are classified as Formerly Used Defense Sites (FUDS), or Base Realignment and Closure (BRAC) sites. Land on FUDS and BRAC sites must be evaluated and remediated as appropriate, and must be certified as suitable for the planned end use depending upon the pending disposition. Oversight and evaluation of these processes involves non-DOD agencies including EPA, state, county and local governments, and the civilian community.

Current techniques typically used for buried UXO detection, site characterization, and

remediation are slow, labor intensive, and inefficient. Typical detection and characterization technologies involve hand-held detectors operated by explosives ordnance disposal (EOD) or civilian UXO technicians who must slowly walk across the survey area. Time consuming and sometimes dangerous, this process has been well documented as inefficient, as well as marginally effective. [1-3] Many ordnance items are disguised by the presence of extensive surface clutter and shrapnel from ordnance operations. Large and deep ordnance targets are often not found, because either their footprints are too large to be "visualized" by the walking operator or their signatures are lost in magnetic disturbances associated with geophysical anomalies. Developing an image of a deep target, especially in a field of shallow targets, is most difficult for the hand-held surveyor.[2] The Multi-Sensor Towed Array Detection System *(MTADS)* technology is designed to address these issues.

The Environmental Security Technology Certification Program (ESTCP) provided funds to NRL for the development and demonstration of a multi-sensor vehicular towed-array system. The *MTADS* incorporates both cesium (Cs) vapor, full-field magnetometers and active, pulsed induction sensors. The sensors are mounted as linear arrays on low-signature platforms that are towed over survey sites by an all-terrain vehicle. The position-over-ground is plotted using state-of-the-art Real-Time Kinematic (RTK, or on-the-fly) technology that also provides vehicle guidance during the survey. Using mature sensor technologies, the Naval Research Laboratory (NRL) focused on the development and integration of a Data Analysis System (DAS) to locate, identify and categorize all military ordnance at its maximum probable self-burial depths. The DAS is efficient and simple to operate by relatively untrained personnel.

The performance of the *MTADS* system has been evaluated and documented in several demonstrations.[4-6] Following demonstrations at prepared ranges, *MTADS* has conducted demonstrations and geophysical site characterizations at several live-sites. These activities include surveys on Native American lands,[2, 3, 7-9] an ordnance survey at the former Ft. Pierce Naval Amphibious Base[9] and at the former Buckley Air Base.[10] At the Badlands Bombing Range on the Pine Ridge Reservation in South Dakota, NRL surveyed over 150 acres on Cuny Table, identifying and analyzing over 1400 targets.[7] Over 400 of these targets were selectively dug; 71 bombs, 50 rocket bodies and warheads were remediated and 220 items of ordnance related scrap were recovered. The site characterization at the former Ft. Pierce Base[9] included the survey of over 12

miles of beach between the towns of Vero Beach and Ft. Pierce. Over 1000 targets were analyzed and about 100 targets were remediated on one short stretch of beach that was not heavily populated. The majority of the recovered targets were beach obstacles, such as horned sculleys, that were part of the amphibious training operations in the early 1940's. The demonstration at the Buckley Range is ongoing while this document is being prepared. At this site the *MTADS* surveyed an area of 90 acres surrounding Bombing Target 2, identifying over 15,000 buried targets on the range. To date about 500 of these targets have been dug. All remaining ordnance targets will be way pointed and remediated by contractors working for the Army Corps of Engineers.

During the summer and fall of 1998, NRL used the *MTADS* to survey areas of two Native American reservations for ordnance contamination. This document deals with a demonstration survey on the Walker River Paiute Reservation immediately south of NAS Fallon Training Range Bravo-19. Earlier in the summer the *MTADS* was used to conduct magnetometry surveys on Bombing Targets N-9 and N-10 on the Laguna Pueblo Reservation west of Albuquerque, NM. On bombing target N-9 analysis indicates that over 20,000 targets are buried within 600 feet of the bull's eye. In a sample remediation we excavated and removed about 1,500 of these targets.[2]

1.2 Technology Requirements Statement

The Navy Tri-Service Environmental Quality Research Development Test and Evaluation Strategic Plan[11] specifically addresses under Thrust Requirements l.A.1 and 1.A.2, the requirements for improved detection, location and removal of UXO on land and under water. The index numbers associated with these requirements are 1.I.4.e and 1.III.2.f. The priority 1 rankings of these requirements indicate that they address existing statutory requirements, executive orders or significant health and safety issues. Specifically the requirements document states:

> *There are more than twenty million acres of bombing and target ranges under DOD control. Of particular concern for the Navy are the many underwater sites which have yet to be characterized. Each year a significant fraction (200,000-500,000 acres) of these spaces are returned to civilian (Private or Commercial) use. All these areas must be surveyed for buried ordnance and other hazardous materials, rendered certified and safe for the intended end use. This is an extremely labor intensive and expensive process, with costs often far exceeding the value of the land.... Improved technologies for locating, identifying and marking ordnance items must be developed to address all types of terrain, such as open fields, wooded areas,*

rugged inaccessible areas, and underwater sites.[11]

The *MTADS* addresses all aspects of the Tri-Service Requirements for land-based buried UXO. It is designed to rapidly and efficiently survey large sites, with commensurate economic benefits. Moreover, it is capable of detecting all classes of buried UXO at their maximum likely self-burial depths. The system will correctly locate buried targets, determine their burial depths, classify the likely ordnance size, provide for future target way pointing, as well as create GIS-compatible target output maps and sorted target tables.

1.3 Objectives of The Native American Lands Demonstrations

There are several objectives in the *MTADS* demonstrations at Native American Reservations. *MTADS* represents the current state-of-the-art in automated detection technology for buried UXO. The Environmental Security Technology Office of the Undersecretary of Defense for Environmental Security, who sponsored the development of the technology, is interested in evaluating the performance of the system in a variety of scenarios that will aid in the transfer of the technology to the private sector. For instance, earlier demonstrations have led to current ongoing programs (sponsored by SERDP and ESTCP) to develop improved data analysis capabilities to allow discrimination between intact ordnance and ordnance waste and scrap. The objectives of these programs are to decrease the costs of remediating buried ordnance. For this reason, prior *MTADS* Native Lands Demonstration Surveys have also involved a remediation component wherein a significant fraction of the detected targets have been dug and evaluated.

Overarching these technology evaluation goals are objectives that involve providing information, service, and technology capabilities to the Native American Communities that have ordnance contamination problems resulting from prior and ongoing Department of Defense activities associated with their reservations. The completed demonstrations on the Pine Ridge and Laguna Pueblo Reservations involved surveys and evaluations of known or suspected bombing and aerial gunnery targets from World War II training activities conducted on lands that were subsequently returned to the control of the reservations.

1.4 *MTADS* Objectives at the Walker River Paiute Reservation

Bravo-19, which is currently an active training range, shares a common 7-mile border with the Reservation. Figure 1 shows the location of Range Bravo-19 in relation to the NAS Fallon, US Highway 95, and the town of Schurz on the Reservation. For many years there have been Tribal concerns about possible ordnance contamination of Reservation lands adjacent to this target. Indeed, documented surface UXO clearances by NAS Fallon EOD teams dating back to 1989 have resulted in discovery and removal of ordnance items from this area.[12, 13] An objective of this demonstration was to conduct a geophysical survey of areas most likely to have been contaminated by earlier training activities on Range Bravo-19. Since several square miles of Reservation lands adjacent to this target are in question and since the resources provided would support an *MTADS* survey of only 100-200 acres, a primary challenge was to carefully choose the survey areas to provide the best information possible to the Walker River Paiute Tribe and to the NAS Fallon command. These surveys must be associated with remediation of at least a fraction of the discovered targets to allow a statistical evaluation and prediction of likely contamination.

NRL used the *MTADS* to conduct a magnetic survey south of the perimeter fence of Target Bravo-19, on land that lies within the boundaries of the Walker River Reservation. The primary objectives and products delivered by NRL from this demonstration included the following:

- A surface walkover and clean-up of primary survey areas was conducted;
- The surface walkover and clean-up was continued in a 50 meter wide path east of the surveyed areas, extending to the southeast corner of Bravo 19;
- A magnetometer survey of selected areas south of the Bravo-19 perimeter was conducted;
- A target list, including positions and descriptions of all detected buried objects was developed;
- Information was prepared to support way pointing and remediation of all detected targets with a size above a selected threshold;
- This report documenting all activities taking place on site during the *MTADS* survey, will be submitted for review by Walker River Tribal representative and by the command at NAS Fallon; and
- This report documents our observations, and based upon statistical analysis of the survey and remediation results, predicts the likely types and levels of ordnance and ordnance waste contamination of the area south of the Bravo-19 perimeter.

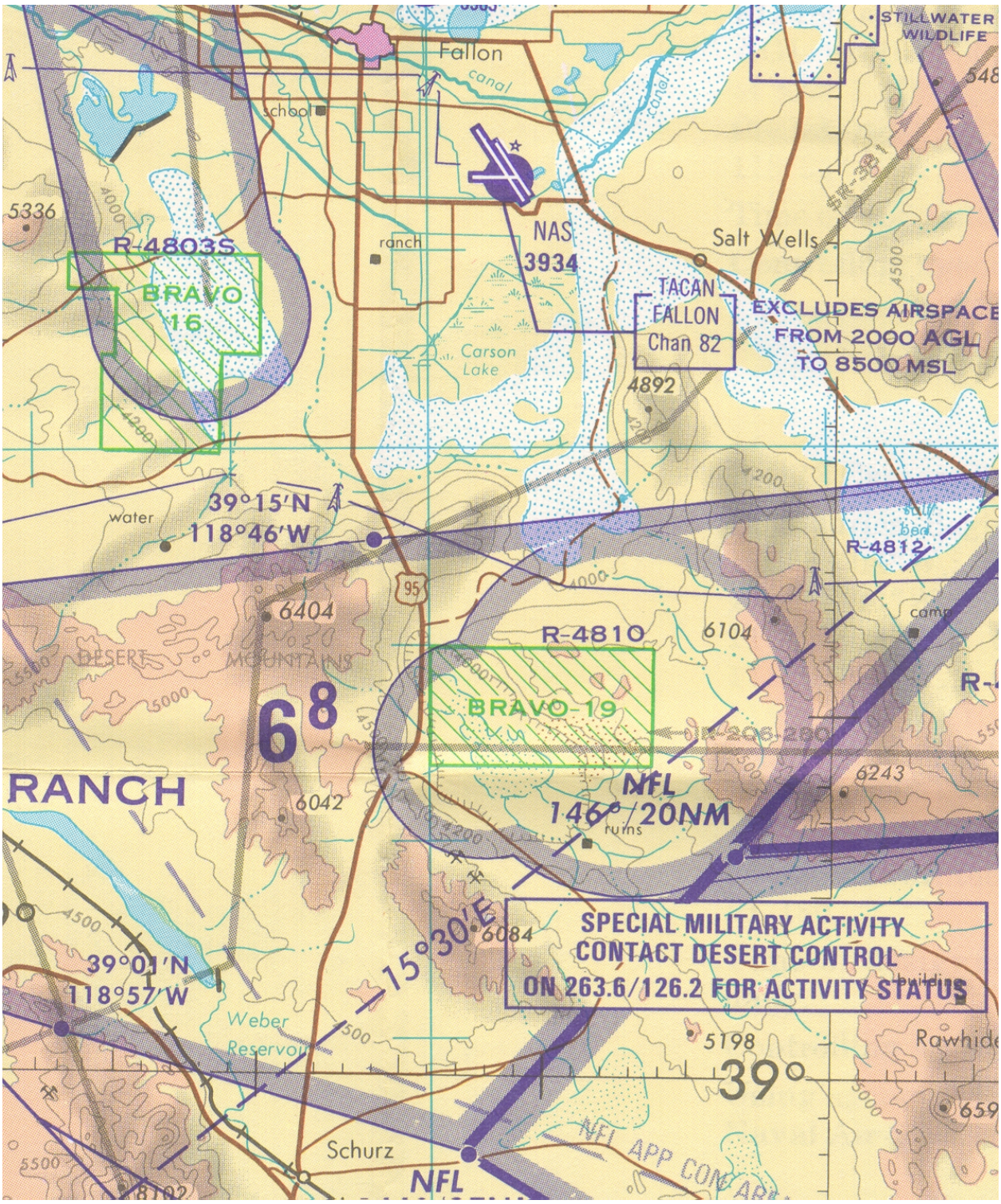


Figure 1. Map showing Training Range Bravo-19 in relation to the NAS Fallon.[14] The Range dimensions are 4 miles N-S by 7 miles E-W.

1.5 Regulatory Issues

Regulatory drivers impacting the UXO problem are most frequently associated with the BRAC and FUDS processes involving the transfer of DoD property to other agencies or to the civilian sector. When transfer of responsibility to other government agencies or to the civilian sector takes place, the DoD lands fall under the compliance requirements of the Superfund statutes, and Section 2908 of the 1993 Public Law 103-160 that requires adherence to CERCLA provisions. The basic issues center upon the assumption of liability for ordnance contamination on previously DoD-controlled sites. The Walker River Paiute Reservation lands that are the subject of this demonstration are not, and have never been, DoD controlled lands so CERCLA requirements do not apply.

1.5.1 Geophysical Site Characterization. The *MTADS* surveys are non-intrusive. No soil is disturbed, the pressure on the ground (in pounds per square inch) from the vehicle and survey platforms is less than a human foot-print. Therefore, under the guidelines of 40 CFR Section 1501.4, no Environmental Impact Statement (EIS) is required as the survey has no detectible impact on the environment. A meeting was scheduled for 7 August 1998 at NAS Fallon for the purpose of discussing the proposed *MTADS* Demonstration and exploring possible regulatory issues and issues of environmental and cultural concern for the Tribe. Attendees are listed below:

NAS Fallon

CAPT Scott Ronnie, Commanding Officer
Mr. Del Pursel, Public Works Dept.
Mr. Larry Jones, Public Works Dept.
Chief Molidor, EOD Mobile Unit 3

Naval Surface Warfare Center

Mr. Johnathan Stacy

Bureau of Indian Affairs

Mr. Curtis Milsap

Naval Research Laboratory

Dr. Jim McDonald

Walker River Paiute Tribe

Mr. Cassidy Williams, Chairman
Ms. Gypsy Williams, Environmental

An *MTADS* Demonstration Test Plan was drafted by NRL and submitted on 11 September 1998 to ESTCP, NAS Fallon, the Walker River Tribe, and the Bureau of Indian Affairs for comment and approval. Comments were received from ESTCP, NAS Fallon, and the Walker River Tribe. These comments and concerns were incorporated as a comments section in the Final Demonstration Test Plan.[15] The Tribal Council Resolution No. WR-63-98 of 17 September 1998 and Tribal Letter of 2 November 1998 constitute the authority to proceed with the *MTADS* Demonstration on Tribal land and satisfy necessary regulatory requirements. These documents are included as Appendices.

1.5.2 Excavating Buried Targets. Following the *MTADS* survey and data analysis, NRL designated 500 buried targets for excavation. The designated targets were located on all four of the survey areas, occupying both areas within the Playa and on the slopes rising to the east and south of the Playa. NRL developed a Health and Safety Work Plan for the project based upon guidance from the Army Corps of Engineers for intrusive UXO activities and developed a Remediation Plan covering all other aspects of the planned operation. These documents, in draft form, were submitted to NAS Fallon, the Bureau of Indian Affairs for the Department of Interior, and to the Walker River Paiute Tribe. To satisfy concerns of involved parties, a detailed evaluation of the need for regulatory approvals and environmental permitting was undertaken. NAS Fallon acted as the lead agency in this process and the Bureau of Indian Affairs and the Walker River Paiute Tribe officially were consulting parties.

NAS Fallon prepared a request for a Record of Categorical Exclusion for the Interim Remediation of Off-Range Ordnance on the Reservation based upon information in the NRL Target Excavation and Recovery Plan. The categorical exclusion incorporated a Class III Cultural Resource Survey of the impacted area.[16] The State of Nevada Historic Preservation Office concurred that the site is not eligible for the National Register of Historic Places under any of the Secretary's criteria. A wildlife biological survey of the impact area was conducted by NAS Fallon's wildlife biologist. It was concluded that neither threatened or endangered species nor species of concern were present

in the remediation area. It was furthermore concluded that habitat was not present in these areas to support either plant communities or animal populations from these lists. Several individual Sand Cholla plants within Area 4 were marked with engineering ribbon to alert the remediation teams that this species is listed as a Candidate Category 3 species which is protected by the Nevada Cactus and Yucca law.

The prepared petition addressed issues of Public Health and Safety, Cultural Resources, Clean Water Act, Wetlands requirements, and issues relating to endangered and threatened species. The proposed actions were concluded to be consistent with current land use and to not threaten to violate Federal, State, and local laws and regulations. The petition was concluded to be in compliance with OPNAVINST 5090.1B, CH 1, Chapter 2, Subsection 2-4.2 "N" and "Z." Therefore no further regulatory action was required prior to target excavation. The Record of Exclusion, without the supporting documentation, is included as an appendix to this report.[16]

Also included as appendices to the report are Resolution No. WR-43-99 of 2 June 1999 from the Walker River Paiute Tribe and a letter of 9 June 1999 from the Real Property Management Office of the Bureau of Indian Affairs of the United States Department of Interior. These documents, along with the fully executed Work Plan Sign-off Sheet constituted authority to begin target recovery operations on the Reservation.

2.0 Technology Description

2.1 Background and Applications

The *MTADS* technology has been described in detail previously.[2-10] The performance of many of the *MTADS* system components and some of the subsystems have been tested and verified against the performance requirements and manufacturing or procurement specifications. Briefly, the system hardware includes a low magnetic signature vehicle that is used to tow linear arrays of magnetic and electromagnetic (EM) sensors to conduct surveys of large-areas to detect buried UXO. The *MTADS* Tow Vehicle, manufactured by Chenowth Racing Vehicles, is a custom-built off-road vehicle, specifically modified to have an extremely low magnetic self-signature. Most ferrous components have been removed from the body, drive train and engine and replaced by nonferrous

alloys. The vehicle is powered by a modified Volkswagen aluminum engine. Details of the construction and performance are described in the Vehicle Owners/Shop Manual.[17, 18]

The *MTADS* magnetic sensors are Cs-vapor full-field magnetometers (a variant of the Geometrics 822 sensor, designated as the Model 822ROV). An array of eight sensors is deployed either as a magnetometer array or as a four-unit gradiometer array measuring the vertical component of the Earth's total field. The time-dependence of the Earth's background field is measured by a ninth sensor deployed at a static site during survey operations. The magnetometers were acceptance tested at the manufacturer's facility to verify sensitivity, sensor noise, heading error, dead zones, inter-sensor compatibility, and performance with the multisensor interface modules. Figure 2 shows the *MTADS* Tow Vehicle deployed with the magnetometer array.

The EM sensors are deployed as an array of three pulsed induction sensors (a variant of the Geonics EM-61 instrument). These sensors, configured as an overlapping horizontal array, transmit a tailored electromagnetic pulse into the Earth. Metallic objects absorb the transmitted energy, inducing eddy currents that reradiate electromagnetic energy. This secondary signal is time sampled by six detection coils that are co-located with and above the three transmission coils as shown in Figure 3.

Figure 2. The *MTADS* magnetometer towed-array is shown surveying south of the Bravo-19 perimeter fence.

Figure 3. The *MTADS* is shown surveying with the EM towed-array.

The sensor positions on the surface of the Earth (latitude, longitude, and height above ellipsoid) are determined using GPS navigation employing the latest Real Time Kinematic (RTK) technology which provides a real-time position update (at 5 Hz) with an accuracy of about 5 cm. GPS satellite clock time is used to time-stamp

both position and sensor data information for later correlation. In addition, an electronic compass, attitude sensors (pitch, roll and yaw), and tick wheel sensors provide navigation back-up and dead reckoning capability. All navigation and sensor data are provided through electronic interfaces to the Data Acquisition Computer (DAQ) in the Tow Vehicle. The DAQ computer also functions as a survey set-up tool and provides real-time guidance displays and information for the driver.

Perimeter surveys or point landmarks are used to define the survey bounds. The DAQ develops a survey track grid that is presented to the vehicle operator *via* a touch screen display located beside the steering wheel. The survey course-over-ground (COG) is plotted in real time on the display, as are presentations of the course heading error and distance-off-track information. This allows the operator to respond to both visual cues on the ground and to the survey guidance display. Following a survey, the operator can return to survey any missed areas before leaving the field.

Survey data in the DAQ computer is downloaded onto 4mm DAT tape for transfer to the Data Analysis System (DAS) computer. The DAS software was developed specifically for this program as a stand-alone suite of programs written using IDL development tools, and graphical user interfaces (GUI's) working in a UNIX-based workstation environment. Figure 4 shows the site view and analysis screens with their associated menus. The DAS is written in multiple levels for both sophisticated and novice users. An extensive range of expert options are available to facilitate the cleanup of navigation data, sensor nulling and leveling, noise filtering, and other electronic data preprocessing options.

2.2 Previous Testing of the Technology

The *MTADS* was developed with ESTCP support from the UXO Cleanup Pillar. Its performance was validated at multiple field demonstrations.[4-6] Subsequently, with ESTCP support from the Native American Lands Programs, the *MTADS* has been deployed to former DoD bombing ranges on the Pine Ridge Reservation in South Dakota[7] and the

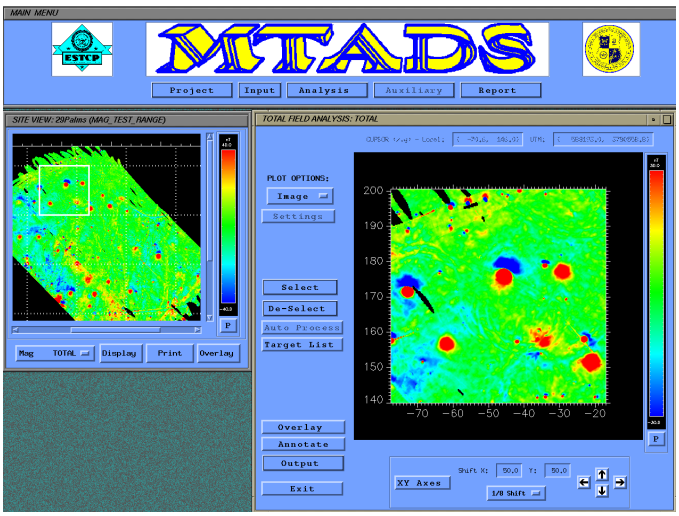


Figure 4. The *MTADS* Data Analysis System showing the Site View and Data Analysis Windows.

