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SECRETARY OF THE AIR FORCE**

**AIR FORCE TACTICS, TECHNIQUES,
AND PROCEDURES 3-32.11**

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Tactical Doctrine

AIRFIELD DAMAGE ASSESSMENT AFTER ATTACK

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PURPOSE: This publication supports Air Force Instruction (AFI) 10-209, *RED HORSE Program*, AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, Air Force Pamphlet (AFPAM) 10-219, Volume 4, *Airfield Damage Repair Operations*, and Air Force Doctrine Publication (AFDP) 3-34, *Engineer Operations*. To provide tactics, techniques and procedures (TTP) to accurately and expeditiously assess airfield damage immediately after an attack. Ensure all records generated as a result of processes prescribed in this publication adhere to Air Force Instruction 33-322, *Records Management and Information Governance Program* and are disposed in accordance with the Air Force Records Disposition Schedule which is located in the Air Force Records information Management System. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

APPLICATION: This publication applies to all Regular Air Force (Reg AF), Air National Guard (ANG), and Air Force Reserve (AFR) Civil Engineer personnel performing airfield damage assessment after an attack. This document is authoritative but not directive. The airfield damage assessment TTPs found in this publication take precedence over those found in other nondirective publications. The applicable AFI will take precedence in cases where this publication and AFIs conflict. Units may supplement this publication as required, but must be coordinated through the AF Civil Engineer Readiness Division (AF/A4CX), prior to publication.

SCOPE: This publication provides guidance for assessing damage on an airfield after attack. It describes team organization and composition, equipment requirements, assessment techniques, and damage recording and reporting procedures.

SUMMARY OF CHANGES: Added procedures for using the Rapid Airfield Damage Assessment System (RADAS) and divided the publication into [Part 1](#), *Legacy Airfield Damage Assessment*, and [Part 2](#), *Rapid Airfield Damage Assessment System*. Updated [paragraph 3.2.2.2.1.8](#), to better

define crater fields. Updated [paragraph 4.2.1](#) to clarify entering damage type in damage recording form.

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PART 1—LEGACY AIRFIELD DAMAGE ASSESSMENT**Chapter 1****INTRODUCTION**

1.1. Overview. Airfield damage assessment is the process of locating, classifying, and measuring airfield damage and unexploded ordnance (UXO) after an attack. Traditionally, this task is performed by Airfield Damage Assessment Teams (ADAT) surveying the airfield while traveling predetermined routes and reporting damage to the Minimum Airfield Operating Surface (MAOS) Selection Team.

1.1.1. The MAOS Selection Cell should be co-located with the Emergency Operations Center (EOC) whenever possible. (**Note:** damage is recorded and plotted in the alternate EOC and Civil Engineer [CE] Unit Control Center [UCC] to provide redundancy and crosschecks for accuracy). The MAOS Selection Cell is managed under Emergency Support Function (ESF) 3-Public Works and Engineering Responsibilities. The MAOS Selection Cell is subordinate to the EOC Director and serves as an advisory element to the EOC and Installation Commander. The ADATs collect necessary data for the MAOS selection cell to select at least three MAOS candidates to be briefed to the Installation Commander as soon as possible after the attack.

1.1.2. From an engineering perspective, damage assessment activities are categorized into two distinct areas: airfield damage assessment and facility /utility damage assessment. Resources permitting, both assessment operations should be conducted simultaneously and, depending on the situation at hand, may be of equal importance.

1.1.2.1. Airfield damage assessment includes evaluation of runway, taxiway, and parking apron surfaces, and airfield infrastructure such as lighting, aircraft arresting systems, utility lines, signage, etc. The ADATs should also report any visual damage to navigational aids (NAVAIDs) along their routes. The ADAT model will eventually transition towards the RADAS concept, whereby airfield damage assessment is conducted via remote sensors mounted on unmanned vehicles, stationary towers, and other platforms. RADAS will remove personnel from the hazardous UXO-laden environment and should significantly accelerate the assessment process.

1.1.2.2. Facility damage assessment includes evaluation of damage to all other airbase facilities, infrastructure, and utility systems.