Pueblo of Laguna in New Mexico.[2] In addition the US Army Corps of Engineers (Huntsville, AL) has sponsored *MTADS* demonstrations at former ranges at the Ft. Pierce Naval Amphibious Training Base[9] south of Vero Beach, FL and the Buckley Air Field[10] near Denver, CO. These demonstrations involved surveys of sites formerly used as either bombing or aerial gunnery targets. As such they were characterized by high concentrations of buried ordnance items clustered about the designated target bull's eye. At the Badlands and the Laguna Bombing Ranges the range of ordnance deployed included only a few different ordnance types, all of a similar size. At the Buckley Bombing Range more than a half dozen ordnance items were present varying in size from fuzes and 20-mm projectiles, to large cluster munitions. The Badlands Bombing Range and the Laguna Ranges are located on lands with very low geomagnetic soil interferences. The Buckley Bombing targets are located in soils with high magnetite content which has been further concentrated by collection in ravines and ponds. The ordnance at the Former Ft. Pierce Amphibious Training Base (Vero Beach) is extremely heterogeneous, varying from small M-4 and M-6 antitank mines to depth charges and 1000-lb bombs. In addition, there are many man-made reinforced concrete obstructions which are buried on the beach along with debris from prior demolition activities.

3.0 Site/Facility Description

3.1 Background

The Walker River demonstration survey is unique in two respects from prior *MTADS* surveys conducted with Native American Lands support. This area of the Reservation, unlike our earlier surveys, has never been used specifically as a practice range. However, periodic Off-Range Ordnance (ORO) surface clearances dating from 1989 have clearly demonstrated a continuing UXO and OEW contamination of Reservation lands adjacent to NAS Fallon Training Range B-19. We therefore, were looking for isolated, individual buried targets rather than distributions of targets about a bull's eye. Second, and more important, Bravo-19 is an active range that is currently used and has been used for several decades. The range of expected ordnance therefore includes both items from current and obsolete inventories. The recovered items from previous surface sweeps also

contain a variety of aerial gunnery and bombing ordnance covering a wide range of ammunition and ordnance sizes and types. Table 1 provides a partial list of items recovered from ORO sweeps on Reservation lands adjacent to Range Bravo-19.

3.2 NAS Fallon, Site/Facility History

The mission of NAS Fallon is to provide services and materials to tenants and transient units stationed at or deploying to NAS Fallon for Chief of Naval Operations (CNO) approved aviation training. The Naval Strike and Air Warfare Center (NSAWC) is the major tenant command. NSAWC develops realistic combat training scenarios for military aircrews flying high-performance aircraft and helicopters, employing state-of-the-art military equipment and tactics. NSAWC operates, maintains, schedules, develops, and configures the Fallon Range Training Complex (FRTC).

NAS Fallon is in the Lahontan Valley of Churchill County in west-central Nevada, approximately 70 miles east of Reno and six miles southeast of the City of Fallon. The Dead Camel Mountains and Sheckler Reservoir are west of NAS Fallon, and the Carson River lies to the northwest. The Walker River Indian Reservation is south of NAS Fallon.

Table 1. Record of recovered ordnance from off-range sweeps of Training Range Bravo-19 between December 1989 and January 1998. [12, 13]

	Comment	Live	Practice
Ammo			
5.56-mm	Ball Ammo		X
7.62-mm	Ball Ammo		X
Projectiles			
50-cal	Practice & Incendiary	X	X
20-mm	Practice, HEI	X	X
30-mm	Practice	X	X
40-mm		?	
5-in	Illumination		X
105-mm	Howitzer (Designation from Report)	X	X
Rockets			
2.25-in	SCAR		X
2.75-in	Inert, HE & WP W/H	X	X
5-in Zuni	Inert & HE W/H	X	X
Bombs			
Mk 76	Practice		X
250-lb	Old Style, HE	X	
100-lb GP		X	X
Mk 106	Practice		X
Mk 81 GP	HE	X	
Mk 82	Practice		X
Mk 82 GP	Inert & HE	X	X
Mk 83	Inert & LDGP HE	X	X
Other			
Luu-2/B	Flare	X	X
Mk 45	Flare	X	X
15-lb	Propellant	X	
Bomb Fuzes	MK 344, M 904, Mk 376, M 103		
Fire Bomb Igniters	M 23, Mk 13		

The original facilities at NAS Fallon[19] were established in 1942 by the U.S. Army Air Corps for inland defense during World War II. The Navy took over the base in 1943, and in 1944 the facility was commissioned as the Naval Auxiliary Air Station under the control of NAAS Alameda, California. Under the National Emergency War Powers Act, the NAS Fallon training range was created in April of 1944, with the temporary establishment of Bravo-20, a high impact air-to-ground bombing range. Two additional ranges, Bravo-17 and Bravo-19 were established by use permits in 1945. Following World War II, NAS Fallon was deactivated to a maintenance level, placed in caretaker status, and turned over to the Bureau of Indian Affairs. The airstrip was reopened in 1951 as a naval auxiliary air station, and in 1953, lands were withdrawn by the Navy to create Bravo-16, Bravo-17 and Bravo-19.

In 1942, the Navy withdrew approximately 623,000 acres of public land to establish the Black Rock Desert Bombing Range; the withdrawal was revoked in 1943. The range was reestablished in 1944 with 700,000 acres. This area was reduced in 1949 to 272,000 acres, and the remaining land was returned to the BLM. In 1944, the Navy withdrew 800,000 acres to establish the Sahwave Gunnery Range. The lands were relinquished in 1946. The range was reestablished in 1958, with 519,000 acres of public land, and was relinquished again in 1965. Blackrock and Suhwave Ranges were both located approximately 50 miles northwest of NAS Fallon in Humbolt and Pershing counties.

In 1972, NAS Fallon was reclassified as a major command and was upgraded to a naval air station with the primary mission of training and supporting naval air groups. NAS Fallon formally established the FRTC in 1977 to provide airspace and range facilities for air warfare training. Lands were withdrawn in 1986, to formally establish Range Bravo-20. The FRTC currently includes four geographically separate training ranges (Bravo-16, Bravo-17, Bravo-19 and Bravo-20), three air traffic control gap filler radar stations, a tactical aircrew combat training system (TACTS), and electronic warfare (EW) system, and special use airspace. All of the training ranges originally were designed for the performance and tactics of World War II-era and Korean Conflict-era aircraft.

The Bravo-19 range is west of the Blow Sand Mountains and is 15 miles south of NAS Fallon. It consists of 17,332 acres, was established by permit in 1945, and was withdrawn for Navy use in 1953. The range is used for strafing, laser ranging and targeting, close air support, mortar, small arms, artillery spotting, and inert and live air-to-ground ordnance delivery training using bombs and

rockets. The range also has facilities to support simulated surface-to-air missile firing. A strafing banner, and conventional bull's eye, a high explosive impact area, and three spotting towers are contained within Bravo-19. The run-in lines for the range run west to east for most operations, and occasionally run from other directions. Live ordnance, up to 500 lbs, is dropped on the high explosive impact target area. The seven mile southern border of Bravo-19 is adjacent to the Walker River Indian Reservation.

3.3 Walker River Paiute Reservation, Site/Facility History

The Walker River Indian Reservation is comprised of an area of approximately 323,386 acres, located within 3 counties in western central Nevada: Mineral County; Churchill County; and Lyon County, the bulk residing in Churchill County (estimated 1998 population of 24,720). The Walker River Indian Reservation was established 19 March 1859 by Executive Order. Other statutory establishments include:

- 7 February 1887 - General Allotment Act (24 Stat. 388)
- 27 May 1902 - (32 Stat. 245-260
- 15 March 1918 - Executive Order #2820
- 3 March 1928 - (45 Stat. 1 60)
- 26 June 1936 - Public Law 74-748 (48 Stat. 1806)
- 19 June 1972 - By Authority of the Act of 22 June, 1936 (49 Stat. 1806) supplemented by the Act of 14 September 1961 (75 Stat. 409).

The area surrounding the Walker River Reservation includes the city of Fallon to the north, the Cities of Reno and Carson City to the northwest and the Town of Schurz on the Reservation. Primary nonmilitary land use activities within the three county area include mining, livestock grazing, recreation, and rights-of-way, easements and leases.[19] The principal areas to be surveyed lie near the northern boundary of the Walker River Reservation, adjacent to the southern perimeter of Range Bravo-19, Figure 1.

3.4 Site/Facility Characteristics

3.4.1 Climate and Weather. As described in Ref 19:

NAS Fallon and the FRTC are located in an area of the intermountain west, which tends to be dominated meteorologically by recurring high and low pressure systems. Summer is often marked by stationary high pressure systems that develop over the region. These systems augment clear-sky conditions but also can result in large scale stagnation of underlying air when light wind conditions persist. Winter weather conditions are influenced predominantly by transient storm systems. Precipitation in the vicinity .... is limited because the Sierra Nevada Mountain Range, located approximately 50 miles to the west, acts as a barrier. This barrier results in precipitation in the mountains, rather than in the lowlands to the east. Precipitation in the region occurs mostly from December through March. Winter precipitation is typically rain and snow from large-scale weather systems. Summer precipitation is rain, which is often the result of localized activity caused by solar heating, rising air, and associated thunderstorms.

3.4.2 Geology and Soils. The topography of the region is characterized by linear, roughly north-south trending, mountain ranges that are separated by valleys, many of which are closed basins. Training Range Bravo-19 occupies much of Rawhide Flats, a dry lake bed and stretches into the Blow Sand Mountains on the east. The rocks exposed in the mountain ranges are predominantly Tertiary volcanic and volcaniclastic rocks. These rocks and soils derived from them are expected to be magnetically active. The exposed volcanic areas are underlain by Mesozoic and Paleozoic marine sedimentary, volcanic, and intrusive rocks that are exposed locally in the western, central and northeastern portions. Mineralization occurs in or is hosted by Tertiary and Mesozoic rocks near igneous intrusions. The valleys between the mountain ranges are underlain by unconsolidated alluvial and lake deposits.

Soils in the area follow a characteristic progression from the steep hill slopes to the lake deposits at the center of basins. The soils on the hill slopes are typically thin rocky soils derived from volcanic rocks. Farther down slope, the soils near the base of the hill slopes consist of reworked alluvium, lake bed and dune sand deposits. The presence of fine-grained materials in these deposits makes them relatively impermeable, although they tend to be friable and subject to wind erosion.

Soils in the northeast and southern portions of NAS Fallon contain a higher proportion of dune sands; these soils are highly permeable. Toward the center of the basin, the soils have formed on low lake terraces and are characterized by a thin impermeable subsurface layer at a depth of approximately six inches. In this layer lacustine clays and precipitated salts cement the sand grains together when dry. Below this layer, the soil consists of loose, highly permeable coarse sand. The deepest portions of the basin are underlain by lake deposits, which are fine-grained, poorly drained, saline deposits that do not support vegetation. The susceptibility of soils to water erosion depends largely on slope and clay content. The general characteristics of soils within the area of Bravo-19 vary depending on their location, from steeply sloping uplands, to alluvial fans and fan piedmonts, to the playa on the valley floor. Bravo-19 straddles the Blow Sand Mountains, which form the topographic divide between the Rawhide Flats and the Carson Desert Basins. There is no perennial surface water flow into or out of Rawhide Flats. No streams, and only one (stinking) spring exist within the boundaries of Bravo-19.

4.0 Demonstration Approach

4.1 Performance Objectives

During our preliminary site visit in early August 1998 we met with CAPT Ronnie and members of the Range Control staff. They described to us the layout of the Range and current and former typical use patterns for the Range. Members of the NAS Fallon EOD staff described the techniques used to conduct the periodic ORO sweeps and showed us a grid map of the area surrounding Bravo 19 with notations of where significant concentrations of ordnance were removed during large sweeps in 1989 and 1990. We also met with members of the Tribal Council and Tribal environmental staff. They described their experiences and observations relative to sightings of ordnance and ordnance debris on Tribal Lands. Accompanied by members of the NAS Fallon Real Estate Division (Public Works), we carried out a driving and walking inspection of the Tribal lands south of Bravo-19 and inspected the tower facilities on the Range. We discussed possible logistic support that could be provided to the *MTADS* during the demonstration survey and remediation. Subsequent to this visit, members of the Tribal Council provided us with printouts documenting recoveries of ordnance

and ordnance scrap resulting from comprehensive ORO sweeps around Bravo-19 by NAS Fallon EOD personnel during November and December 1989 and in June 1990.[12] Recovery of nearly 10,000 intact live and inert ordnance items was documented during these sweeps. The NAS Fallon Public Works Department provided us with copies of monthly (ORO) Surveillance Program Reports for the period of 1992-1998, which had been submitted to the State of Nevada Environmental and Land Management Offices.[13] These reports documented ordnance recoveries from ORO surface and aerial sweeps during the specified period. From the above information we compiled a list of recovered ordnance. Table 1 was prepared from this list.

It was the objective of the *MTADS* Demonstration to survey areas of the Reservation that had the most probable concentrations of buried ordnance and, if possible, to estimate the distance that ORO was likely to be found from the perimeter of the Range. The extensive documented records and our visual inspections led us to concentrate our studies on the area adjacent to the Range extending from the Center Tower eastward for a distance of about 3 miles. Observed shrapnel and ordnance debris appeared to have the highest concentrations near the range and clearly became more sparse with increasing distance south of the fence. The exception to this pattern are the parachute flares (such as the Luu-2) which, depending on the wind, may drift for long distances. Because of their large canopies, these items are highly visible in either driving or aerial inspections, Figure 5.

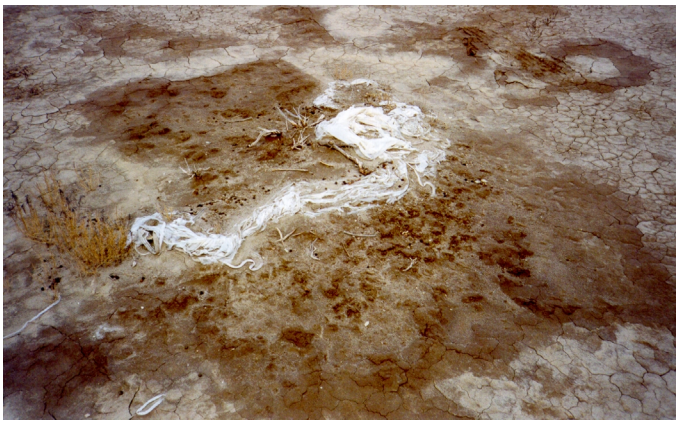


Figure 5. The parachute canopy and shrouds from a Luu-2 illumination flare are shown where they landed about 0.5 miles south of the Bravo-19 perimeter fence.

Programmatic *MTADS* objectives included:

- Evaluating performance of the magnetometer array in volcanic soils varying from water saturated sands in the lake bed to rugged rocky outcroppings and boulder fields on the rising slopes;
- Demonstrating the value of the EM array, used in conjunction with the magnetometer array, in improving ordnance detection in geophysically-difficult areas;
- Devising strategies to efficiently geophysically evaluate large areas that may have sparse UXO contamination; and

- Creating information and transferring knowledge and capabilities to aid the Native American

community in mitigating problems associated with DoD ranges;

Because of long standing difficulties between the Tribe and the Navy relating to ORO contamination on the Reservation, the *MTADS* demonstration objectives must also address specific issues of importance both to the Tribe and to NAS Fallon. The Tribal Council has strongly stressed the importance of conducting the *MTADS* demonstration in a manner that will openly document the presence of buried UXO if it is discovered. By agreement, our work was carried out in the presence of a Tribal consultant who is a UXO expert. He had complete access to our geophysical survey technology. We demonstrated to him the data analysis process, and he was present at and monitored our target recovery operations. The Tribal Council emphasized that we must respect the fact that the Reservation is Tribal land and that our presence is by invitation which could be withdrawn at any time. Finally, we were asked to be aware of and respect the possible presence of cultural artifacts and traditions.

While the NAS Fallon command is interested in documenting the presence (or absence) of buried UXO on the Reservation, their overarching priority is to establish the severity of the problem and to determine the extent and boundaries of potential contamination. At a minimum, this information is required by them, to scope an ultimate complete remediation plan.

Bravo-19 is an active range. Some training exercises are scheduled far in advance, but Range Control and Range Management also retain the option to schedule and modify exercises on a daily basis. Some exercises involve the use of inert stores or items containing only spotting charges. Other exercises are scheduled as live fire training and involve live ammunition or HE-filled ordnance. NRL's conditions for scheduling the *MTADS* demonstration required assurance that the Range would not be used for live fire exercises during our presence and that no exercises would be undertaken that involved aircraft with run-in paths over our positions. Neither NRL, nor NRL contractors, were willing to work within a few meters of the Range perimeter during live fire exercises or any exercises that involved overflights of our positions. These issues involving NAS Fallon Command, Range Control, and NRL were not satisfactorily resolved when we began work.

4.2 Demonstration Setup

4.2.1 Logistics and Accommodations NAS Fallon Public Works Department provided logistics support for the *MTADS* demonstration on the Reservation. The base of operations was

located at the Center Tower because power was available at this point, as was telephone service directly to Fallon Range Control. A hole was cut in the fence and an access gate onto the Reservation was installed that was wide enough to accommodate the *MTADS* equipment. An office trailer and a Conex storage trailer were set up adjacent to the tower, as shown in Figure 6. Portable toilets were located at this point and further east along the Range Road adjacent to the south fence. A loading dock was also available at this point to allow unloading the equipment from the transport trailer. We were provided with Range Control radios. The radios were used to inform Range Control when we were entering or leaving the range and were always carried by teams working on the Reservation adjacent to the range.

Figure 6. The office and storage trailers to support the *MTADS* demonstration are shown set up next to the Center Range Control Tower on Bravo-19.

4.2.2 The Survey Transect Plan The Site Survey Plan[15] was designed to produce a statistically relevant sampling of the types and concentrations of UXO items present at the site. The goal was to cover the maximum practical area consistent with maintaining safety and remaining within the available budget. Depending on the types and patterns of buried ordnance or ordnance-related materials found within the initial survey areas, we planned to adjust the survey plan to maximize the sampling of targets, and if clustering was observed, to plot out the approximate limits of the contamination. This approach required us to have data processing and analysis capability on site to map and analyze data on an overnight turn-around to allow us to adjust the survey plan on the fly. A data analyst was present during all survey operations. A data analysis workstation, PCs, and black and white and color printers were accommodated in half of the office trailer to support the survey, target way pointing, and remediation. The other half of the trailer served for radio and electronic equipment storage and for battery charging stations.

The initial plan involved conducting magnetometry transect surveys of four areas. Each of the transects was planned to be 50 meters wide by 2,100 meters long. The placement of the transects are shown in Figure 7 which is adapted from the Allen Springs, NV USGS 7.5 Minute Map. The east-west surveys are located in areas having relatively higher concentrations of previously recovered

surface ordnance as described in References 16 and 17. The north-south surveys were intended to sample the density of buried targets as one proceeds away from the Bravo-19 border into the Reservation. The center lines of the east-west surveys are located 75 meters south of the perimeter fence. This removes the signature of the fence from the study, along with metallic debris from fence repair and clutter that historically has been thrown into the fence line. The north end of the north-south surveys are 200 meters south of the fence line.

4.2.3 GPS Control Points A commercial surveyor, GeoMetrics GPS, Inc., was contracted to establish first-order survey control points to support the demonstration. On 27 October 1998, the control points listed in Table 2 were established.[20] NAS 2, 3 and 4 are on Bravo-19, immediately north of, or in the fence line. NAS 1 is at a corral located on the Reservation about 6.8 miles east of Highway 95 on Rawhide Road. NAS-3 is at the fence line 16 feet east of the center of the gate at the Center Tower on Bravo-19. NAS-2 is at the fence line about 600 meters east of the East Tower on Bravo-19. The monument (previously established by BLM/GLO) is located between two tall 4" X 4" posts on a brass disk on a 1/2-in pipe. NAS-1 is located about 1400 meters east of NAS-2.

Table 2. Coordinates for the GPS Survey Control Points.

Station Name	Latitude (N)	Longitude (W)	UTM Northing (meters)	UTM Easting (meters)	Elevation (m) (above Ellipsoid)
NAS-1	39º08'30.22826"	118º41'32.79877"	4487337.010	790567.954	1161.024
NAS-2	39º08'30.14923"	118º40'19.97742"	4487332.666	792316.568	1164.226
NAS-3	39º08'30.09822"	118º39'22.30870"	4487329.859	793701.332	1174.715
NAS-4	39º06'09.64770"	118º38'43.42524"	4482998.345	794632.058	1204.503

At the same time the center lines for each of the transect surveys were staked out using the roving GPS equipment. Numbered bicycle flags were placed at 150 meter intervals along each transect. The western marker on Transect 1 was numbered 1-0, the eastern marker was numbered 1-14. The northern marker on Transect 3 was numbered 3-0 and the southern marker was 3-14. The other two transects were marked similarly.

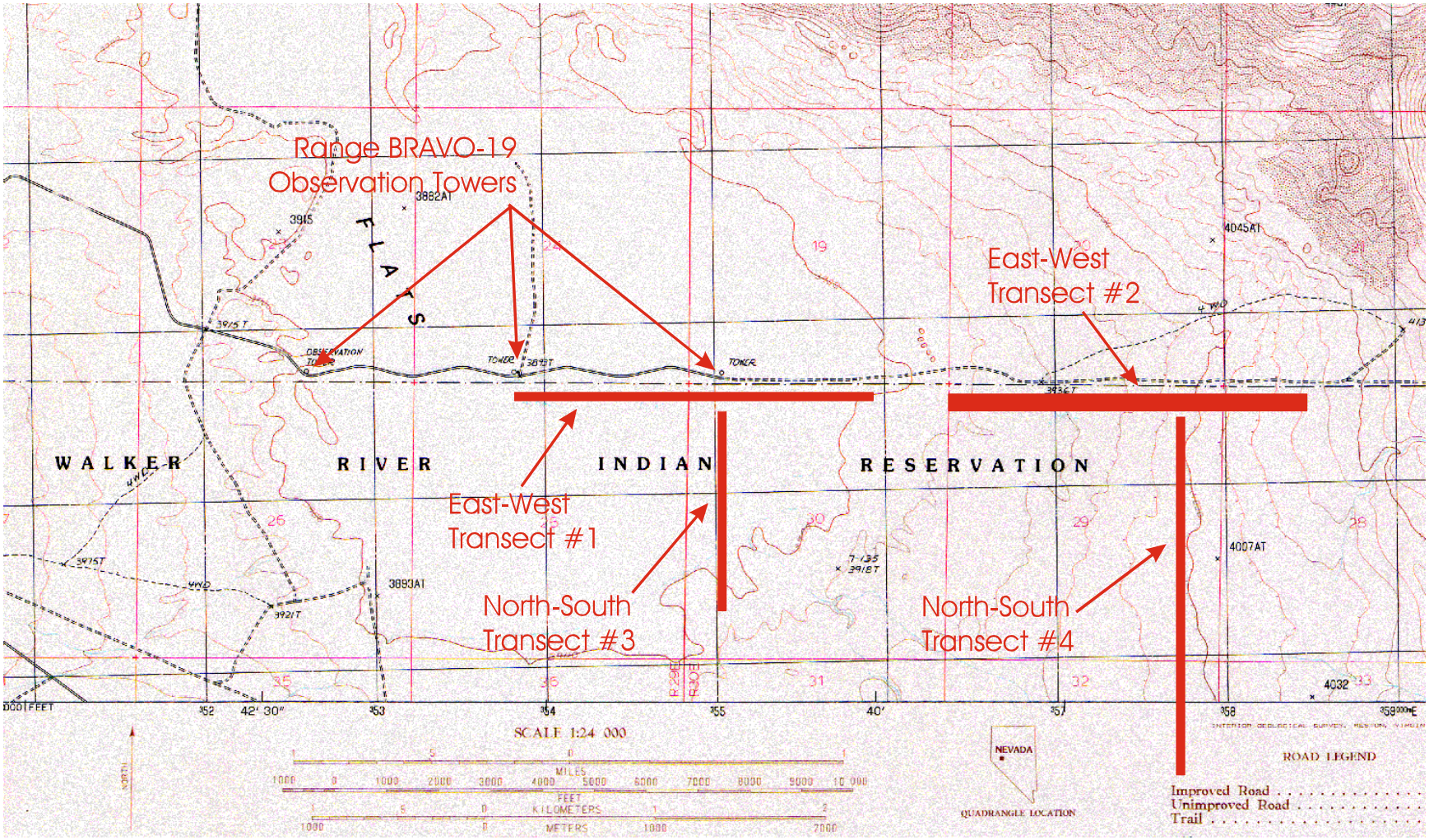


Figure 7. Portion of a USGS 7.5 Minute Map showing the Observation Towers for NAS Fallon Range Bravo-19. The approximate positions of the *MTADS* transect surveys on the Reservation are shown in red.

4.2.4 Surface Clearance Carrying out a comprehensive surface clearance prior to conducting an *MTADS* survey serves several purposes. Picking up and removing an item during a walkover is much less expensive than leaving it as a target that must be surveyed, analyzed, way pointed, and finally remediated by a UXO-certified dig team. Potentially dangerous items are removed from the field before the driving survey, thus decreasing danger for this operation. Finally, conducting a surface clearance provides an excellent inventory of the items that have been expended over the area. This information can be used to set up a prove-out site containing new or unusual ordnance items and aids the analyst in making dig decisions during the data analysis operations.

We conducted the surface clearance using a ten-man sweep line. The members of the sweep line were either Hazwopr-certified, or were trained on-site by a UXO-certified technician. We contracted with EOTI, Inc. to provide UXO technicians and supervisors to support the UXO surface clearance and the target remediation operations. A UXO technician and a UXO supervisor supported the surface clearance. Two UXO remediation teams from EOTI subsequently conducted target digging operations. Surface clearance began one week prior to surveying and continued throughout the survey period. We contracted with the Walker River Native American Employment Office to provide ten persons to support the sweep line and an additional 4-6 persons to assist as flaggers during the survey operations. Figure 8 shows a picture of Mr. Dave Bruce, on the right who served as a UXO consultant to the Tribe, Ms. Gypsy Williams, the environmental specialist for the Tribe, and Mr. Tad Williams, who was the supervisor for the employees of the Native American Employment Office.

The members of the sweep team, Figure 9, walk in a line at arm's length separation and monitor the surface for metallic objects. Objects which are clearly not UXO-related are picked up by the sweep line member and placed in their plastic buckets. Objects of doubtful origin are pointed out to the UXO technician following the sweep line. After inspection, he either instructs them to pick up the object, or conducts a further investigation of the object. If the object is a potential live ordnance item, the technician marks the object with a red pin flag for further investigation. It is subsequently removed or, if required, flagged to be blown in place. Several tons of ordnance related scrap were removed from the site. Typical OEW scrap included base plates, strong backs, shrapnel from bombs, and fragments and casings from projectiles. Figure 10 shows typical intact ordnance items recovered during the sweep. Over 8,000 20-mm projectiles were

recovered. All were TP inert rounds, many had obviously been expelled from prior detonation pit explosions. Several craters more than 2 meters deep, Figure 11, were located within 200 meters of the fence. Based upon debris around the them, it is presumed that they were detonation pits. Figure 11 shows a typical crater located within 50 meters south of the perimeter fence line.

After the *MTADS* magnetometer array had been used to complete surveying of Transects 1, 2, and 3, a decision was made to expand the survey area about Transect number 2. The width of Transect 2 was doubled to 100 meters and the surface walk over team was returned to this area to complete the surface clearance of the expanded area before continued surveying. This was carried out while the magnetometer array surveyed Transect 4.

Figure 8. Mr. Tad Williams, Ms. Gypsy Williams, and Mr. Dave Bruce, representatives of the Tribe supported the *MTADS* Demonstration.

Figure 9. The sweep line supervised by a UXO technician is conducting a surface clearance near the Bravo-19 fence.

Figure 10. Items recovered during the surface sweep included BDU-33s, 50 cal, and 20-mm ordnance. Also not shown are 2.75-in warheads. Only about 25 of the 8,000 recovered 20-mm projectiles were unfired cartridges as shown above.

Based upon the observations of materials recovered in the surface clearance and a preliminary analysis of targets from the transect surveys, it was apparent that the density of ordnance scrap recoveries effectively dropped to nearly zero within 1000-1500 meters south of the Range fence. However, we continued to find significant OE scrap at the eastern limit of transect number 2. Based upon these observations it was decided to extend the surface walk over and clearance. Ultimately, an additional path, 50 meters wide (75 meters south of the fence line), was surface cleared to the eastern border of the Range. The extended clearance covered 29 hectares.

Figure 11. Detonation pit crater on the south side of the Bravo-19 perimeter fence.

4.2.5 Prove Out Site Three intact ordnance items recovered in the surface clearance were temporarily buried on the Reservation southwest of the Center Range Tower and surveyed using the *MTADS* magnetometer and EM arrays. The survey images are shown in Figures 12 and 13. These signatures served as a baseline for discriminating these items during data analysis and for estimating thresholds for picking targets for remediation. The target on the right is a 2.75-in rocket warhead lying flat and oriented north/south. The other two items are BDU-33 warheads oriented north/south (on the left) and east/west (in the center). All targets are buried at 1 foot to the center of the

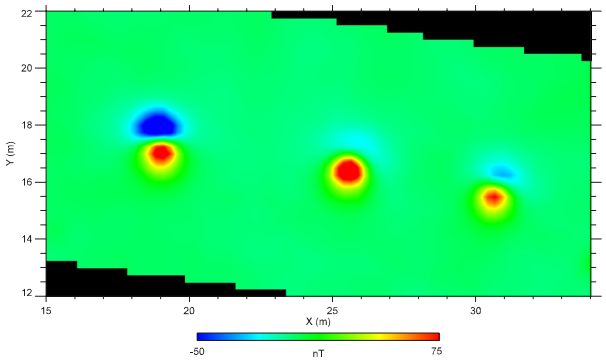


Figure 12. Magnetometer anomaly image of the Prove Out Site.

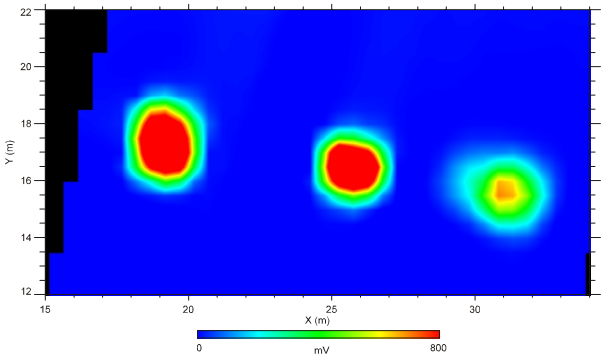


Figure 13. EM anomaly image of the Prove Out Site.

ordnance.

5.0 Site Survey

5.1 Surface Clearance

UXO technicians and supervisors from EOTI, with support of personnel from the Walker River Native American Employment Office, conducted the surface clearance of Transects 1-4 as described in Section 4.2.4. Relatively large concentrations of OE scrap were found in Transects 1 and 2, along with several practice and live ordnance items. Much lower concentrations of ordnance-related materials were found on the north/south Transects, 3 and 4. This information, documented from the EOTI Operation Report, is summarized in Table 3. The NAS Fallon EOD detachment conducts ORO sweeps of this area on an almost monthly basis. These are usually done either from a helicopter or from ATV vehicles. Reports document that the primary purpose of these sweeps is removal of intact live and inert ordnance. This correlates with our findings of shrapnel and OE scrap (bomb base plates and strongbacks) that clearly resulted from much earlier operations.

Table 3. Results of Surface Sweep and Clearance of Transects 1-4

Transect	Dates/ Hours On-Site	OE Scrap Recovered	Ordnance Recovered		
			Type	Number Recovered	Comment
1	Nov 3 6 hours	325 lbs	2.75-in Rocket WH	2	HE-Filled
			50-cal Projectile	2	Full-up, unfired
			20-mm Projectile	2,100	TP
2	Nov 4, 5, 6, 11, 12 41 hours	1,100 lbs	20-mm Projectile	6,000	TP
			BDU-33	4	Live Spot Charge
3	Nov 2, 3 6 hours	20 lbs	Luu-2	4	Scrap Pile
			50-cal Projectile	4	Empty Casings
4	Nov 9, 10 10 hours		Luu-2	3	Scrap Pile

In addition to the times noted in Table 3 that were required to collect the materials from the transects, two additional days were spent inspecting, sorting and transporting materials to a central stockpile point on the Reservation west of Transect 1. Recovered live ordnance was transferred to

NAS Fallon EOD.

In June 1999 when NRL and EOTI returned to the Demonstration Area to way point and dig targets, a second walk over and surface clearance was scheduled. This operation cleared an area 50 meters wide extending from end of Transect 2 eastward for 6000 meters to the southeast corner of Bravo-19. This area of 30 hectares required about 450 man-hours of work over a period of 5 working days to clear. The area was laid out using tapes and stakes to define 50 meter wide by 150 meter long search cells. The eastern 30% of this area is very steep and rugged terrain. Table 4 lists the ordnance-related materials recovered from this sweep. The western 2.5 km of this area contained a few ordnance items and 2-25 kg of OE scrap per hectare were recovered. The eastern 3 km of the search area yielded only very small amounts of OE scrap and in many of the search cells no metallic material was recovered. This extended search was conducted to determine the relative levels of ordnance contamination on this area of the Reservation adjacent to the Range.

5.2 *MTADS* Magnetometer and EM Surveys

MTADS magnetometer surveys were conduced on 10-16 November. EM surveys were carried out on 17-19 November. The Demonstration Survey Log, summarized in Table 5, documents progress and notes specific events. Surveying was terminated on 19 November because of a vehicle engine failure that could not be quickly repaired in the field. Transects 1, 2, and 4 were completely surveyed using the magnetometer array. Transect 3 was surveyed between Flags 3-0 and 3-8 (1,200 meters) using the magnetometer array. Because of the relatively sparse number of apparent targets on this section, the ruggedness of the terrain on the remainder of the transect, and because of the high density of apparently large buried targets discovered on Transect 2, surveying with the magnetometer array was halted to increase the survey width on Transect 2 to 100 meters. The EM array was also used to begin surveying on Transect 2 starting on 17 November. EM surveying was halted on 19 November because of the vehicle engine breakdown.

The terrain in the Playa was very flat, the surface was soft, but not difficult to negotiate, and survey progress was fast. Obvious wheel tracks made navigation very easy, Figure 14. As the terrain rose from the lake bed, the very soft shifting sand and stubborn vegetation created problems for the vehicle which became stuck dozens of times, Figure 15. The vegetation also led to numerous flat

tires because of punctures from broken limbs on the brush. As we were not

Table 4. Materials Recovered from the Extended Walkover East of Transect 2

SEARCH CELL	Search Extent Easting UTM (m)	OE/SCRAP RECOVERED
S2-15	358085-358235	100lbs of frag/scrap
S2-16	358085-358385	100lbs of frag/scrap
S2-17	358085-358235	100lbs of frag/scrap
S2-18	358235-358385	150 lbs remains of aircraft
S2-19	358385-358535	<50lbs of frag
S2-20	358535-358685	<50lbs of frag
S2-21	358685-358835	2.75 Illum Rocket WH (empty)
S2-22	358835-358985	<25lbs of frag, large target remnants
S2-23	359135-359285	~100lbs of frag/scrap, Parts of Luu2 flare, Base of 105mm spotter round, 2 small propellant pieces
S2-24	359285-359435	100lbs of frag/scrap
S2-25	359435-359585	<10lbs of frag
S2-26	359585-359735	<10lbs of frag
S2-27	359735-359885	Aircraft parts/1lb of frag
S2-28	359885-360035	<1lb frag
S2-29	360035-360185	<5lbs of frag
S2-30	360185-360335	BDU-33, fired
S2-31	360335-360485	<1lb frag
S2-32	360485-360635	<2lb frag
S2-33	360635-360785	Portion of Bomb Fin
S2-34	360785-360935	<1lb frag
S2-35	360935-361085	<1lb frag
S2-36	361085-361235	<1lb frag
S2-37	361235-361385	20mm/50cal casings (4)
S2-38	361385-361535	20mm casings (2)
S2-39	361535-361685	<1lb of frag/scrap
S2-40	361685-361835	<1lb of frag/scrap
S2-41	361835-361985	<1lb of frag/scrap
S2-42	361835-362135	<1lb of frag/scrap
S2-43	362135-362285	<2lb of frag/scrap
S2-44	362285-362435	none
S2-45	362435-362585	none
S2-46	362585-362735	none
S2-47	362735-362885	none
S2-48	362885-363035	One 20 mm TP
S2-49	363035-363185	none
S2-50	363185-363335	none
S2-51	363335-363485	none
S2-52	363485-363635	<1lb of scrap
S2-53	363635-363785	none
S2-54	363785-363935	none
S2-55	363935-364085	none

Table 5. *MTADS* Walker River Demonstration Survey Log.

Date	Action	Result
9 Nov	*MTADS* arrives on Site at Bravo-19	Safety Briefing NAS Fallon, Hanger 3
10 Nov	Office Trailers Set Up at Tower 2 Mag Survey Begins, Transect 2, Flags 2-5 to 2-12	*MTADS* Unpacked and Tested Survey 255 min, 12.6 acres
11 Nov	Mag Survey Transect 1, Flags 1-0 to 1-14 Mag survey Transect 3, Flags 3-0 to 3-8	Survey 307 min, 25 acres Survey 110 min, 7.4 acres
12 Nov	Mag Survey on Transect 3, Flags 3-0 to 3-8 Mag Survey on Transect 2, Flags 2-5 to 2-14 2 flat tires on Tow Vehicle	Survey 114 min, 7.4 acres Survey 228 min, 11.6 acres
13 Nov	Mag Survey on Transect 2, Flags 2-0 to 2-14 Installed coil springs to elevate vehicle Replaced sensor, sensor cable, repeater cable	Survey 262 min, 12.5 acres
14 Nov	Mag Survey on Transect 2, Flags 2-0 to 2-5 Extended Area Mag survey on Transect 4, Flags 4-0 to 4-7 Replaced sensor cables	Survey 213 min, 13.5 acres Survey 87 min, 6.3 acres
16 Nov	Mag survey on Transect 4, Flags 4-8 to 4-14 Transect 4 complete	Survey 300 min, 12.8 acres
17 Nov	EM Survey (E-W), Transect 2, Flags 2-6 to 2-13 Replaced all EM cables after trailer disconnect	Survey 395 min, 12.6 acres
18 Nov	EM Survey (N-S) Transect 2, Flags 2-11 to 2-12 EM Survey (E-W) Transect 2, Flags 2-6 to 2-13	Survey 192 min, 3.6 acres Survey 194 in, 6.3 acres
19 Nov	EM Survey (N-S) Transect 2, Fill-in Vehicle Breakdown, not repairable *MTADS* Packout	
20 Nov	*MTADS* Departs Fallon	
	Survey Rate Summary: Magnetometer EM	 115 acres/31.3 hr = 3.7 acres/hr 22.5 acres/13 hr = 1.7 acres/hr

remediating at the same time as we were surveying, we did not have four-wheel drive backhoes on site to drag the vehicle out when it was stuck. Four-wheel drive rental trucks also stuck easily because of the soft sand and the brush. If extended surveys are to be done on this site, the vehicle ground clearance should be increased or brush cut ahead of the survey. Alternatively, a four-wheel tractor will be required on site to assist the vehicle in difficult areas.

We continuously processed data on site to evaluate the survey progress and to guide the survey planning. It was obvious, both from the ORO sweep and the preliminary data analysis, that buried targets were much more prevalent near the perimeter fence and that they were concentrated along Transect 2. For this reason the survey width of Transect 2 was doubled to 100 meters.

Because of the volcanic history of this area, we anticipated significant geological interferences in the magnetometry data. These were manifested in three different forms. As shown in Figure 16, there are numerous circular features in the magnetometry anomaly maps. These are associated with soil deposits in the lake bed at the edges of evaporation ponds in low lying areas. While on site, in some cases, we were able to associate significant magnetic anomaly features with rock outcroppings as the terrain rose above the lake bed. This makes it probable that large buried rocks may be mistaken for ferrous targets in our analyses. We decided to dig numerous targets of this type to determine the relative responses of

Figure 14. *MTADS* magnetometer survey on the lake bed on Transect 1 near the center Tower.

Figure 15. *MTADS* survey in Transect 2 as it rises from the lake bed.

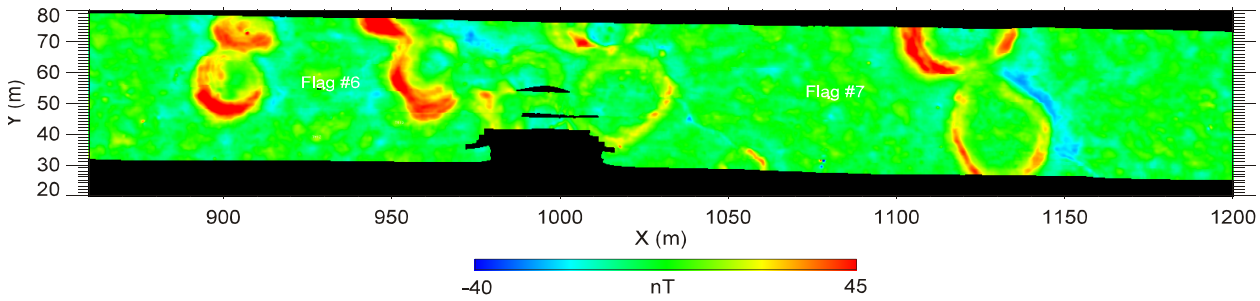


Figure 16. *MTADS* magnetic anomaly image map of a portion of Transect 1 showing circular features associated with water evaporation.

the magnetometer and EM sensor arrays to the anomaly features. Finally, there is a strong positive trending in the Earth's background field level as the altitude increases above the lake bed. This is clearly associated with individual geological strata because the background field strength rose and fell as the survey was extended away from the Playa. Both of these features are evident in Figure 17 where a strong rock outcropping bisects Transect 4 at about the 840 meter level and a second outcropping is evident at the surface at the 930-970 meter level. The overall background field strength varies by more than 60 nT over a distance of 150 meters as one crosses the emergences of these geological strata.

All survey data were preprocessed and added to the individual transect images by the day following collection. The on-site Tribal representative was briefed daily on our progress and observations. On 16 November, separate briefings were presented to the NAS Fallon Commanding Officer, and to Mr. David Bruce and several members of the Tribal Council, informing them of our progress and our intentions to complete the survey portion of our operations and depart the site by 20 November. Preliminary results from our surface sweep were described, along with information about ordnance items from the ORO sweep that had been turned over to NAS Fallon EOD for disposal. Preliminary anomaly image maps such as shown in Figure 17 and 18, were presented to each group. Preliminary discussions were held with each group about our return to the site to excavate designated targets. Preparation for these activities required coordination with Fallon Range Control, resolution of the appropriate level of environmental documentation to meet the requirements of the National Environmental Policy Act, and negotiating the required access authority with the Tribal Council.