1.1.3. This publication is limited to airfield damage assessment procedures. Facility damage assessment, conducted by teams referred to as Damage Assessment and Response Teams (DART), is presented in AFPAM 10-219, Volume 3, *Civil Engineer Contingency Response and Recovery Procedures*.

1.2. General Information. The ADATs should be comprised of experienced personnel; provided with adequate communications, transport, and protective equipment; and trained on airfield damage assessment procedures. In addition, a pavement reference marking system (PRMS) used to assist in identifying locations of damage and UXO on all takeoff and landing surfaces, may be employed if the airfield damage assessment process is to be within required accuracy. The military grid reference system (MGRS) is used when reporting damages on airfield pavements not on the takeoff or landing surfaces.

1.2.1. Airfield damage assessment is the critical first step toward recovering a damaged airfield. Since major recovery tasks cannot start until damage assessment and MAOS selection are completed, speed and accuracy during damage assessment are essential for the success of subsequent rapid airfield damage recovery (RADR) activities.

1.2.2. The MAOS Selection Cell enters reported damage into the Geospatial Expeditionary Planning Tool (GeoExPT) for automated MAOS selection, or uses the backup legacy method to manually plot damage on maps. The MAOS Selection Cell should consider damage to the entire airfield operating surfaces including takeoff or landing surfaces, access taxiways and aircraft parking areas, when selecting MAOS candidates. The MAOS Selection Team briefs the MAOS candidates by order of preference to the Installation Commander or Senior Airfield Authority who then selects the preferred MAOS that should be cleared and repaired to launch or recover aircraft.

1.2.3. To shorten airfield recovery time, damage assessment and locating UXO should be accomplished jointly. Accordingly, the damage assessment team is organized to locate and classify UXO and conduct ground assessments of runway, taxiway, and parking apron pavement. The assessments are conducted either mounted in hardened vehicles or dismounted on foot when damage and/or UXO prevent the use of vehicles.

Chapter 2

RESOURCES

2.1. Team Composition. An ADAT normally consists of one engineering specialist (usually an engineering craftsman) and two Explosive Ordnance Disposal (EOD) technicians (a CE member trained as an EOD assistant may substitute for one EOD technician when two are unavailable). Due to the size of a typical airfield, more than one ADAT is usually required to meet the air tasking order (ATO). The exact number of ADATs is determined by the Base Civil Engineer (BCE).

2.1.1. The engineering craftsman reports location and size of craters, camouflets, spall fields, camouflet fields, bomblet fields, damage to airfield infrastructure such as lighting, arresting systems, signage, underground utilities, and any visible damage to NAVAIDs along their route to the MAOS Selection Cell.

2.1.2. Explosive ordnance technicians typically operate the armored vehicle; accurately locate, classify, and report UXO; perform limited “render safe” procedures on selected ordnance; and safely guide the team when near UXO. **Note:** As a general rule, “render safe” procedures are not performed unless two EOD members are present.

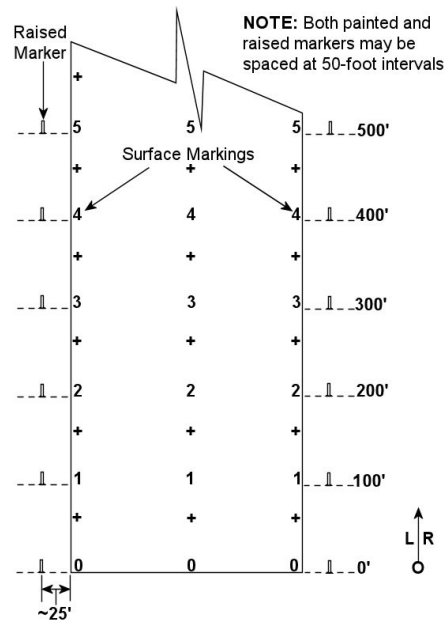
2.2. Equipment. Equipment requirements depend upon the assessment technique. For example, dismounted ADATs have different requirements than mounted teams. In addition to chemical warfare defense ensembles, each team member may require specific equipment to perform a particular function. Explosive ordnance disposal personnel should reference AFTTP 3-32.5V6, Explosive Ordnance Disposal (EOD) UXO Operations, for EOD equipment requirements. [Table 2.1](#) lists basic engineering items for the ADAT.