5.3 Data Analysis

Final processing of survey data took place at NRL after returning from the field. Single data files were created for each of the transects for the magnetometer and EM surveys. Target analyses were conducted using the magnetometry data, choosing targets as large or larger than 2.75-in rocket warheads. No attempt was made to identify 20-mm projectiles or 50-cal rounds because their threat was deemed minimal compared to the larger ordnance. Moreover, the density of small frag and or scrap items would have severely limited our ability to sample the larger targets if recovery efforts were concentrated on the numerous smaller signals. We were specifically concerned with determining the presence of ordnance on Transects 3 and 4, knowing that these areas have a high incidence of geological "hot rock" interferences. Consequently, many low probability targets were chosen for remediation on the north/south traverses as shown in Figure 17 on the right. Target choices for remediation were made exclusively on the basis of the magnetometry survey. The data in the EM survey were reserved for post-remediation consideration in the hope that it could be used for training purposes to guide potential future surveys which would rely only on EM survey data. The results of the EM surveys will be discussed in a later section of this report.

The target choices specified for remediation are summarized in Table 6. The number of targets and their distribution of depths fall within the scope of

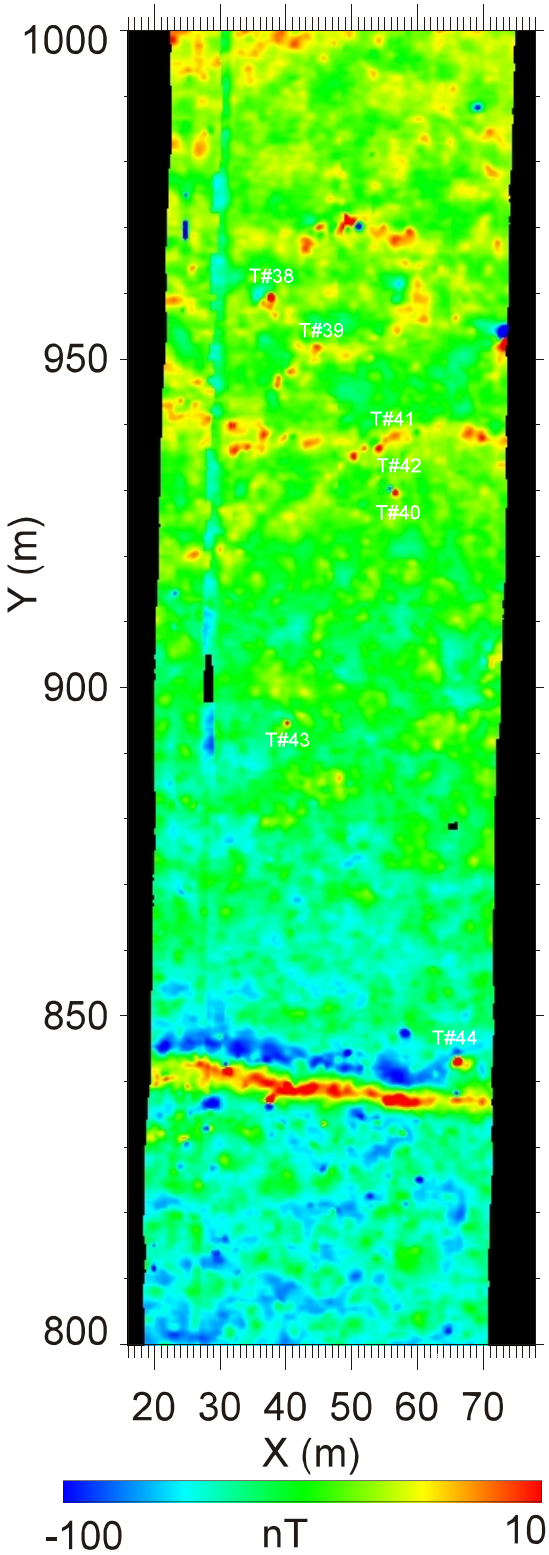


Figure 17. *MTADS* magnetic anomaly map of a portion of Transect 4 showing geological interferences resulting from rock outcroppings.

what could be accomplished with the resources remaining at the end of the survey. The inclusion of even low-probability targets on the north/south transects was intended to capture all ordnance items in the transects. As previously described, the observation of significant quantities of OE scrap at the east end of Transect 2 was addressed by setting up a second ORO surface walkover extending eastward from Transect 2. The additional costs for this effort were provided by the ESTCP Program Office; the ORO sweep described in Table 4 was carried out concurrently with target remediation.

Table 6. Targets selected for remediation from the magnetometer survey.

Transect Number	Targets on Dig List	Comments
1	56	All targets >0.04m (includes 30% likely geology signals)
2	315	Includes group of about 2 dozen large-deep targets, likely candidates for Mk82-Mk84. Includes selected targets down to 0.04 meter diameter with highest UXO potential. Sampling adjusted to bring total to about 500 targets.
3	6	Includes all potential UXO targets
4	132	Includes many targets with low UXO probability

5.4 Preparing for Way Pointing and Remediation

5.4.1 Environmental Impact Assessment Following discussions involving the BIA, the Walker River Tribe, and the Environmental Division of the Public Works Department at NAS Fallon, an investigation of the NEPA requirements for appropriate environmental impact documentation was undertaken. NAS Fallon took the lead in the investigation.[16] Geological, cultural, historical, and environmental studies were conducted by the appropriate agencies. Ultimately, a filing for a Categorical Exclusion was developed and accepted by the BIA, the Walker River Paiute Tribe and NAS Fallon.

5.4.2 Access Permit from the Walker River Paiute Tribe NRL requested and was granted an access permit by the Walker River Tribe for conducting the remediation activities on the site. Appendices D and E document these permits. Mr. Dave Bruce returned to the site to act as the Tribal UXO Consultant during the remediation phase of the demonstration. Mr. Bruce was present for and monitored all UXO target recovery activities and witnessed the demolition activities at the

end of the operation when all remaining live UXO was blown in place.

5.4.3 Dig Lists, Dig Images, and Dig Sheets After completing data analysis, Dig Lists, Dig Images, and Dig Sheets were prepared to support the Way Pointing Team and the Remediation Teams. The Dig Lists are Excel Spreadsheets, prepared from *MTADS* Target Report Files, that list the results of the target analysis edited to include only the targets selected for remediation. The Dig Lists are imported as electronic files (via serial port connection to a PC) into the Trimble TDC, a Way Pointing field instrument that guides the Way Pointing team to each set of target coordinates. In the Dig Lists each target is identified by a unique target number that is also printed on the Dig Image. The Dig Image is a magnetic anomaly image plotted on a scale that allows both the Way Pointing and the Dig Teams to orient themselves in the field, locate individual targets in relation to nearby targets, and in some cases to identify nearby clutter around the target. The Dig Image also allows the Way Pointing Team to logically proceed from one target to the next nearby target regardless of the sequence in which the targets were picked or analyzed. Figure 18 shows a Dig Image for two sections of Transect 2 at the eastern end of the Transect. The remainder of the Dig Images are included in an Appendix to this report which is included as a CD ROM . The postscript output graphics used to create the Dig Images are a product of the *MTADS* DAS. In addition to the Dig Image, the Dig Team is presented with a Dig Sheet for each target on the Dig List. The Dig Sheet, prepared from the information in the Excel Target Dig List, presents the remediator with a summary of size, depth, location, and orientation information, and the analyst's comments noted when the target was analyzed. The Dig Sheet, an example is shown in Figure 19, also includes spaces for the remediator to record observations for comparison with the DAS predictions, a space for presenting a sketch of the recovered item, and a set of boxes to fill in describing the identity of the item, and if it is UXO, descriptions of the markings and fuzing on the ordnance. In addition, the remediation team carries a 35-mm camera and is instructed to photograph all ordnance, in place, as it is uncovered. Each photograph is identified by the unique target number of the UXO item which can be paired up with the Dig Sheet for information purposes after the item is removed or blown-in-place.

In the Dig Sheet shown in Figure 19 the analyst identified the target as a possible Mk 84 buried at 6.6 feet to the center of the object. He pointed out metallic clutter to the southwest of the target. The clutter is not detectible at the presentation scale in the Dig Image, in Figure 18. The remediation

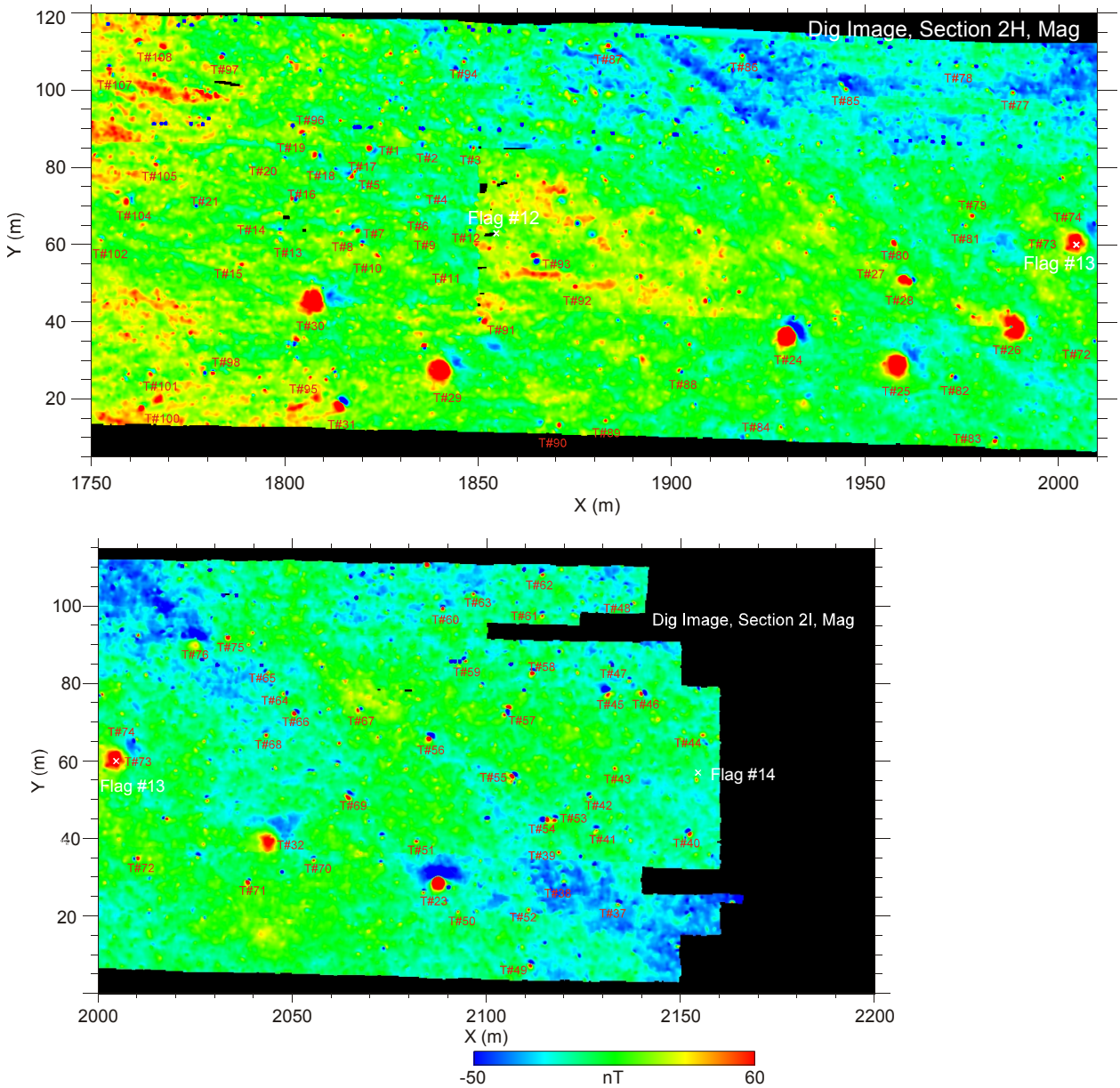
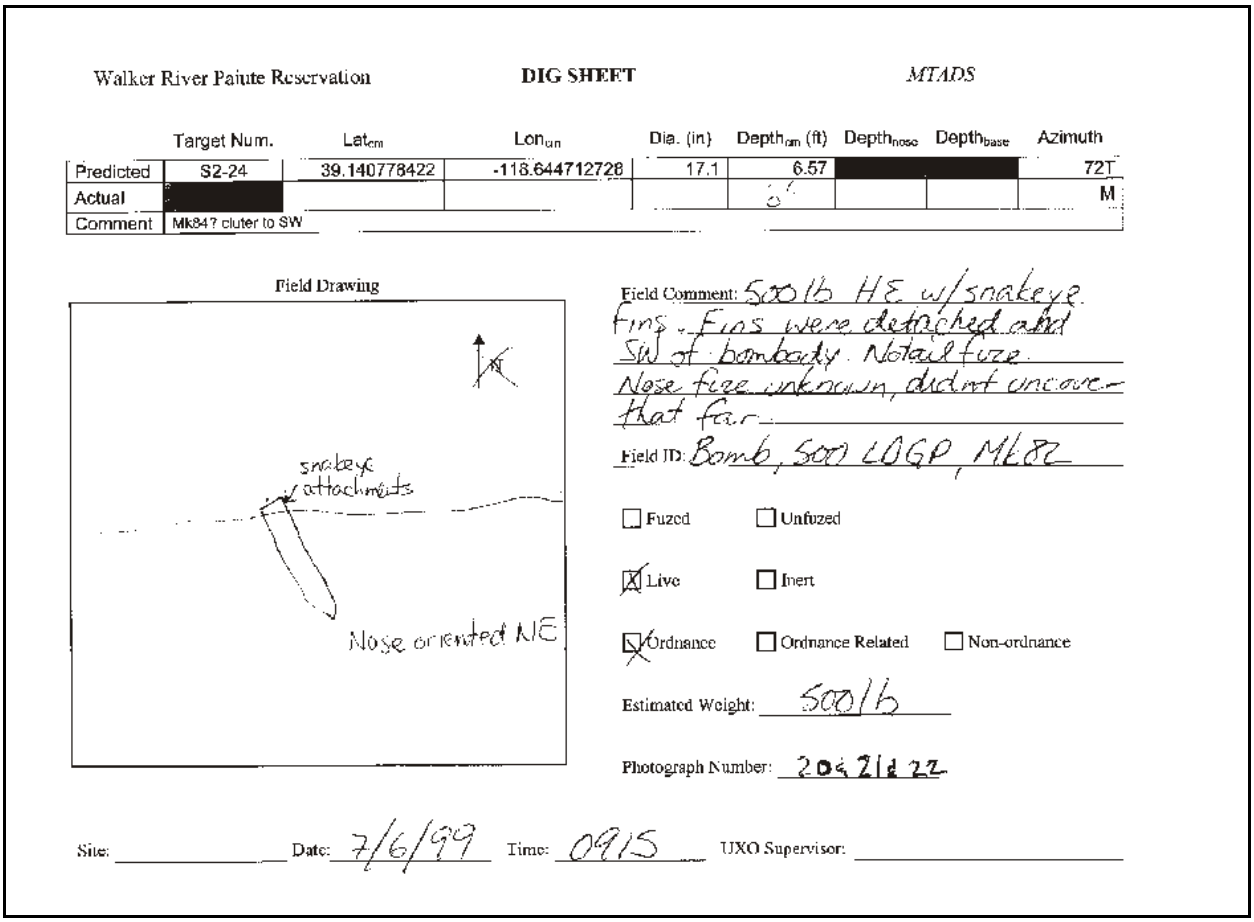


Figure 18. Example of Dig Images from Transect 2 provided to the Way Pointing and Remediation Teams to support their target reacquisition and recovery operations.

team identified the target as an HE-filled Low-Drag GP, Mk 82 buried at 6 ft. The remediator noted the detached snakeye fins buried southwest of the bomb body. Three photographs, Figure 20, were taken of the UXO before it was blown in place.



Walker River Paiute Reservation **DIG SHEET** *MTADS*

	Target Num.	Lat_{cm}	Lon_{cm}	Dia. (in)	$Depth_{cm}$ (ft)	$Depth_{nose}$	$Depth_{base}$	Azimuth
Predicted	S2-24	39.140778422	-118.644712728	17.1	6.57	[redacted]		72T
Actual	[redacted]				6'			M
Comment	Mk84? cluter to SW							

Field Drawing

Field Comment: 500 lb HE w/snakeye fins. Fins were detached and SW of bombody. No tail fuze. Nose fuze unknown, didnot uncover that far.

Field ID: Bomb, 500 LOGP, Mk82

☐ Fuzed ☐ Unfuzed

☒ Live ☐ Inert

☒ Ordnance ☐ Ordnance Related ☐ Non-ordnance

Estimated Weight: 500 lb

Photograph Number: 20 & 21 & 22

Site: _____ Date: 7/6/99 Time: 0915 UXO Supervisor: _____

Figure 19. Dig Sheet for Target 24 on Transect 2.

5.5 Target Way Pointing

In late June 1999, NRL returned to the site to conduct the target way pointing. Using the first-order control points in Table 2, the three-man team reacquired and flagged 510 targets on the four Transects on 28-30 June 1999. These activities are summarized below.

Table 7. *MTADS* Demonstration Way Point Remediation Log

Date	Site	Targets Way Pointed
27 June 1999	Arrived at NAS Fallon	
28, 29 June 1999	Transect # 1	56
29, 30 June 1999	Transect # 2	316
29 June 1999	Transect # 3	6
30 June 1999	Transect #4	132
	Total Targets Flagged	510

6.0 Target Recovery

EOTI, Inc. supported the target digging operation with 2 UXO technicians, 2 UXO team leaders and a Senior UXO supervisor. Two concurrent operations were conducted. One UXO team leader, or the UXO supervisor, managed the activities of 10 Hazwopr-certified workers conducting the extended sweep-line clearance east of Transect 2 which is described in Section 4.2.4 and in Table 4. On 29 June, two UXO teams began excavating the flagged targets listed in Table 6. Small and shallow targets were excavated using hand tools. Backhoes were used to excavate the deeper targets and to create the sloped excavations for targets deeper than 6 feet where danger of cave-ins existed. Target excavation took place during seven working days between 29 June and 8 July. On 9 July, NAS Fallon EOD blew-in-place, the live ordnance excavated during the previous week. Tables 8, 9, 10, and 11 summarize the analysis and remediation results for the flagged targets on each of the transects.

Figure 20. The upper half of an HE-filled LDGP Mk 82, target number 2-24 is shown as it was uncovered by the remediation team.

6.1 Results

On Transects 1, 3, and 4 the target analyst attempted to identify all objects that might be ordnance of a size equal to or larger than 2.75-in rocket warheads. Transect 1 had bothersome, but not difficult, geological interferences from magnetic silt deposits. Transect 3 was geologically very quiet and had only very sparse targets with significant potential to be UXO. Transect 4 had several hard target hits at the north end of the survey; the remainder of the survey was dominated by strong returns from geological structures. Transect 3 was also geologically very active, and had a relatively

Table 8. Target Dig Sheet and Remediation Results from Transect 1.

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin.	Azim.	Fit Quality	Analyst Comments	Observed Size (in)	Observed Depth (m)	Fuzed	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
T1-1	2049.06	31.50	0.32	0.12	0.8675	4	347	0.960	very good target								NO TARGET FOUND TO 6 FT
T1-2	2058.65	31.52	0.23	0.11	0.7070	8	302	0.991	very good target	2X17X1				Y			SCRAP-PART OF BASE PLATE FOR MK82. ON THE SURFACE
T1-3	2095.26	23.53	0.24	0.07	0.2033	-11	344	0.975									NEGATIVE FIND
T1-4	1411.43	47.99	2.49	0.43	42.4347	-3	253	0.929	inverted signal, very large target								NEGATIVE FIND
T1-5	1411.06	48.03	2.09	0.37	26.5707	-7	252	0.915	inverted signal - mixed up with S1-4								NEGATIVE FIND
T1-6	210.39	63.13	1.19	0.08	0.3016	71	104	0.967	deep, is likely geology								NEGATIVE FIND
T1-7	237.78	79.67	0.90	0.07	0.1991	44	71	0.968	deep, is likely geology								NEGATIVE FIND
T1-8	264.81	86.68	1.50	0.12	0.8074	72	129	0.930	low probability as UXO								NEGATIVE FIND
T1-9	257.75	86.49	1.54	0.12	0.9475	23	150	0.911	deep, is likely geology								NEGATIVE FIND
T1-10	397.22	55.16	1.32	0.09	0.3841	31	309	0.936	low probability as UXO								NEGATIVE FIND
T1-11	622.22	82.24	2.03	0.12	0.9242	50	308	0.949	deep, is likely geology								FLAG Missing
T1-12	927.68	38.68	1.68	0.10	0.5441	82	148	0.857	deep, is likely geology								NEGATIVE FIND
T1-13	952.26	43.34	1.15	0.08	0.2721	13	170	0.861	deep, is likely geology								NEGATIVE FIND
T1-14	1322.93	45.06	0.33	0.07	0.1770	84	217	0.957	good dipole at 1 ft.								NEGATIVE FIND
T1-15	1443.94	43.75	1.22	0.11	0.6610	59	44	0.969	possible is geology								NO TARGET FOUND TO 5 FT - GEOLOGY RETURN
T1-16	1536.97	50.46	0.26	0.06	0.1133	58	11	0.993	good dipole at 1 ft.	5	0.05			Y		19 - 22	SCRAP - BACK END OF 5" ROCKET MOTOR
T1-17	1586.76	50.27	0.26	0.07	0.1783	20	69	0.946	good dipole at 1 ft.	1 X 1/4	0.2			Y			SCRAP
T1-18	1594.57	19.04	0.23	0.06	0.1154	4	257	0.986	inverted signal								NEGATIVE FIND
T1-19	1594.28	49.87	1.73	0.13	1.1941	84	172	0.912	possible is geology								NO TARGET FOUND TO 6 FT - GEOLOGY RETURN
T1-20	1627.40	46.51	0.25	0.07	0.1958	-3	276	0.975	inverted signal						Y		CABLE
T1-21	1669.29	60.57	0.49	0.06	0.1159	86	22	0.990	good target								NEGATIVE FIND
T1-22	1693.95	41.90	0.28	0.07	0.2112	51	50	0.986	good target	1 X 7	0.08			?		17	METAL SCRAP
T1-23	1700.98	45.16	0.25	0.06	0.1030	59	356	0.985	possible is geology	2	0.08			Y		18	METAL SCRAP
T1-24	1679.24	31.97	0.48	0.05	0.0786	63	25	0.863									NEGATIVE FIND
T1-25	1725.47	30.39	0.23	0.04	0.0442	13	18	0.931									NEGATIVE FIND
T1-26	1755.12	31.03	0.74	0.09	0.3964	38	9	0.993									NEGATIVE FIND
T1-27	1771.07	30.41	0.27	0.06	0.1152	62	2	0.994									NEGATIVE FIND
T1-28	1769.18	14.96	0.39	0.06	0.1349	27	291	0.928	possible is geology								NEGATIVE FIND

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin.	Azim.	Fit Quality	Analyst Comments	Observed Size (in)	Observed Depth (m)	Fuzed	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
T1-29	1803.84	29.60	0.23	0.04	0.0428	53	333	0.964	very small								NEGATIVE FIND
T1-30	1815.47	54.88	1.33	0.15	1.9212	31	295	0.990	good target			Y	Y			15-16	25-LB PRACTICE BOMB, BDU-33 OR MK 76
T1-31	1808.76	40.69	0.22	0.05	0.0811	26	289	0.977	very small	2.5	0.21			Y		14	METAL SCRAP
T1-32	1823.50	28.83	0.25	0.05	0.0490	73	218	0.978	very small								NEGATIVE FIND
T1-33	1854.91	44.13	0.21	0.08	0.2606	40	131	0.980	inverted, good target	3 X 2	S					13	METAL SCRAP
T1-34	1896.15	35.15	0.23	0.05	0.0611	28	247	0.973	very small								NEGATIVE FIND
T1-35	1902.09	32.66	0.19	0.05	0.0514	46	275	0.904	very small	1 X 1/4"	S						POTTED COMPONENT
T1-36	1936.46	40.44	0.31	0.16	1.9530	26	316	0.995	good target	8	0.15			Y		12	PART OF BOMB BASE PLATE
T1-37	1926.29	25.11	0.40	0.08	0.2353	40	42	0.948	small								NEGATIVE FIND
T1-38	1932.74	56.34	0.23	0.07	0.1563	-2	220	0.813	inverted, multiple targs?								NEGATIVE FIND
T1-39	1943.10	13.54	0.22	0.06	0.0952	12	241	0.995	inverted, small								METAL PIECES 1.5 FT EAST, SCRAP 6' WEST
T1-40	1994.30	52.50	0.40	0.08	0.2458	-15	20	0.828									NEGATIVE FIND
T1-41	1975.08	25.35	0.43	0.10	0.5862	36	201	0.951	inverted signal								NEGATIVE FIND, RUST 2 FEET EAST OF HOLE ON SURFACE
T1-42	1978.33	23.83	0.19	0.07	0.2165	-10	283	0.932									NEGATIVE FIND
T1-43	1974.52	16.55	0.34	0.07	0.2130	0	359	0.922	small								NEGATIVE FIND
T1-44	1999.13	38.68	0.29	0.05	0.0802	43	148	0.964	small	2 X 1.5	0.2			Y			SCRAP METAL
T1-45	2011.19	34.67	0.15	0.05	0.0555	12	109	0.925	inverted signal	8 X 1/2							SCRAP METAL (HANDLE)
T1-46	2047.42	51.20	0.25	0.08	0.2358	-12	299	0.880	complex signal								NEGATIVE FIND
T1-47	2033.02	9.77	0.33	0.07	0.1894	66	271	0.598	probable overlapping targets								NEGATIVE FIND
T1-48	2049.06	31.50	0.32	0.12	0.8675	4	348	0.960	delete, same as target S1-1								DELETE-SAME TARGET AS S1-1
T1-50	2065.52	34.34	0.20	0.06	0.1211	27	262	0.991	inverted small	3.5 X2X1	0.2			Y			SCRAP
T1-51	2090.69	45.78	0.24	0.06	0.1125	8	237	0.985	inverted signal								NEGATIVE FIND
T1-52	2103.71	48.49	0.45	0.06	0.1002	79	231	0.979		2.5X1	0.2						SCRAP ON SURFACE 1 METER FROM MARKER
T1-53	2085.99	30.92	0.43	0.06	0.1060	73	293	0.992	small								NEGATIVE FIND
T1-54	2083.64	23.53	0.34	0.05	0.0830	60	328	0.867	small								NEGATIVE FIND
T1-55	2116.09	38.93	0.18	0.04	0.0440	14	306	0.936	small	1 X 1.5							SCRAP ON SURFACE
T1-56	2106.83	46.19	0.32	0.06	0.1416	73	302	0.991									NEGATIVE FIND

Table 9. Target Dig Sheet and Remediation Rusults form Transect 2.

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-1	1822.18	84.81	0.58	0.12	0.9253	38	127	0.882	Inverted Signature	0.46	20			Y			LOTS OF FRAG (BLOW HOLE)
S2-2	1835.85	85.75	0.33	0.07	0.1493	3	319	0.933		0.31	1			Y			FRAG
S2-3	1848.47	85.08	0.15	0.07	0.1567	19	282	0.846	inverted signature	0.16	0.5			Y			FRAG
S2-4	1834.45	72.59	0.18	0.05	0.0787	27	19	0.864		0.16	.0.5			Y			FRAG
S2-5	1820.25	74.33	0.24	0.06	0.1119	1	5	0.859		0.16	.0.5			Y			FRAG
S2-6	1834.47	68.33	0.20	0.06	0.0951	14	41	0.835		0.16	0.5			Y			FRAG
S2-7	1818.88	63.77	0.41	0.10	0.4955	71	13	0.961		NG	8	Y	Y			16 & 17	3" WARHEAD, 60 DEGREE HORIZONTAL OFFSET
S2-8	1819.98	60.37	0.23	0.08	0.2195	3	10	0.943		0.31	0.5			Y			FRAG
S2-9	1834.11	62.90	0.70	0.08	0.2482	23	39	0.852	geology?	0.61	0.25			Y			SMALL PIECE OF FRAG AND ROCKS
S2-10	1824.31	57.22	0.24	0.06	0.1295	32	56	0.642	several pieces of clutter	0.23	0.5			Y			FRAG
S2-11	1839.69	50.12	0.19	0.05	0.0810	12	359	0.924		0.08	0.5			Y			2 PIECES OF FRAG
S2-12	1847.63	63.64	0.14	0.05	0.0714	-34	57	0.845	likely not ordnance	0.15	1			Y			SMALL FRAG
S2-13	1798.43	61.12	0.43	0.08	0.2293	7	60	0.928		0.05	1			Y			FRAG ON SURFACE
S2-14	1798.77	63.62	0.50	0.09	0.3920	-2	355	0.900		0.31	1			Y			SMALL FRAG
S2-15	1788.68	54.57	0.22	0.06	0.1323	22	208	0.749	inverted, clutter to W	0.16	1			Y			FRAG
S2-16	1802.32	71.87	0.24	0.09	0.3382	3	94	0.939	inverted signature	0.16	2			Y			FRAG
S2-17	1818.00	79.02	0.25	0.06	0.1400	59	306	0.951		0.16	5			Y			SEVERAL PIECES OF FRAG
S2-18	1817.09	77.98	0.54	0.10	0.5278	25	324	0.827	cluster of clutter	0.46	1			Y			SEVERAL PIECES OF FRAG
S2-19	1808.29	83.26	0.77	0.13	1.1626	13	101	0.915	inverted signature	0.61	8			Y			SEVERAL PIECES OF FRAG
S2-20	1799.83	82.23	0.21	0.06	0.1291	-3	28	0.948		0.16	1			Y			FRAG
S2-21	1777.20	70.03	0.21	0.06	0.1009	-73	284	0.913	likely not ordnance	0.05	0.5			Y			FRAG ON SURFACE
S2-22	1184.48	92.85	1.41	0.33	19.2551	1	349	0.978		0.92	1000		Y			11 &10 & 9	MK 83; NO FUSE
S2-23	2087.36	29.43	1.20	0.33	18.6461	84	260	0.948	MK82? nose down, fins all around	1.17	500	Y	Y			23 &24	MK82 OD LIVE; NO TAIL FUSE; NOSE FUSE UNKNOWN STILL BURIED; ARMING WIRES VISIBLE AT FRONT LUG 80-85 DEGREE IMPACT HORIZONTAL OFFSET; OFFSET TOWARD THE NORTH
S2-24	1930.42	37.08	2.00	0.44	43.0314	61	72	0.979	Mk84? clutter to SW	1.84	500	Y	Y			20 &21 & 22	500LB HE W/SNAKEYE FINS-FINS WERE DETACHED AND SW OF BOMBBODY. NO TAIL FUSE. NOSE FUSE UNKNOWN, DIDN'T UNCOVER THAT FAR. BOMB, 500 LDGP, MK82

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
																	REMNANTS OF HIGH DRAG FINS FOUND WHILE DIGGING FROM SURFACE TO 13
S2-25	1959.11	29.79	3.18	0.42	39.7018	63	77	0.970	Mk84? fins to E & W, check EM	4	500		Y			9	FT. NO NOSE FUZE NO TAIL FUZE, CONCRETE FILLER. BOMB, 500 LB PRACTICE, MK82
S2-26	1989.64	38.67	3.92	0.49	62.8188	51	103	0.916	Confused, much clutter directly above	NG	NG				Y		LAYER OF HOT ROCK 14' DEEP. BACK HOE FULLY EXTENDED. SOFT SAND 8'DEEP; PACKED SAND 8'-14'
S2-27	1959.89	51.74	1.15	0.19	3.4769	47	6	0.959	2nd targ 2m ESE	1.08	30			Y			CONICAL BOMB FINS
S2-28	1961.89	50.70	0.43	0.11	0.7381	25	65	0.865	Bigger Targ 2m WNW & deeper	0.46	3			Y			FRAG
S2-29	1841.60	28.55	3.18	0.46	49.5053	38	70	0.977	Mk84? much clutter above & W	3.69	500		Y			ROLL 2; 4 &5	BOMB ORIENTED E-W. CONICAL FINS STILL ATTACHED AND BADLY DAMAGED. NO VISIBLE NOSE FUZE OR TAIL FUSE. BOMB, 500LB PRACTICE MK82
S2-30	1808.84	46.23	3.47	0.49	61.1554	36	82	0.968	Mk 84? Much clutter above	4.62	500		Y			ROLL 2; 6 &7	CONICAL FINS DETACHED BUT VERY CLOSE TO BOMB BODY. NO NOSE OR TAIL FUZES NOTED. COLOR WAS PRIMER RED WITH TRACES OF LIGHT BLUE. BOMB, 500LB PRACTICE, MK82
S2-31	1814.57	19.23	0.86	0.19	3.5113	2	41	0.938		NG	NG						FLAG MISSING
S2-32	2044.86	41.04	3.96	0.45	48.2435	28	48	0.902	Iffy target, but have to dig	NG	NG				Y		SOFT SAND 1-11FEET; PACKED SAND11-14 FEET; LAYER OF ROCKS 14' - HOT ROCKS
S2-33	1256.05	72.25	1.48	0.28	10.9470	-15	217	0.974	Inverted target	NG	NG				Y		SCRAP METAL
S2-34	1301.53	66.00	0.53	0.20	4.3282	6	166	0.953	Inverted, 2 Targets?	NG	NG						FLAG MISSING
S2-35	1099.17	52.80	1.95	0.46	51.3073	58	48	0.971	Mk84? clutter above and all around	NG	NG				Y		HOT ROCKS
S2-36	1105.80	44.62	0.37	0.21	4.8780	8	16	0.983		NG	NG				Y		HOT ROCKS
S2-37	2133.93	23.51	0.16	0.07	0.1568	15	30	0.920		0.03	2				Y		SCRAP
S2-38	2119.85	28.69	0.14	0.06	0.1105	-10	178	0.899	inverted signature	0.03	3			Y			FRAG
S2-39	2118.58	36.67	0.39	0.07	0.2003	73	92	0.933		0.15	10			Y			BASE PLATE
S2-40	2152.03	41.77	0.15	0.09	0.3853	14	327	0.987		0.03	3			Y			FRAG
S2-41	2128.20	42.70	0.39	0.09	0.3224	7	357	0.946		0.1	5			Y			BASE PLATE RING
S2-42	2126.41	51.23	0.19	0.07	0.2065	11	329	0.946		0.16	3			Y			FRAG
S2-43	2132.71	58.16	0.30	0.06	0.1408	48	236	0.842		0.31	NG				Y		HOT ROCKS
S2-44	2155.59	66.49	0.70	0.10	0.5586	29	181	0.941		NG	NG				Y		NEEDS TO BE EXCAVATED; ROCKS 75-100LBS
S2-45	2130.91	78.14	0.70	0.16	1.9585	-19	338	0.970		.31-.61	50				Y		SEVERAL LARGE ROCKS

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-46	2140.17	77.70	0.21	0.10	0.4492	0	71	0.975	inverted signature	0.13	1			Y			SCRAP
S2-47	2136.65	81.09	0.13	0.06	0.1174	4	2	0.954		0.03	2			Y			SCRAP
S2-48	2137.47	100.69	0.06	0.06	0.0948	-15	236	0.935	inverted signature	0.051	2			Y			SCRAP
S2-49	2111.26	7.88	0.24	0.09	0.3334	17	17	0.963		0.03	4			Y			SCRAP
S2-50	2092.39	21.42	0.14	0.06	0.0877	37	312	0.953		NG	0.5			Y			SCRAP
S2-51	2081.90	39.72	0.17	0.06	0.1399	35	14	0.938		0.03	20			Y			BOMB BASE PLATE
S2-52	2110.91	21.91	0.27	0.07	0.1771	57	84	0.972		NG	10	Y	Y			7 & 8	2.75" ROCKET WARHEAD. POSSIBLE HE OR WP FILLER
S2-53	2117.58	45.30	0.32	0.09	0.3848	5	15	0.938		0.1	5			Y			FRAG
S2-54	2114.98	45.20	0.27	0.11	0.6588	-5	275	0.959	inverted signature	0.077	7			Y			SCRAP
S2-55	2106.92	56.58	0.19	0.10	0.5126	6	51	0.926	much slutter to S	0.03	1			Y			SCRAP
S2-56	2085.41	66.42	0.20	0.12	0.8921	9	35	0.956		0.077	5			Y			SCRAP
S2-57	2105.52	73.66	0.24	0.10	0.4942	9	198	0.942	2nd targ 1m S	0.03	4			Y			SCRAP
S2-58	2111.80	83.24	0.25	0.10	0.4874	6	11	0.975		0.05	5			Y			SCRAP
S2-59	2094.27	86.23	0.13	0.07	0.1546	8	330	0.829		0.03	2				Y		SCRAP
S2-60	2088.65	99.62	0.13	0.07	0.1755	9	357	0.937		0.05	1				Y		SCRAP
S2-61	2114.19	97.95	0.33	0.08	0.2603	15	353	0.908		0.1	5			Y			BASE PLATE RING
S2-62	2114.20	108.54	0.43	0.10	0.5172	19	337	0.823		0	NG				Y		BARB WIRE
S2-63	2096.73	103.39	0.11	0.06	0.1059	38	50	0.913		0.16	1			Y			SCRAP
S2-64	2048.04	77.55	0.24	0.07	0.1972	7	82	0.849	inverted signature	0.16	2			Y			FRAG
S2-65	2043.32	83.20	0.18	0.07	0.1451	5	305	0.981		0.1	2			Y			FRAG
S2-66	2050.68	72.70	0.19	0.09	0.3605	19	47	0.948		0.05	8			Y			FRAG
S2-67	2067.24	73.52	0.24	0.08	0.2283	-10	63	0.854		0.03	2			Y			SCRAP
S2-68	2043.13	67.08	0.33	0.08	0.2348	50	343	0.953		NG	25		Y				BOMB, 25LB PRACTICE, BDU-33
S2-69	2064.51	51.16	0.66	0.12	0.9136	31	32	0.801	likely 2 targs	0.31	5						SEVERAL SMALL PIECES OF FRAG; TOTAL WEIGHT 5 LBS
S2-70	2055.39	34.98	0.20	0.07	0.1535	14	350	0.888		0.13	5			Y			BASE PLATE RING
S2-71	2038.61	29.28	0.17	0.07	0.1783	7	30	0.830	likely 2 targs	0.051	1			Y			SCRAP
S2-72	2009.73	35.10	0.24	0.08	0.2356	10	260	0.930		0.16	1			Y			FRAG
S2-73	2005.73	62.05	4.27	0.50	64.0863	34	63	0.918	iffy target, must dig	NG	NG				Y		LAYER OF HOT ROCK 12' DEEP. BACK HOE FULLY EXTENDED; SOFT SAND 1-7", PACKED SAND 8-14"

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-74	2009.49	65.62	0.15	0.06	0.1289	-7	251	0.953	inverted	0.16	1			Y			FRAG 2" X 5"
S2-75	2033.29	91.97	0.49	0.09	0.3500	68	326	0.792		NG	NG		Y			9 & 10	FUZE. HEAVY CONSTRUCTION
S2-76	2025.27	91.46	2.17	0.28	11.9525	6	19	0.840	Mk 82? clutter above	NG	NG				Y		BOULDER AT 4' HOT ROCKS 4'-8'
S2-77	1988.18	99.53	0.32	0.08	0.2419	54	23	0.965		0.03	10				Y		TARGET SCRAP
S2-78	1973.50	106.70	0.21	0.06	0.1341	8	343	0.889		0.16	1			Y			FRAG
S2-79	1977.79	67.58	0.42	0.08	0.2769	58	66	0.907		0.31	3			Y			PORTION OF BASE PLATE
S2-80	1957.52	60.68	0.57	0.11	0.7889	58	45	0.935		NG	12			Y			SEVERAL PIECES OF FRAG AND RUST
S2-81	1975.51	65.01	0.12	0.06	0.1018	6	289	0.962		0.16	0.75			Y			LESS THAN 1 LB OF FRAG
S2-82	1972.77	25.88	0.26	0.08	0.2690	2	110	0.961	inverted	0.5	0.75			Y			FRAG
S2-83	1983.61	9.61	0.20	0.08	0.2979	23	12	0.869		0.009	1			Y			FRAG
S2-84	1928.39	13.02	0.21	0.06	0.1264	22	48	0.902		0.75	1			Y			FRAG
S2-85	1945.04	100.58	0.34	0.09	0.3376	22	17	0.893		0.31	2			Y			FRAG
S2-86	1918.33	109.00	0.48	0.09	0.3608	63	46	0.836		0.46	1			Y			FRAG
S2-87	1883.65	111.45	0.42	0.10	0.5126	77	140	0.852		0.31	1			Y			FRAG
S2-88	1902.22	27.28	0.17	0.07	0.1686	-7	123	0.827	inverted	0.16	0.25			Y			FRAG
S2-89	1882.79	14.44	0.29	0.06	0.1105	87	90	0.845		0.16	1			Y			FRAG
S2-90	1870.82	13.21	0.52	0.09	0.4249	64	196	0.660		0.16	2			Y			LARGE PIECE OF FRAG
S2-91	1850.88	40.52	0.52	0.11	0.7007	-1	295	0.866		0.46	5				Y		ROCKS HOT
S2-92	1874.98	49.18	0.29	0.06	0.1366	86	275	0.895		0.16	1			Y			FRAG
S2-93	1864.91	56.11	0.63	0.15	1.6129	-45	148	0.769	inverted	0.37	8	Y	Y			18 &19	3" WARHEAD, 85 DEGREE OFF SET
S2-94	1846.36	107.52	0.25	0.07	0.1890	34	27	0.924		0.16	0.5			Y			FRAG
S2-95	1810.89	25.33	0.15	0.06	0.0976	21	39	0.935		0.16	0.5			Y			FRAG
S2-96	1804.67	88.83	0.18	0.08	0.2500	4	151	0.970	inverted	0.16	1			Y			FRAG
S2-97	1783.84	108.86	0.07	0.07	0.2056	31	29	0.950		0.077	0.25			Y			SMALL FRAG
S2-98	1781.42	27.01	0.18	0.07	0.1432	0	355	0.875		0.16	0.5			Y			FRAG
S2-99	1740.48	19.89	0.20	0.06	0.1188	1	327	0.913		0.16	0.75			Y			FRAG
S2-100	1763.17	18.05	0.39	0.10	0.4758	56	42	0.962		0.46	8	Y	Y			14 & 15	3 INCH WARHEAD, 45 DEGREES HORIZONTAL OFFSET WEST TO EAST IMPACT
S2-101	1765.52	26.89	0.52	0.09	0.3486	19	24	0.782		0.92	NG				Y		ROCKS