Table 2.1. Basic ADAT Engineering Items.

Item	Quantity
1. Safety rope (for rescuing team members from a collapsed camouflet)	2
2. Crash grid map, 1:50,000 (MGRS)	1
3. Airfield pavement map, 1" = 400' (with PRMS grid)	1
4. Damage assessment forms	25
5. Clip board	3
6. Writing instrument	6
7. Radio (with spare batteries)	2
8. Binocular	2
9. Night vision device	2
10. Flashlight, explosion-proof plastic-cased	3
11. Measuring tape, nonmetallic	2
12. Marking tape, roll	5
13. Marking flags	50
14. UXO Marker	100
15. Backpack (for dismounted assessments)	3
16. ADAT Overlay/Coordinate Grid Reader & Protractor	1

2.3. Pavement Reference Marking System (PRMS). Use a PRMS to assist with locating damage and expediting the damage assessment process ([Figure 2.1](#)). This reference system should be in place prior to an attack and be able to withstand its effects. To achieve maximum effectiveness, the PRMS should be employed on all takeoff or landing (TOL) surfaces.

Figure 2.1. Typical Pavement Reference Marking System.



2.3.1. A zero point is established for each pavement surface. To eliminate the need for time-consuming measurements, the PRMS provides a visual cue to locate damage and UXO. Damage and UXO may be located by determining how far down the pavement they are from the zero point and how far they are right or left of centerline.

2.3.2. These markers are painted on the pavement surface at 50- or 100-foot intervals along the centerline and along the marked runway edge starting at the zero point. Additionally, raised markers ([Figure 2.2](#)) are placed at 50- or 100-foot intervals at a distance between 25 to 50 feet from the pavement edge on both sides of the runway. Spacing these markers from the marked runway edge helps ensure the reference system remains usable following an attack and during recovery operations.

2.3.3. Placement of these raised markers is accomplished as part of attack preparation and is included on the engineer attack preparation playbook checklists in the CE Contingency Response Plan (CRP), which is located at <https://usaf.dps.mil/teams/10041/CEPlaybooks/Pages/default.aspx>. Three basic rules need to be followed when using the PRMS:

Figure 2.2. PRMS Raised Marker.



2.3.3.1. Zero Point Rule. For an airfield pavement section, the zero point is fixed. It does not switch from one end of the pavement to the other. The zero point is usually established at the runway threshold where normal aircraft operations occur.

2.3.3.2. Centerline Rule. All distances along the length of the pavement section are measured along the centerline from the zero point for that pavement.

2.3.3.3. Right/Left Rule. Right and left of the centerline are determined as the ADAT faces down the centerline of the pavement away from the zero point.

2.4. Military Grid Reference System (MGRS). The ADATs use the MGRS to locate damage that is not on the TOL surfaces.

2.4.1. There is only one rule to remember when reading or reporting MGRS grid coordinates: always read to the right and then up. The first half of the reported set of coordinate digits represents the left-to-right (easting) grid label, and the second half represents the label as read from the bottom to top (northing). The grid coordinates may represent the location to the nearest 10-, 100-, or 1,000-meter increment. The following paragraphs explain how to determine grid coordinates of a point on a military map.

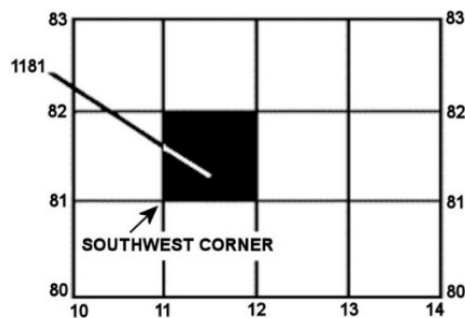
2.4.2. A military map has vertical lines (top to bottom) and horizontal lines (left to right). These lines form small squares 1,000 meters on each side called grid squares. The lines that form grid squares are numbered along the outside edge of the map picture. No two grid squares have the same number.