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-102	1752.72	61.47	0.20	0.06	0.1078	10	29	0.876		NG	NG						NO FIND
S2-103	1743.51	73.02	0.30	0.12	0.8271	-20	291	0.982	inverted	0.31	15				Y		LARSE ROCK
S2-104	1759.68	71.48	0.86	0.14	1.3447	13	74	0.835	inverted	1.23	NG						ROCKS
S2-105	1766.94	81.09	0.20	0.07	0.1795	18	35	0.903		0.16	1			Y			FRAG
S2-106	1740.81	95.73	0.15	0.06	0.1164	26	22	0.871		0.16	0.5			Y			FRAG
S2-107	1754.60	105.95	0.12	0.07	0.2125	-1	5	0.960		0.16	0.5			Y			FRAG
S2-108	1762.26	112.52	0.23	0.09	0.3303	13	151	0.938	inverted	0.16	0.5			Y			FRAG
S2-109	1734.78	95.96	0.28	0.08	0.2383	-1	205	0.881	inverted	0.18	0.75			Y			FRAG
S2-110	1736.73	83.32	0.15	0.05	0.0795	2	325	0.953		0.16	0.5			Y			FRAG
S2-111	1706.84	17.22	0.24	0.06	0.0996	59	343	0.903		0.092	0.75			Y			FRAG
S2-112	1686.93	39.36	0.06	0.08	0.2331	7	358	0.978		0.1	0.67			Y			FRAG
S2-113	1687.04	62.37	0.90	0.16	2.2452	5	214	0.883	strongly inverted	1.23	NG				Y		ROCKS
S2-114	1687.60	66.51	0.34	0.09	0.3930	30	4	0.897		0.31	0.5			Y			FRAG
S2-115	1712.15	65.97	0.17	0.06	0.1420	1	162	0.884	inverted	0.16	0.5			Y			FRAG
S2-116	1703.71	84.19	0.23	0.07	0.2021	3	108	0.950	inverted	0.16	1			Y			FRAG
S2-117	1691.05	90.82	0.15	0.07	0.2061	13	279	0.970		0.16	1			Y			FRAG
S2-118	1681.23	97.43	0.29	0.08	0.3084	10	153	0.968	inverted	0.31	1			Y			FRAG
S2-119	1724.05	95.56	0.81	0.15	1.6248	16	330	0.755		0.46	10				Y		HOT ROCKS
S2-120	1703.80	92.87	0.33	0.07	0.2138	54	330	0.851		0.31	1			Y			FRAG
S2-121	1702.55	112.01	0.32	0.07	0.1855	30	304	0.819		0.16	1			Y			FRAG
S2-122	1685.50	95.36	0.36	0.07	0.1461	45	338	0.864		0.31	2			Y			FRAG (3 EA)
S2-123	1652.80	119.12	0.19	0.08	0.2205	5	302	0.896		0.16	1			Y			FRAG
S2-124	1653.79	111.10	1.08	0.15	1.7222	45	3	0.790	confused by geology	NG	NG				Y		HOT ROCK
S2-125	1670.00	116.91	0.30	0.06	0.1386	62	250	0.930		0.16	5			Y			BASE PLATE ON END
S2-126	1665.56	113.23	0.18	0.06	0.1322	10	81	0.866	inverted signal	0.16	0.2			Y			FRAG
S2-127	1666.07	94.45	0.94	0.14	1.4908	1	227	0.839	inverted signal	0.77	OE 15LBS			Y	Y		SCRAP METAL, FIN PARTS & ROCKS 50 LBS
S2-128	1665.51	89.26	0.91	0.15	1.7840	14	162	0.877	inverted signal	1.23	NG				Y		ROCKS
S2-129	1657.36	88.83	0.98	0.19	3.4411	-4	180	0.879	inverted, clutter 1m NE	NG	NG				Y		HOT ROCKS
S2-130	1655.95	70.03	0.25	0.08	0.2270	10	263	0.782	inverted signal	0.16	0.5			Y			FRAG

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-131	1644.44	63.45	0.90	0.13	1.0469	-5	73	0.847	geology?	1.08	10				Y		ROCKS
S2-132	1661.76	44.34	0.18	0.07	0.2172	10	130	0.908	multiple targets	0.16	3			Y			FRAG
S2-133	1651.62	53.91	1.72	0.19	3.5958	22	215	0.833	inverted, clutter 1 m N	0.16	5				Y		ROCKS
S2-134	1668.65	42.09	0.24	0.07	0.1434	44	325	0.903		0.16	4			Y			BASE PLATE SECTION
S2-135	1652.96	39.42	0.23	0.10	0.5019	-1	283	0.897		0.16	2			Y			FRAG
S2-136	1644.61	27.12	0.18	0.07	0.1441	1	34	0.958		0.16	0.5			Y			FRAG
S2-137	1612.28	17.24	0.22	0.11	0.6477	-6	27	0.934	partial signature	0.16	0.5			Y			FRAG
S2-138	1635.38	27.09	0.14	0.06	0.0931	0	8	0.930		0.12	0.5			Y			FRAG
S2-139	1634.21	77.23	0.26	0.07	0.1555	6	2	0.876		0.16	0.75			Y			FRAG
S2-140	1610.40	79.79	0.17	0.05	0.0727	4	20	0.916		0.12	0.5			Y			FRAG
S2-141	1642.18	52.15	0.31	0.06	0.1040	4	20	0.813		0.23	0.75			Y			FRAG
S2-142	1602.19	87.07	0.14	0.06	0.1232	16	335	0.835		0.062	0.5			Y			FRAG
S2-143	1602.73	96.65	0.43	0.06	0.0989	68	112	0.901		0.31	0.5			Y			FRAG
S2-144	1621.72	106.89	0.23	0.06	0.1246	-12	340	0.899		0.062	25				Y		ROCKS
S2-145	1631.98	98.75	0.19	0.06	0.1060	13	58	0.909		NG	2.5			Y			FRAG; LUG WELL
S2-146	1605.92	113.67	0.14	0.07	0.1861	-17	183	0.927		0.12	0.5			Y			FRAG
S2-147	1598.43	118.74	0.16	0.06	0.1039	17	20	0.909		0.16	0.5			Y			FRAG
S2-148	1574.37	121.59	0.29	0.07	0.1559	-2	62	0.942		0.16	0.5			Y			FRAG
S2-149	1580.93	96.67	0.28	0.06	0.1360	14	352	0.980		0.16	0.75			Y			FRAG
S2-150	1582.84	95.51	0.26	0.13	1.0776	9	57	0.974	large targ, shallow, clutter 1 m N	0.16	1.75			Y			FRAG
S2-151	1584.56	84.01	0.55	0.11	0.7368	64	160	0.930	2 targs, adjacent E-W	0.37	10				Y		ROCKS
S2-152	1581.98	73.03	1.42	0.17	2.5599	-5	331	0.778	confused by geology	1.54	10				Y		ROCKS
S2-153	1601.86	67.16	0.22	0.06	0.1197	16	258	0.908	inverted	0.062	0.25			Y			FRAG
S2-154	1596.37	45.17	0.78	0.13	1.2653	39	64	0.957	dig this	0.92	25	Y	Y			12 &13	BOMB, 25LB PRACTICE, BDU-33
S2-155	1587.83	43.81	0.90	0.17	2.3613	54	70	0.929	good targ.	NG	25	Y	Y			10 & 11	BOMB, 25LB PRACTICE, BDU-33
S2-156	1573.36	41.06	0.15	0.07	0.1901	18	352	0.918		0.031	15			Y			BASE PLATE
S2-157	1566.02	42.99	0.12	0.05	0.0760	11	20	0.916		0.12	0.25			Y			FRAG
S2-158	1601.90	41.43	0.11	0.05	0.0567	21	336	0.880		SURFACE	0.25			Y			FRAG
S2-159	1564.37	35.67	0.16	0.05	0.0817	-3	74	0.961		0.16	0.5			Y			FRAG

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-160	1536.92	37.71	1.27	0.20	4.0938	-14	2	0.909	maybe 2nd targ to S	NG	NG						FLAG MISSING
S2-161	1545.47	75.64	0.23	0.09	0.3223	1	324	0.977		0.16	0.5			Y			FRAG
S2-162	1529.06	100.89	0.25	0.12	0.8691	6	17	0.977		0.16	0.75			Y			FRAG
S2-163	1527.01	102.26	0.21	0.07	0.1838	0	59	0.842		0.16	0.5			Y			FRAG
S2-164	1481.51	118.01	0.29	0.07	0.1969	20	341	0.899		0.31	2			Y			FRAG
S2-165	1477.49	118.33	0.20	0.06	0.1213	-2	12	0.905		0.23	1			Y			FRAG
S2-166	1515.78	88.60	0.20	0.09	0.3591	8	326	0.941		0.092	1.5			Y			FRAG- BASE PLATE RING
S2-167	1461.89	20.79	0.55	0.11	0.6966	44	329	0.872	partial signature	0.46	3			Y			FRAG; CRATER HOLE
S2-168	1450.02	26.93	0.25	0.08	0.2331	73	50	0.927		0.18	1			Y			FRAG
S2-169	1473.14	39.61	0.38	0.07	0.1944	19	67	0.883		0.16	0.5			Y			FRAG
S2-170	1475.55	67.33	3.37	0.53	76.4891	38	327	0.953	likely not ordnance (?)	4	500	Y	Y			6 & 7 & 8	BOMB 500LB GENERAL PURPOSE, MK 82. NO TAIL FUZE. 14" SUSPENSION. NO VISIBLE STAMPING ON STRONGBACK. 30-40 DEGREE NOSE DOWN ATTITUDE ALMOST DUE NORTH
S2-171	1460.53	63.73	1.69	0.24	7.1149	10	19	0.919	in a line of clutter targets	1.85	100				Y		ROCKS, LOTS OF THEM. VARIOUS SHAPES AND SIZES, ALSO VARYING SIGNAL STRENGTH ON SCHOENSTEDT
S2-172	1446.01	65.07	0.23	0.11	0.7093	4	357	0.955	in a line of clutter targets	0.16	1			Y			FRAG
S2-173	1449.84	78.47	0.91	0.23	6.2282	7	120	0.924	inverted in clutter	.31-.46	NG				Y		ROCKS
S2-174	1447.20	116.53	0.28	0.09	0.3621	38	92	0.977	inverted	0.16	2			Y			FRAG
S2-175	1450.51	108.81	0.24	0.07	0.1454	4	298	0.904	inverted	0.16	0.5			Y			FRAG
S2-176	1456.07	120.23	1.42	0.25	8.1763	2	53	0.930	fuzzy image (Mk 81?)	1.54	100				Y		ROCKS
S2-177	1435.57	79.50	0.62	0.13	1.2664	63	328	0.961		.128-.61	75				Y		BIG ROCK
S2-178	1434.17	103.82	0.22	0.07	0.1628	5	336	0.977		0.092	0.5			Y			FRAG
S2-179	1436.46	75.71	0.38	0.11	0.7326	61	41	0.966		0.031	50				Y		SERIES OF ROCKS
S2-180	1421.90	51.80	0.77	0.13	1.2009	25	314	0.964		0.92	25				Y		ROCKS
S2-181	1408.14	65.95	0.29	0.11	0.6318	-22	103	0.912	in a line of clutter (Fence?)	0.16	75				Y		ROCKS; 1/2 TO 1 FOOT DEPTH
S2-182	1413.52	27.46	0.19	0.07	0.1561	15	360	0.985		0.12	0.5			Y			FRAG
S2-183	1428.88	28.62	0.07	0.05	0.0699	16	341	0.951	surface trash?	0.062	0.25			Y			FRAG
S2-184	1379.13	58.69	0.22	0.09	0.3280	0	260	0.978		0.23	1			Y			FRAG
S2-185	1368.08	60.83	1.14	0.17	2.4361	89	90	0.962		1.76	100				Y		LARGE ROCKS

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-186	1377.39	71.32	0.62	0.13	1.1111	76	292	0.745	clutter line (fence?)	0.31	0.5			Y			FRAG
S2-187	1335.46	127.22							half a signal, dig	0.31	50			Y			FRAG; CRATER HOLE; A LOT OF FRAG PIECES
S2-188	1353.29	124.47	0.20	0.09	0.4147	15	249	0.977	inverted	0.05	0.75			Y			FRAG
S2-189	1347.10	120.00	0.23	0.09	0.3627	3	285	0.976	inverted	0.077	1			Y			FRAG
S2-190	1333.16	117.08	0.14	0.07	0.1991	10	43	0.823		0.16	1			Y			FRAG
S2-191	1338.38	52.41	1.25	0.21	4.6565	66	81	0.814	Mk 81?	NG	NG						FLAG MISSING
S2-192	1325.59	51.44	1.05	0.18	2.9783	62	186	0.953	clutter on top	NG	NG						FLAG MISSING
S2-193	1320.94	42.99	0.14	0.06	0.1262	69	359	0.969		NG	NG						FLAG MISSING
S2-194	1286.92	49.36	0.17	0.08	0.2622	10	18	0.933		NG	NG						FLAG MISSING
S2-195	1318.61	57.86	0.74	0.10	0.4697	69	253	0.973		NG	NG						FLAG MISSING
S2-196	1302.89	62.96	0.31	0.11	0.7053	5	246	0.960	inverted, see targ 34	NG	NG						FLAG MISSING
S2-197	1308.87	96.19	0.29	0.07	0.1827	43	167	0.970		NG	NG						FLAG MISSING
S2-198	1311.67	64.92	0.18	0.07	0.1499	-1	16	0.958		NG	NG						FLAG MISSING
S2-199	1321.76	122.32	0.36	0.08	0.2456	6	23	0.896		0.16	0.75			Y			FRAG
S2-200	1261.32	111.05	0.78	0.14	1.3494	14	311	0.849	possibly multiple targets	NG	NG						FLAG MISSING
S2-201	1246.62	104.25	0.19	0.09	0.3357	-3	28	0.983		NG	0.5			Y			FRAG; 1.5" X 3"
S2-202	1246.51	101.03	0.21	0.07	0.1636	4	33	0.982		0.16	0.5			Y			FRAG 3" X 1" X .75"
S2-203	1271.02	92.21	0.23	0.08	0.2632	-7	59	0.956		0.16	0.25			Y			FRAG
S2-204	1259.87	87.15	0.16	0.08	0.2544	21	72	0.983		0.031	0.25						FRAG 1" X 6" X .75"
S2-205	1248.89	85.62	0.27	0.08	0.2274	54	342	0.976		0.015	25	Y	Y			3	BDU 33 NOSE UP ALMOST LEVEL WITH THE GROUND
S2-206	1252.54	39.29	0.21	0.08	0.2485	0	310	0.978		NG	NG						FLAG MISSING
S2-207	1228.00	88.38	0.23	0.09	0.3606	1	3	0.975		0.16	1.75			Y			FRAG
S2-208	1223.34	88.45	0.31	0.07	0.1885	56	84	0.954		0.16	1.25			Y			FRAG & 20MM
S2-209	1189.29	111.80	0.22	0.07	0.2166	31	57	0.969		0.16	7		Y			4 &5	2.75" ROCKET WARHEAD; 6" DEEP LEVEL DEPTH
S2-210	1184.56	114.78	0.21	0.08	0.2483	-6	359	0.882		NG	1			Y			FRAG 1" X 5" X .75"
S2-211	1170.33	111.43	0.44	0.07	0.2000	49	350	0.912		1	2			Y			SECTION OF BOMB FRAG
S2-212	1171.68	111.24	0.78	0.11	0.6501	36	350	0.884		0.77	5			Y			4" X 8"SECTION OF BOMB FRAGMENT
S2-213	1183.85	63.79	0.19	0.09	0.3265	31	88	0.929	inverted - likely not ordnance	0.16	1			Y			FRAG 1" X 2" X .75"
S2-214	1160.52	32.65	0.46	0.08	0.2721	52	31	0.939		0.23	0.5			Y			FRAG 1" X 1" x 1"

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-215	1118.09	28.89	0.33	0.08	0.2818	30	0	0.982		NG	NG				Y		ROCKS
S2-216	1129.57	39.14	0.44	0.18	3.0232	22	256	0.960	on edge of missed area - questionable ordnance	NG	NG				Y		ROCKS
S2-217	1125.71	57.81	0.55	0.09	0.3728	33	77	0.957		NG	0.5			Y	Y		SURFACE SMALL FRAG - BIG ROCK 1.75' DEEP
S2-218	1135.95	83.84	0.50	0.10	0.5460	42	351	0.942		NG	NG				Y		BIG ROCK 1' X .75'
S2-219	1146.61	115.15	0.63	0.13	1.0251	51	316	0.984		1.08	45			Y			TAIL FIN- SNAKE-EYE PARTS; 7 JULY 1999 - DUG FURTHER FOUND MORE SNAKE EYE PARTS FRAG FROM OLD STYLE GP BOMB. FINAL DEPTH ± 3.5'
S2-220	1142.38	112.00	0.65	0.15	1.6747	21	57	0.965	adjacent target E	0.77	20			Y			SEVERAL PIECES OF FRAG (BELOW HOLE)
S2-221	1143.17	111.57	0.74	0.14	1.5513	8	339	0.965	adjacent target W	0.77	20			Y			SEVERAL PIECES OF FRAG
S2-222	1144.67	115.69	0.62	0.09	0.3517	36	328	0.871		NG	8			Y			SCRAP FIN PARTS
S2-223	1155.72	106.19	0.19	0.10	0.5181	2	343	0.927		NG	1			Y			FRAG 1" X 6" X .75"
S2-224	1106.07	122.35	0.43	0.09	0.4105	19	10	0.525	possible target - interlaced scans disagree	NG	0.75			Y			FRAG .75LB
S2-225	1101.21	103.37	0.43	0.09	0.3837	46	66	0.977		0.31	15				Y		1' X 6" BOULDER
S2-226	1085.72	98.40	0.44	0.11	0.6258	68	339	0.910		NG	NG				Y		BIG ROCK - HIGH IRON CONTENT
S2-227	1085.41	84.06	0.52	0.14	1.2849	51	71	0.963		NG	NG				Y		(GEOLOGY) SEVERAL LARGE ROCKS
S2-228	1095.04	78.28	0.66	0.12	0.8241	59	179	0.944		NG	20				Y		GEOLOGY - HUGE ROCK
S2-229	1077.52	94.62	0.52	0.10	0.4783	67	233	0.939		0.52	NG				Y		ROCKS- GROUP
S2-230	1092.91	56.97	0.55	0.11	0.6650	29	46	0.882		NG	20				Y		ROCKS
S2-231	1074.32	34.42	0.33	0.11	0.7317	11	350	0.881		NG	0.5				Y		BARBED WIRE 2.5" ON SURFACE
S2-232	1055.58	37.93	0.46	0.14	1.4233	13	37	0.951		0.31	0.25			Y			FRAG 1 ROCKS
S2-233	1074.57	54.55	0.52	0.09	0.3567	69	190	0.817		0.92	75				Y		HUGE ROCK
S2-234	1080.64	51.03	0.42	0.14	1.5184	20	41	0.845		NG	0.5				Y		BARBED WIRE 3'; 2" BELOW SURFACE
S2-235	1045.29	63.69	0.37	0.11	0.6572	54	316	0.933		0.031	8			Y			FRAG
S2-236	1048.46	54.29	0.27	0.08	0.2431	52	294	0.980		0.16	2				Y		ROCKS
S2-237	1042.23	63.54	0.40	0.09	0.3254	58	149	0.947		0.1	15				Y		ROCK
S2-238	1053.68	71.82	0.75	0.12	0.9363	58	278	0.981		0.77	50				Y		SEVERAL LARGE ROCKS
S2-239	1038.09	67.74	0.15	0.12	0.9301	8	313	0.989	adjacent target S	NG	5				Y		ROCKS ON SURFACE
S2-240	1037.58	66.47	0.30	0.13	1.0757	-4	291	0.953	adjacent target N	NG	5				Y		ROCKS ON SURFACE
S2-241	1073.43	87.88	0.33	0.10	0.5230	43	247	0.989	inverted signal	0.22	NG				Y		ROCK
S2-242	1074.47	83.41	0.42	0.10	0.5459	19	350	0.987		0.22	NG				Y		ROCK

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-243	1059.09	86.67	0.34	0.11	0.7729	-1	324	0.944		SURFACE	1				Y		BARB WIRE
S2-244	1064.98	90.44	0.38	0.10	0.5612	22	311	0.932		0.16	15				Y		ROCK
S2-245	1057.75	107.41	0.25	0.11	0.7146	50	32	0.860		SURFACE	1				Y		BARB WIRE
S2-246	1069.43	110.34	0.32	0.10	0.5073	48	299	0.980		0.31	3			Y			FRAG 8" X 3"
S2-247	1062.79	123.86	0.29	0.08	0.2771	60	57	0.991		0.1	3			Y			FRAG 8" X 2" DIA
S2-248	1042.55	125.04	0.42	0.08	0.2312	88	174	0.920		0.16	8			Y			FRAG
S2-249	1039.25	123.98							edge of missed area	NG	NG				Y		ROCKS
S2-250	1008.70	120.01	0.32	0.09	0.3811	62	12	0.950		4"	15			Y			FRAG
S2-251	1001.37	73.47	0.32	0.11	0.7529	67	203	0.942		0.05	10				Y		ROCK
S2-252	1012.42	49.52	0.22	0.13	1.0710	7	319	0.940		0.05	3			Y			FRAG
S2-253	997.16	44.01	0.31	0.10	0.4822	42	285	0.964		0.077	20				Y		ROCK
S2-254	983.08	50.26	0.22	0.10	0.4938	4	298	0.982		0.031	1.5			Y			FRAG
S2-255	989.06	63.61	0.32	0.14	1.3840	11	64	0.908		0.077	20			Y			FRAG 2" X 8"
S2-256	996.45	96.98	0.35	0.16	1.9540	-4	62	0.983		0.16	25			Y			FRAG
S2-257	985.72	97.78	0.27	0.11	0.6060	-10	9	0.986		0.16	15			Y			BOMB FRAG
S2-258	968.41	102.96	0.17	0.10	0.4607	2	332	0.980		0.077	1			Y			FRAG
S2-259	972.05	124.57	0.35	0.08	0.2623	4	18	0.948		NG	2			Y			FRAG .5 " DEEP
S2-260	996.21	129.82	1.45	0.27	9.9086	78	250	0.914	probable adjacent target SE	NG	NG						NEGATIVE FIND
S2-261	928.13	118.03	0.19	0.07	0.1837	11	323	0.993		0.031	1			Y			FRAG
S2-262	932.64	126.00	0.44	0.08	0.2959	55	258	0.982		0.18	20				Y		ROCK
S2-263	939.42	126.41	0.25	0.07	0.1729	20	9	0.982		0	1				Y		SCRAP
S2-264	936.57	110.63	0.31	0.07	0.1850	48	175	0.993		0.077	10			Y			FRAG
S2-265	951.22	48.44	0.33	0.19	3.5087	-33	355	0.978		NG	NG						FLAG MISSING
S2-266	931.33	34.36	0.56	0.10	0.5415	30	319	0.908		0.31	2				Y		SCRAP
S2-267	912.93	87.94	0.79	0.13	1.0239	45	13	0.970		0.61	2			Y			SMALL PIECES OF FRAG
S2-268	906.60	99.82	0.28	0.08	0.3094	13	267	0.981		0.077	3			Y			SCRAP
S2-269	900.46	116.91	0.55	0.16	2.1774	81	333	0.887	straddles missed area	0.61	10			Y			BOMB FRAG
S2-270	892.55	112.69	0.39	0.07	0.1915	50	165	0.950		0.16	5			Y			BASE PLATE PART
S2-271	875.34	124.91	0.20	0.08	0.3133	33	113	0.963		0.077	20			Y			MK 82 BASE PLATE

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-272	872.78	117.06	0.25	0.07	0.2165	85	228	0.975		0.05	5			Y			BOMB BASE PLATE
S2-273	839.30	90.35	0.17	0.08	0.3097	28	4	0.944		0.05	10			Y			BOMB BASE PLATE
S2-274	859.08	90.98	0.19	0.08	0.2887	33	37	0.948		0.031	20			Y			BASE PLATE
S2-275	851.29	61.18	0.25	0.07	0.1872	44	23	0.892		0.077	15			Y			BASE PLATE FOR BOMB
S2-276	843.29	57.72	0.21	0.08	0.3060	5	62	0.942		0.077	0.5		Y				20MM TP
S2-277	839.00	57.48	0.26	0.08	0.3124	4	84	0.892		0.92	2				Y		SCRAP
S2-278	830.13	42.43	0.17	0.09	0.3881	26	103	0.917		0	1				Y		SCRAP
S2-279	805.77	75.71	0.20	0.10	0.5335	12	67	0.891		0.05	10				Y		SCRAP
S2-280	833.45	78.60	0.21	0.12	0.9611	0	296	0.887	possibly multiple targets	NG	NG						NEGATIVE FIND
S2-281	835.96	81.66	0.47	0.10	0.5704	33	341	0.934		0.31	1			Y			SCRAP
S2-282	809.15	99.40	0.25	0.08	0.2858	17	122	0.991		0	NG				Y		SCRAP
S2-283	802.34	103.52	0.23	0.13	1.2137	17	106	0.844	possible ordnance - straddles missed area	0.077	10			Y			SCRAP
S2-284	802.38	106.87	0.46	0.13	1.0530	25	63	0.909		0.31	20			Y			FRAG
S2-285	812.88	107.54	0.12	0.09	0.4060	23	357	0.869		NG	15			Y			BOMB BASE PLATE
S2-286	824.18	110.60	0.07	0.09	0.3805	60	167	0.848		0.031	3			Y			FRAG
S2-287	811.38	123.39	0.29	0.09	0.3197	39	339	0.782		0.61	1			Y			FRAG
S2-288	795.39	111.14	0.58	0.17	2.6111	21	32	0.951		0.61	5			Y			BOMB FRAG 12" X 2" DIA
S2-289	780.37	88.26	0.33	0.11	0.7433	11	85	0.940		0.077	15			Y			BOMB FRAG
S2-290	740.70	121.09	0.30	0.20	3.9391	34	247	0.685	multiple targets	0.052	15			Y			BOMB FRAG
S2-291	749.31	110.11	0.60	0.17	2.5455	11	2	0.950		NG	NG						NEGATIVE FIND
S2-292	720.10	54.23	0.21	0.08	0.2376	16	345	0.940		0.031	0.25			Y			FRAG
S2-293	717.05	84.28	0.11	0.13	1.2224	4	122	0.984	inverted signal	0.031	10			Y			FRAG
S2-294	716.25	119.17	0.22	0.09	0.4265	30	354	0.963		0.077	25			Y			BASE PLATE FROM OLD STYLE BOMB
S2-295	708.18	126.78							on edge of missed area	NG	NG						NEGATIVE FIND
S2-296	675.73	48.24	0.26	0.12	0.9104	2	330	0.972		0.077	5			Y			OE SCRAP; PROJO. FRAG
S2-297	621.27	129.42	0.02	0.03	0.0210	78	168	0.804	possible, on edge of missed area	NG	NG						NEGATIVE FIND
S2-298	569.39	124.72	0.15	0.09	0.4429	36	103	0.957		0.13	1			Y			FRAG
S2-299	582.93	88.66	0.30	0.08	0.2756	2	323	0.968		NG	0.5			Y			FRAG
S2-300	547.76	75.96	0.64	0.15	1.6392	8	58	0.932		0.051	3			Y			OE RELATED SCRAP

Target ID	Local X (m)	Local Y (m)	Depth (m)	Size (m)	Moment	Inclin. (deg)	Azim. (deg)	Fit Quality	Comments	Depth (m)	Weight (lbs)	Live	Ordnance	Ordnance Related	Non-Ordance	Photo ID	Field Comments
S2-301	435.73	127.26	0.22	0.07	0.2032	70	24	0.904		NG	NG						FLAG MISSING
S2-302	399.41	70.37	0.22	0.08	0.3000	3	278	0.986		0.16	0.5			Y			FRAG
S2-303	370.24	112.60	0.21	0.08	0.2937	10	56	0.982		0.051	0.5				Y		BUCKET HANDLE
S2-304	327.70	134.46	0.22	0.10	0.5378	-10	36	0.986		0.051	1			Y			FRAG
S2-305	315.84	100.79	2.67	0.40	33.8685	35	7	0.966	Mk 83?	2.77	500	Y	Y				MK 82; 500 LB LIVE
S2-306	317.52	40.13	0.27	0.12	0.8063	-17	109	0.816	possible - on edge of survey	NG	15			Y			20MM PROJECTILE 18" SSE OF HOLE, ON SURFACE. HOLE WAS NEGATIVE FIND
S2-307	296.94	45.78	0.38	0.14	1.4953	-33	38	0.877		NG	NG						NEGATIVE FIND
S2-308	309.21	134.15	0.23	0.09	0.4384	15	187	0.970	inverted signal	0.051	1			Y			FRAG
S2-309	272.54	95.20	0.34	0.09	0.3407	44	324	0.982		0.18	5			Y			FRAG, 12" LONG, FOUND AT 2 " DOWN TO 12"
S2-310	234.71	103.92	0.46	0.07	0.2132	43	352	0.975		12	10			Y			BASE PLATE FROM MK 82
S2-311	134.42	51.99	0.17	0.12	0.8992	11	9	0.891		NG	NG						NEGATIVE FIND
S2-312	82.34	115.49	0.44	0.12	0.8145	45	100	0.951		0.1	10			Y			OE SCRAP
S2-313	83.12	117.05	0.24	0.15	1.7277	-13	147	0.990	probably multiple targets	0.051	5			Y			SCRAP
S2-314	65.20	55.14	0.19	0.07	0.2018	20	330	0.978		NG	NG						NEGATIVE FIND
S2-315	77.01	132.68	0.12	0.07	0.1833	-14	7	0.977		0.051	0.5	Y	Y				20MM HE

high density of both small and large hard target returns. Each of the transects will be discussed in turn.

6.1.1 Transect 1 This survey parallels the fence line; the western end of the survey is across the fence from the Range Center Tower, see Figure 7. The 9 Dig Images for the survey are presented as jpeg images on CD ROM in the Appendix. About 300 meters, near the center of the survey, are shown as **Figure 16**. Of the 56 targets dug, 45 were false alarms, or resulted from geological formation returns. Eleven metallic targets were recovered on the eastern 500 meters of the transect including 9 OE scrap items and one live BDU 33, target T1-30.

6.1.2 Transect 3 This survey stretches south from the East Tower for a distance of about 1,100 meters. The 6 Dig Images for the survey are presented as jpeg images on the CD ROM in the Appendix. Only 6 targets were identified for remediation in this survey. On digging, five were revealed to be geological formation returns. The most southern target, T3-1 located over 1,000 m south of the fence line, was a 2.75-in rocket warhead buried at two feet. The white phosphorous filled war head was heavily corroded and leaking.

6.1.3 Transect 4 Transect 4 stretches south from a point 1,700 meters east of the East Range Tower. The 11 Dig Images for this survey are presented as jpeg images on the CD ROM in the Appendix. A small portion of the survey, highlighting the magnetic returns from geological strata is shown in Figure 17. A total of 132 targets were dug in this survey. The majority of the targets were created by returns from geological formations, mostly from magnetically hot rocks. Eleven OE scrap items, identified as shrapnel from bomb detonations, were recovered from the northern 500 meters of the survey. Many of the targets dug on the remainder of the survey had very low probability of being UXO. They were flagged and dug in an attempt to recover all ordnance-related material and to determine how far it extended south of the fence line.

6.1.4 Transect 2 This 52 acre survey, which stretches for 2,100 meters parallel to the fence line, is centered about 3,500 meters east of the Range Center Control Tower. The 11 magnetic anomaly Dig Images for this survey are presented as jpeg images on the CD ROM in the Appendix. Dig Images 2H and 2I are shown in Figure 18. The 315 targets dug in this area included 20 intact ordnance items, 201 items of OE scrap, 17 metallic scrap (not OE) items, and 77 geological formation returns or false alarms. Recoveries from all Transects are summarized in Table 12.

Table 12. Summary of Remediation Target Recoveries on Transects 1-4

	Ordnance Recovered						Ordnance Scrap	Non-Ordnance Scrap	Geology Returns/ False Alarms
	2.75-in WH	3-in WH	BDU-33	Mk 82	Mk 83	20-mm Proj.			
Transect 1			1				9	2	44
Transect 2	1								5
Transect 3	2	3	4	7	1	2	201	17	77
Transect 4							11		121
Total Survey	3	3	5	7	1	2	221	19	247

6.2 The EM Survey

It was our conviction when we completed surveying on site that use of the EM array would be the preferred approach for future surveys, if they are undertaken. Indeed, this was our preliminary recommendation to NAS Fallon in a brief letter report soon after our return to NRL.[21] Careful analysis has led us to rethink this recommendation. A complete set of EM anomaly images, equivalent to the magnetometer Dig Images in Transect 2, are presented in the Appendix on CD ROM as pdf files.

6.2.1 Comparison of Mag and EM Features. At a much finer scale, on the next page we present a series of magnetometer and EM anomaly images from Transect 2. Figure 21 shows magnetometer (on the right) and EM anomaly images of a 50 X 50 meter area near the center of Transect 2. In this area an outcropping of rocks presents a significant geological interference in the magnetometer survey. Targets 2-184 and 2-186 are small pieces of shrapnel buried at 1 and 2 feet, respectively. Their signal in the EM survey is well below the size threshold to be chosen for analysis. In a joint analysis, these targets would not be chosen for digging. The signal for target 2-185 was produced by a cluster of deeply buried magnetic rocks; they produce no detectible signal in the EM survey. Conversely, EM target 90 (shown in the left panel) has no counterpart in the magnetometer survey. A likely explanation is that the EM signal is produced by aluminum components, perhaps from an aluminum tail fin assembly typical of those used on some BDU-33 practice bombs.

In Figure 22, magnetometer targets 2-171 and 2-173 are produced by magnetic rocks that do not

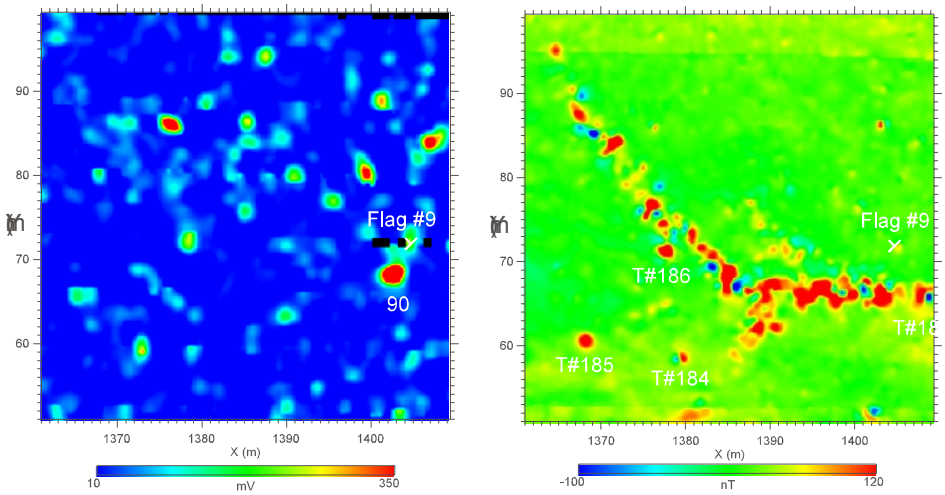


Figure 21. EM and magnetic anomaly images of a portion of Transect 2 showing an area with significant geological interference.

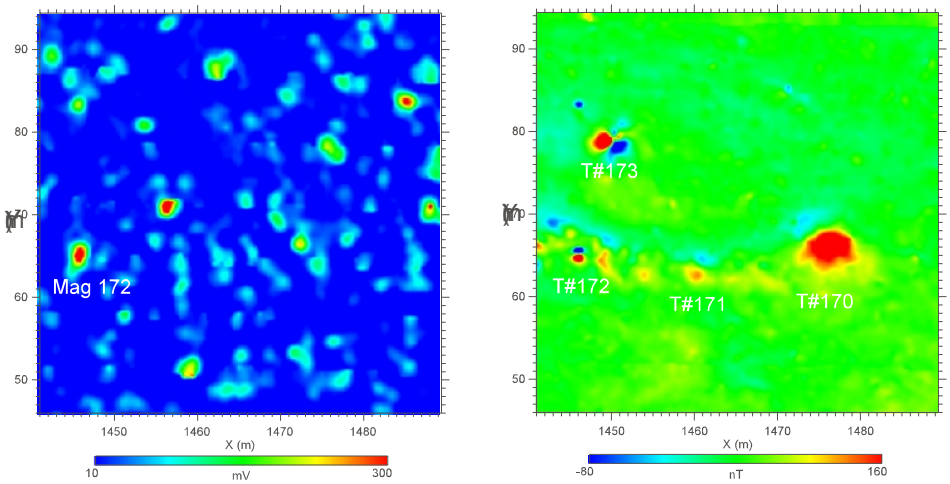


Figure 22. EM and magnetic anomaly images of a portion of Transect 2 showing an area with both geological interferences and deeply buried UXO.

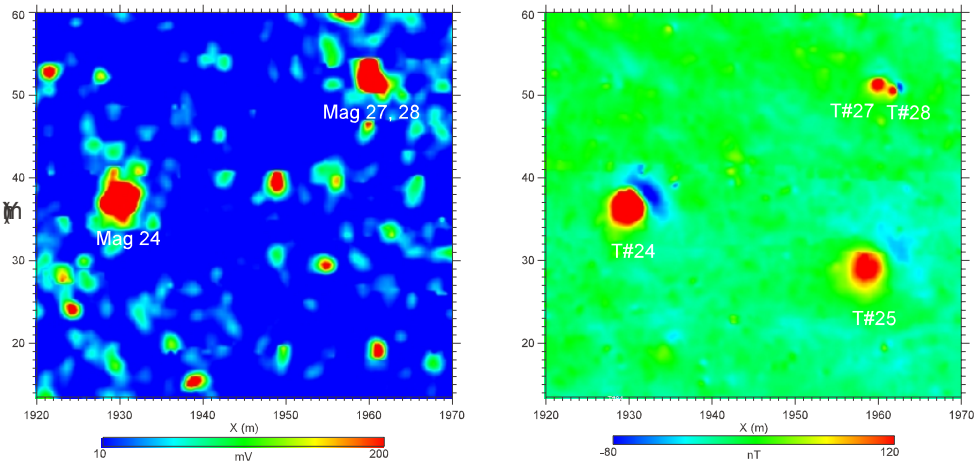


Figure 23. EM and magnetic anomaly images of a portion of Transect 2 showing an area with both shallow and deeply buried UXO targets.

produce a signal in the EM survey. Target 2-172, common to both surveys, is produced by a 1- lb piece of shrapnel buried at 1 foot. Magnetometer target 2-170 is a Mk 82, 500-lb bomb buried at about 4 meters to the center of the target. This target produces no detectible signal in the EM survey and consequently would have been missed in an EM survey.

In Figure 23, Target 2-27 is a 30-lb conical bomb fin assembly buried at 1 meter. Target 2-28 is a small piece of shrapnel lying 2 meters away. In the EM presentation these two easily detectable objects are not separable. Targets 2-24 and 2-25 are both Mk 82, 500-lb bombs. Target 2-24, which is buried at 2 meters, is easily visible in both surveys. Target 2-25, buried at 4 meters, is not detectible in the EM survey.

6.2.2 Survey Comparison Much of the area covered by the North/South and East/West EM surveys is included in the Magnetometer survey of Transect 2. We carried out an independent EM analysis to select targets appropriate for remediation and then carried out a joint target-by-target inspection of the individual targets selected from each analysis. In the common survey area there were 157 targets specified for digging from the mag survey. After digging these targets, 12 ordnance items were recovered including: 1 Mk-83 bomb, 5 Mk-82 bombs, 3 BDU-33 Warheads, and 3 3-inch Warheads.

The EM analysis was carried out after leaving the site, following remediation of targets selected from the mag analysis. In the EM analysis, 62 targets were specified for digging. These included 39 targets that were common to the mag dig list and an additional 23 targets that were not selected in the magnetometry analysis. Most of these 23 targets had substantial EM signatures and small or undetectable mag signatures. They are likely mostly Al components common to BDU assemblies, 2.75-in rocket bodies, or other weapon or aircraft components. We did not find any Al-based ordnance at this site.

The common signature analysis demonstrated that many of the magnetometer dig targets that turned out to be geology ("hot rocks") or clusters of small shrapnel pieces, were either not selected in the EM analysis (92 targets) or were selected and analyzed as too small to dig (an additional 26 targets). On this basis one could make a strong recommendation that an EM survey would provide a much better discrimination against frag and geological interferences than the magnetometer system. However, there was no detectible EM signature from 4 of the 5 Mk-82 bombs in this survey. These items, buried at 3.5-4.0 meters, are below the detection limit of the EM equipment.

The *MTADS* EM array was modified from the original design of the Geonics EM-61 sensor to maximize the detection sensitivity of the array. Because it is an active array, projecting a signal into the ground and relying on detecting a return signal from the buried object, its sensitivity falls off much more strongly with depth than does the passive magnetometer array. Even so, the EM array has a higher signal-to-noise detectible return for objects such as 60 or 81-mm mortars buried to 1 meter or for very small objects, such as 20-mm projectiles buried to 15 cm. The relative sensitivity of the two arrays depends upon the level of geological interference in the magnetometry data. In general, the EM array has a greater detection capability for all ferrous objects to a depth of about 2.5 meters. Many of the Mk 82s, in the soft sand on this part of the Reservation, were buried deeper than we have previously observed.

6.3 Survey Recommendations

In our letter report[21] of 19 August 1999, we recommended that two blocks of land totaling about 1350 acres be surveyed using the *MTADS* EM array and that an additional 260 acres of more rugged terrain be surveyed using the man-portable *MTADS* EM adjunct, or alternatively a "Mag and Flag" survey. These recommendations were predicated on the assumption that (1) all UXO shallower than 18 inches could be detected and cleared using this approach and that (2) this approach would ultimately be less expensive than using the *MTADS* magnetometer array because the EM array is not sensitive to interferences from magnetic rocks.

Detailed consideration of both the magnetometer and EM survey results provides additional insight that was not available at the time that our preliminary recommendations were made to use the *MTADS* array for additional surveys. The density of small, very shallow, targets detectable by either the magnetometer or EM arrays is quite high. Because of the reliability of the depth and size predictions from the magnetometry data analysis, it is possible to confidently discriminate against digging most of these objects. The EM data analysis algorithms much less accurately predict the size of objects at depths less than about 75 cm. Therefore, decisions based solely on EM data would require digging many of these small objects. Finally, it should be noted that a remediation based on only an EM survey would likely leave undetected deeply buried large bombs on the Reservation. A magnetometry survey would record and document their presence and locations, even if it were decided that it was unnecessary to remove them.

If both magnetometer and EM surveys were conducted on the recommended areas, the EM surveys could be used to discriminate against magnetic rocks and small shallow shrapnel targets. However, doing joint magnetometer and EM surveys, with the necessary additional analysis requirements, would likely increase the survey costs on this site by a factor of about 2.5-3 over conducting only magnetometry surveys. It is problematical whether these additional costs would be made up in avoided remediation costs of digging up magnetic rocks. It is our tentative recommendation at this time that a single magnetometer survey using only the *MTADS* magnetometer array would be most cost effective if significant areas of the Reservation are to be evaluated. One could practically use the information gained in digging the 500 targets in the original survey to effectively exclude many "hot rock" targets in future analyses of magnetometer data.

7.0 Technology Implementation

NRL, working under a Cooperative Research and Development Agreement (CRADA) with Blackhawk Geometrics of Golden, CO, has fully transitioned the *MTADS* technology developed under ESTCP support. Both the magnetometer and EM vehicular towed arrays have been replicated using the engineering drawings, plans, and specifications provided to them under a license agreement. The *MTADS* data analysis technology was also transitioned under this plan. Blackhawk and NRL have jointly continued to develop newer versions of the analysis software, and both NRL and Blackhawk have implemented the DAS on PC platforms. These PC systems are more rugged, less expensive, and have lower service and maintenance costs than the Unix-based workstations used in the original development. The PC-based systems continue to use licenced IDL graphics support, but now run under a LINUX operating system. Blackhawk has streamlined some of the field approaches to improve the economies of field operation. Through the CRADA, Blackhawk and NRL (and associated contractors) have continued development of man-portable adjuncts for the vehicular *MTADS* survey equipment. With additional ESTCP support, improved EM sensor systems, improved GPS hardware, and additional acoustic navigation equipment are being integrated into the man-portable instruments. We are currently redesigning the magnetometer and EM carts to improve their ergonomics and have recabled and repowered the systems to improve fieldability and production rates. All these advances will be transitioned to Blackhawk and available for

commercial services within a few months.

8.0 Cost Assessment

Blackhawk Geometrics has almost a year of experience with the commercial vehicular *MTADS* at this point. Production rates, reliability, and maintenance issues have been established through field experience. Per acre survey production costs have dropped and stabilized for the vehicular systems and soon will be firmly established for the man-portable systems. Commercial *MTADS* vehicular surveys have production costs of $350-450 per acre with the magnetometer array, depending upon the terrain and the size of the job. Vehicular EM survey production costs are about $100-150 per acre higher. The more labor intensive man-portable *MTADS* commercial surveys are currently being bid at about $800 per acre. These costs do not include mobilization and demobilization costs, costs for presurvey surface clearances, or any target flagging or remediation. Mobilization costs depend upon the accessibility of the site and travel distances. Sweep line surface UXO clearance operations typically cost $150-200 per acre. This depends to some extent upon the availability of local Hazwopr labor, the amount of material that must be removed from the surface, and the complexity of certifying and disposing of recovered ordnance scrap. A 10-man Hazwopr-certified sweepline with one UXO supervisor can surface clear about 2 acres per hour. The *MTADS*

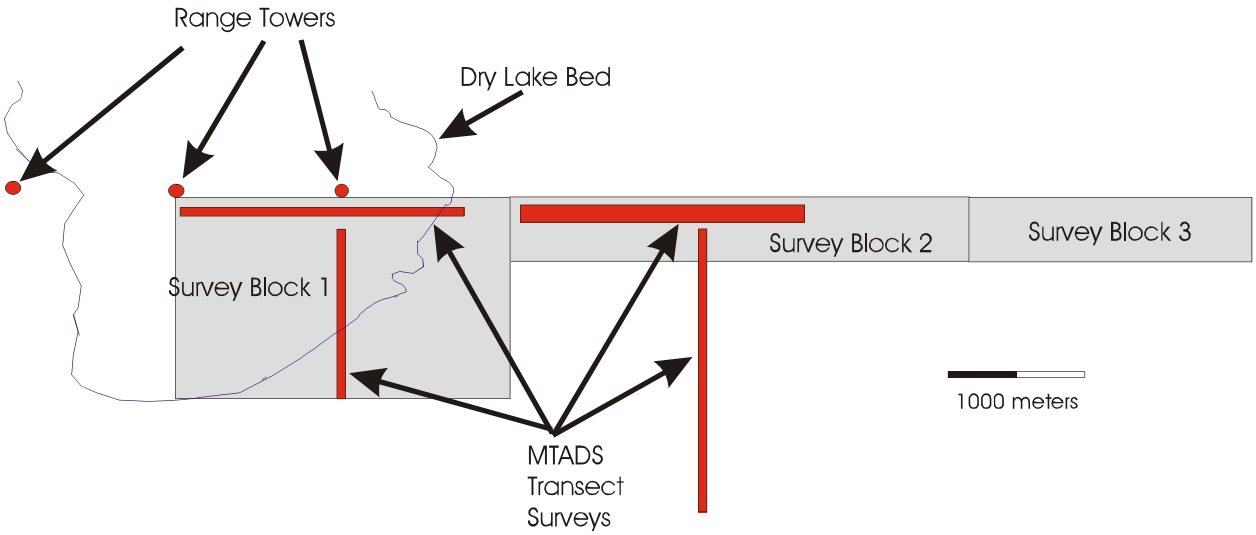


Figure 24. Survey areas proposed for clean up of Reservation Lands south of Range Bravo-19. Survey Blocks 1 and 2 will be conducted by the vehicular *MTADS*. Much of Block 3 will be surveyed using the man-portable adjunct.

commercial survey produces, on the spot data analysis and a report of targets requiring action, based upon pre-established criteria. The dig crews that we used on this site cleared the 500 targets for about $130 per target. This included mobilization costs, local transportation, and equipment costs, but did not include costs to way point the targets or disposal of ordnance and ordnance scrap.

8.1 Cost Performance

In this section we develop an assessment of expected operational costs to implement the *MTADS* commercial technology to effectively clean this site. We propose that the blocks of land described in our earlier report[21] will be cleaned. These areas are shown schematically in Figure 24. The positions of the Bravo-19 Range Towers and Survey Transects 1-4 from the prior surveys are shown overlaid to provide perspective. We assume that local hazwopr-certified labor is hired to support surface clearances. Supervision is by a UXO technician or UXO supervisor. We assume that the commercial vehicular *MTADS* magnetometer array is used for survey in all accessible areas and that the *MTADS* man-portable array is used in more difficult terrain. Data is analyzed on site, targets are chosen, way pointed, and flagged in a single integrated operation. UXO certified crews immediately dig all flagged targets. OE scrap is recovered and stockpiled on the Bravo-19 Range for subsequent disposal by NAS Fallon. As required, live ordnance that cannot be moved, will be blown in place. All holes will be filled and returned to grade. Cost information is presented in Table 13.

The costs in Table 13 are exclusive of the costs of target digging. These costs cannot realistically be budgeted because of uncertainty about the amount of excavation work that must be done. While on site our costs for digging targets averaged about $130 per target. A small fraction of these costs were associated with the documentation that we asked the remediators to perform while they were digging. It is unlikely that extensive target digging can be undertaken using commercial UXO contractors for less than $125 per target. Earlier we estimated that remediating the 1600 acres will require digging 2500-6000 targets. Because we have budgeted for a high quality surface clearance and because maximum advantage will be taken of the prior lessons that have been learned from digging 500 targets, it is likely that the target digging on the 1600 acres can be done for slightly under $1M.

Table 13. Tentative Estimate of Costs of Surveying Areas Shown in Fig. 24.

Mobilization and Logistics		Survey and Cleanup		Demobilization	
Activity	Cost $K	**Activity**	Cost $K	**Activity**	Cost $K
Planning & Contracting	20	**Surface Clearance**		**Scrap Certification**	20
Site Preparation		Labor	241	**Scrap Stockpiling**	10
Offices	10	Travel/Equipment	20	**UXO Demolition**	10
Power	8	**Survey**		**Site Cleanup**	20
Communication	5	Field Labor	748	**Demobilizaton**	10
Security	10	Analysis & Products	30		
		Target Way Pointing			
		Equipment Rental	5		
		Labor	10		
		Target Digging	?		
		Equipment			
		Local Travel			
		Labor			
Total	**53**	**Total**	**1053**	**Total**	**70**

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Appendix A. Points of Contact

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Mr. Russell Jeffries	Logistics Support	Tel: (703) 360-3900 Fax: (703) 360-3911 Page: (703) 518-1950 Email: rjeffr@erols.com

Geocenters, Inc.

Mr. Larry Koppe	Site Safety Officer	Tel: (301) 870-2329 Page: (301) 825-5540 Email: LarryEod@aol.com

***MTADS* Field Office**	Data Analysis Center	Tel: (301) 704-3549

Walker River Paiute Tribe
P.O. Box 220 • Schurz, Nevada 89427
Phone: (702) 773-2306
FAX: (702) 773-2585

RESOLUTION OF THE GOVERNING BODY
OF THE
WALKER RIVER PAIUTE TRIBE
RESOLUTION NO. WR-63-98

BE IT RESOLVED BY THE TRIBAL COUNCIL OF THE WALKER RIVER PAIUTE TRIBE THAT:

WHEREAS, the governing body of the Walker River Paiute Tribe is organized under the provisions of the Indian Reorganization Act of June 18, 1934 (48 stat 984) as amended, to exercise certain rights of home rule and be responsible for the promotion of the economic and social welfare of its members, and

WHEREAS, the Walker River Reservation consists of approximately 323,406 acres, and

WHEREAS, the U.S. Navy has contaminated over 5,000 acres of Tribal land with live and inert ordnance posing a threat to the safety of community members and damaging several stock water wells resulting in a negative impact on the cattle grazing, and

WHEREAS, the U.S. Navy has utilized Tribal land and air-space without permission or right-of-ways from the Tribe, and

WHEREAS, the Naval Research Laboratory (NRL) has developed equipment, called Multi-sensor Towed Array Detection System (MTADS), which uses magnetomics and electromagnetics to detect underground ordnance and the Navy wishes to test this equipment on our reservation to determine its effectiveness in our soil, and

WHEREAS, the NRL would like the Tribal Council's permission to come on to the reservation on September 28th, 29th, 30th and October 1st to flag off areas which are to be used in the demonstration and then bring their MTADS equipment for testing in November, and

WHEREAS, the U.S. Navy/NRL will comply with all Tribal laws and ordinances while within the exterior boundaries of the Walker River Indian Reservation, and

THEREFORE BE IT RESOLVED THAT the Walker River Paiute Tribal Council will allow access to the Navy and their equipment to enter reservation lands for this demonstration and testing with the Tribe's involvement at every stage which will include the designation and limitations of test sites, and

THEREFORE ALSO BE IT RESOLVED THAT the Walker River Paiute Tribe through funding provided by the US Navy will have an independent EOD expert available who will on behalf of the Tribe insure the integrity of the demonstration by interpreting the data both during the compilation and verification of actual test results.

FINALLY BE IT RESOLVED the Chairman or his designate is allowed to enter into, execute and amend said agreement with the US Navy/NRL for the MTADS demonstration.

CERTIFICATION

It is hereby certified that the foregoing resolution of the Walker River Paiute Tribal Council composed of seven (7) members, of whom 4 constituting a quorum were polled on the 17th day of September, 1998, and that the foregoing resolution was adopted by the affirmative vote of 3 FOR 0 AGAINST and 1 ABSTENTIONS, pursuant to the authority contained in the Constitutions and By Laws of the Walker River Paiute Tribe of Nevada on March 26, 1937.

Jon D. McMasters, Tribal Council Secretary
Walker River Paiute Tribe

Walker River Paiute Tribe
P.O. Box 220 • Schurz, Nevada 89427
Phone: (702) 773-2306
FAX: (702) 773-2585

November 2, 1998

Jim R. McDonald
Naval Research Laboratory
Chemistry Division, Code 6110
Washington, D.C. 20375-5000

Dear Mr. McDonald:

As you know the Walker River Paiute Tribe through Council Resolution WR- 63- 98 has agreed to allow for the Multi-Sensor Towed Array Detection System (MTADS) technology as a demonstration to be allowed on our Reservation. A draft plan has been sent to the Tribe for review and comment The Tribe has reviewed and commented on the draft and these comments have been incorporated into a final draft work-plan. We have yet to have a chance to approve the entire document. However, in the interest of time and cooperation we have begun the initial phases of the project and for the walk-over portion of the process have placed on board ten (10) Tribal people. The walk-over portion of the project began on November 2, 1998. We feel that it would be best for all parties involved that we formally agree to the walk-over portion of the project as it is described in the final work plan, see page 17, paragraph 5.1 and page 29, number I I A through J.

Please see attached for the method of payment for this portion of the project. Individuals for the walk-over are considered Tribal employees and payment will be rendered through the Tribal Finance system.

If you agree to this please so indicate by acquiring the proper signature on this letter.

Sincerely,

Cassidy D. Williams, Chairman
WALKER RIVER PAIUTE TRIBE

Agreed and accepted this 2nd day of November 1998.

By: J R McDonald
Its: Chemistry Division Code 6110

Attachment
cc: Navy file

Appendix C

Record of Categorical Exclusion
For the
Interim Remediation of
Off-Range Ordnance
On the
Walker River Indian Reservation
Churchill, Lyon, and Mineral Counties, Nevada

1. Project Description

A. Proposed Action, and Purpose and Need. The Navy proposes to excavate 500 subsurface magnetic anomalies (ferrous material such as ordnance, barb wire, metal fence post, etc.) on approximately 76 acres of land on the Walker River Indian Reservation. This excavation will serve to calibrate and correlate the Multi-Sensor Towed Array Detection System (MTADS) equipment, and verify its accuracy for this area, which has high magnetic-content soils. Using this processed data, it will be possible to estimate the probabilities of correctly identifying ordnance items and clutter, as well as giving a general indication of the number of false alarms that may be expected. The data obtained from these surveys, and the information gained as a product of the remediation efforts will jointly serve to verify the performance of the MTADS . A map of the general remediation area is shown in attachment (1) and a map of the location of targets to be remediated is shown in attachment (2). This action is anticipated to impact approximately 5 percent (3 to 4 acres) of the lands involved and is needed to assess/quantify the level of Off-Range Ordnance contamination on the Walker River Indian Reservation in order for the Navy to clean up these lands.

B. Categorical Exclusion. A Categorical Exclusion (CE) is applicable for this proposed action as proposed it has no significant impacts on the quality of the human environment, and does not:

1. affect public health or safety;
2. affect wetlands, endangered or threatened species or historical or archeological resources;
3. include highly uncertain effects, or involve unique or unknown risks;
4. establish precedents for future actions;
5. violate federal, State, or local laws.

The proposed action qualifies for CE "n" and "z" in the Navy's Environmental and Natural Resources Program Manual, OPNAVINST 5090. 1 B, Ch. 1; CE "n" Routine movement, handling and distribution of materials, including hazardous materials and wastes that when moved, handled, or distributed are under applicable regulations. CE "z" Engineering effort undertaken to define the elements of a proposal or alternative sufficiently so that the environmental effects may be assessed.

Use of these CE is subject to compliance with Section 106 of the National Historic Preservation Act, as amended, Endangered Species Act, and Section 404 of the Clear Water Act. The site has been surveyed to identify any cultural resources and any resources identified through the literature search and survey will be treated in accordance with Section 106. Additionally, the site has been surveyed to identify any endangered, threatened, rare, or species of special concern (fauna and flora) and wetlands and will be treated in accordance with the Endangered Species Act and Section 404 of the Clean Water Act, respectively.

C. Environmental Issues/Findings. Areas of potential concern include: Public health and safety cultural and biological resources, and wetlands.

1. Public Health and Safety: The proposed action would not affect public health or safety because

the Navy, in cooperation with the Walker River Paiute Tribe, posted the lands with signs warning both the Tribal members and the general public that the lands are contaminated. In addition, the Navy has developed a Safety, Health, and Emergency Response Plan, which identifies specific inherent hazards and presents procedures to be followed by explosive ordnance personnel. All activities performed, during the remediation effort, on explosive ordnance comply with the US Army Corps of Engineers safety and Health Requirements Manual, EM 3 85- 1 - 1, and applicable parts of OSHA regulations, primarily 29 CFR Parts 1910 and 1926.

2. Cultural Resources: 'Me proposed interim remediation of off-range ordnance on the Walker River Indian Reservation would not result in an "effect, nor "adverse effect" to cultural resources included on or eligible for listing on the National Register of Historic Places. The area of potential impact was professionally surveyed and no properties that would qualify for the National Register were identified therein. Enclosure (3) is the State Historic Preservation Office concurrence with the Navy's determination of no effect.

3. Wetlands: The proposed action would not affect wetlands because for the purposes of regulation under the Clean Water Act, playas may contain "Waters of the United States" that are "jurisdictional waters" and areas that are not "jurisdictional". Actions within jurisdictional areas may require permits be obtained in accordance with federal regulations. Only a small portion of test site one (see attachment (4)) is within an area of Waters of the United States that is arguably below the ordinary high water mark. Points numbered 6 through 10 are within this Area and represent the only excavations. This excavation is permitted under Nationwide Permit No. 6, Survey Activities and notification is not required. Of the other test site excavations none will require jurisdictional permitting (see attachment (2)) Therefore There is no effect, and no Clean Water Act, Section 404 permit coordination is required.

4. Endangered and threatened species: The proposed action would not affect endangered or threatened species because no endangered, threatened, rare, or species of concern are present in the area affected by the proposed action, nor would any be affected by the proposed action, as determined by Navy biologist (see attachment (5)). Informal discussion with the US Fish and Wildlife Service, January 1999 (see attachment (5)), confirmed the lack of endangered species affected by the proposed action.

II. Analysis of CE

1. Evaluation of CE: The proposed action for the interim remediation of off-range ordnance on the Walker River Indian Reservation is consistent with the current land use, and does not does not threaten to violate Federal, State, and local laws and regulations.

2. Citation/Authority: The interim remediation of off-range ordnance on the Walker River Indian Reservation is consistent with and is in compliance with OPNAVINST 5090. 1 B, CH 1, Chapter 2, Subsection 2-4.2 "n" and "Z".

III. Approval

a. Preparer: Mr. Larry Jones
Naval Air Station Fallon
Public Works Department
Natural Resources / Real Estate Branch
Environmental Division
June 22, 1999

Appendix D

b. Command Approved: Mr. Doug Bonham
Naval Air Station Fallon
Public Works Department
Supervisory Environmental Engineer
Environmental Division
By direction of
the Commanding Officer

Walker River Paiute Tribe
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RESOLUTION OF THE GOVERNING BODY
OF THE
WALKER RIVER PAIUTE TRIBE
RESOLUTION NO. WR-43-99

BE IT RESOLVED BY TEE TRIBAL COUNCIL OF THE WALKER RIVER PAIUTE TRIBE THAT:

1.

WHEREAS, the governing body of the Walker River Paiute Tribe is organized under the provisions of the Indian Reorganization Act of June, 18, 1934 (48 Stat 984) as amended, to exercise certain rights of home rule and be responsible for the promotion of the economic and social welfare of its members, and

WHEREAS, the Walker River Reservation consists of approximately 323,406 acres of which the United States Navy has contaminated over 5,000 acres of this land with live and inert ordnance posing a threat, to the safety of community members and damaging several stock water wells resulting in a negative impact on the cattle grazing, and

WHEREAS, the Tribe has cooperated with and allowed the Naval Research Laboratory (NRL) to test the Multi-Sensor Towed Array Detection System (MTADS) on the reservation for demonstration purposes only, and

WHEREAS, the Tribal Council, through resolution WR-09-99 has given permission to the Tribe's Navy Negotiating committee to proceed with steps necessary to complete the second phase of the demonstration which includes digging selected targets, and

WHEREAS, applicable environmental documentation regarding the project has been completed.

THEREFORE BE IT RESOLVED, that the Walker River Paiute Tribe authorizes the Bureau of Indian Affairs, Western Nevada Agency, to draft a temporary permit to the NRL allowing them access to specified Tribal lands in order to complete the demonstration.

FINALLY BE IT RESOLVED, that the Chairman or his designate is allowed to enter into and execute an agreement with the US Navy/NRL for the second phase of the MTADS demonstration.

Appendix E

CERTIFICATION

It is hereby certified that the foregoing resolution of the Walker River Paiute Tribal council composed of seven (7) members, of whom 4 constituting a quorum were polled on the **2nd day of June, 1999**, and that the foregoing resolution was adopted by the affirmative vote of 3 **FOR,** 0 **AGAINST,** and 1 **ABSTENTION(S),** pursuant to the authority contained in the Constitutions and By Laws of the Walker River Paiute Tribe of Nevada on March 26, 1937.

Jon D. McMasters, Tribal Council Secretary
Walker River Paiute Tribe

Appendix E

United States Department of the Interior

BUREAU OF INDIAN AFFAIRS
WESTERN NEVADA AGENCY
1677 HOT SPRINGS ROAD
CARSON CITY, NEVADA 89706

IN REPLY REFER TO:
Real Property Management
(775) 887-3570

RECEIVED
JUN 10 1999

JUN 0 9 1999

Mr. Cassidy Williams, Chairman
WALKER RIVER TRIBAL COUNCIL
P.O. Box 220
Schurz, Nevada 89427

Dear Mr. Williams:

Reference is made to Walker River Tribal Council Resolution No. WR-43-99, dated June 2,1999. This particular Resolution agrees that the United States Department of the Navy has contaminated approximately 5,000 acres of Walker River Tribal Lands with live and inert ordinance which poses a threat to the safety of community members and damaging several stock water wells resulting in a negative impact on cattle grazing.

The Walker River tribe has cooperated with the Navy in attempting to resolve the continued trespass by the Navy on the Walker River Tribal Lands. The Walker River Paiute Tribe has allowed the Naval Research Laboratory to test the Multi-Sensor Towed Array Detection System on the Reservation for demonstration purposes only.

Pursuant to Walker River Tribal Council Resolution No. WR-43-99, the Walker River Tribal Council has given permission to the Walker River Tribal Navy Negotiating Committee to proceed with steps necessary to complete the second phase of the demonstration which includes digging selected target areas. Applicable compliance with the National Environmental Policy Act regarding this project has been completed.

Pursuant to Title 25 Code of Federal Regulations Part 162, this correspondence will serve as notice to the Department of the Navy granting permission to access certain Walker River Tribal Lands in order to complete the second phase of the demonstration. The Department of the Navy will be held responsible for all it's, activities and conduct of it's personnel, associated with the demonstration project, and in no instance will the Walker River Paiute Tribe and the United States Department of the Interior, Bureau of Indian Affairs, be held responsible or liable for any action which creates a public liability to any person involved with the demonstration project.

If you should have any questions, please feel free to contact this Agency at the address or telephone number provided above.

Sincerely,

Superintendent

Appendix F