2.4.3. The precision of a point location is shown by the number of digits in the coordinates: the more digits, the more precise the location, such as:

- 1996 – 1,000-meter grid square.
- 192961 – to the nearest 100-meters.
- 19269614 – to the nearest 10-meters.

2.4.4. The location is grid square 1181 as seen in the example in [Figure 2.3](#). To determine the address, start from the left and read right until reaching to 11, the first half of the address. Then read up to 81 for the other half. The address is somewhere in grid square 1181.

Figure 2.3. Determining a Six-Digit Grid Coordinate.



NOTE: always begin your reading from the southwest corner.

2.4.5. Grid square 1181 gives a generalized address, but there is a lot of ground inside that grid square. To make the location more accurate, just add another number to the first half and another number to the second half—now the location has six numbers instead of four.

2.4.5.1. To get the additional numbers, break down each grid square to have ten lines inside it running north and south, and another 10 running east and west. This makes 100 smaller squares.

2.4.5.2. Assume a location halfway between grid line 11 and grid line 12. Also assume that the next number is 5; the first half of the address is then 115. Further assume a location 3/10th between grid line 81 and grid line 82. This makes the second half of the address 813. (If located exactly on line 81, the second part is 810). The address is now 115813.

Chapter 3

AIRFIELD DAMAGE ASSESSMENT PROCESS

3.1. Introduction. Airfield damage assessment is the critical first step toward restoring an operational runway after an enemy attack, man-made or natural disaster. Airfield damage assessment includes evaluation of damage on runway surfaces, taxiway surfaces, and other facilities, which directly support aircraft operations. Speed and accuracy during damage assessment are essential to enable airfield repairs to begin as soon as possible.

3.1.1. Dedicated ADATs determine location, types, and numbers of UXO; location, types, and quantity of airfield pavement damage; and report findings to the MAOS Selection Team. The MAOS Selection Team uses this information to select MAOS candidates, which must be cleared and repaired in order to launch and recover aircraft.

3.1.2. This chapter provides guidance for accomplishing airfield damage assessment after attack operations. It also outlines organization, team composition, required equipment, assessment techniques, and damage recording and reporting procedures.

3.2. Damage Assessment Phases. Damage assessment planning is based on a two-phased approach: initial reconnaissance and detailed damage assessment.

3.2.1. Initial Reconnaissance. The purpose of initial reconnaissance is to rapidly assess the attack recovery environment by identifying broad areas where airfield pavement was damaged. This initial gross assessment is made from the control tower, or from manned observation posts that are splinter-protected and elevated to afford clear visibility around the airfield. From these vantage points, trained personnel can quickly locate areas with UXO and pavement damage on the airfield.

3.2.1.1. Precise damage locations or measurements are not expected because most observations are made at some distance from the damaged area. The results of the initial reconnaissance assists the MAOS Selection Cell to quickly direct ADATs to those areas requiring detailed damage assessment, or avoid areas that appear to be too heavily damaged to warrant consideration in MAOS selection.

3.2.1.2. Reporting procedures depend upon attack preparation instructions and available communications equipment. Some observers may report directly to the EOC, while others report to their UCC. For example, security forces observers may report directly to the security forces Base Defense Operations Center (BDOC), and then relayed to the EOC.

3.2.1.3. From these initial reports, pavement areas showing promise as possible MAOS candidates or areas too heavily damaged may become readily apparent. As a result, the MAOS Selection Cell may adjust ADAT routes to avoid severely damaged areas and concentrate on areas that show promise. This adjustment may save valuable time by shortening the ADAT routes.

3.2.1.4. When available, remote sensing systems such as tower-mounted cameras or unmanned aircraft systems (UAS), may be used to get a "snap-shot" of airfield operating surface damage.

3.2.1.5. An EOD team will need to clear UXO findings in order for the team to continue the ADAT route.

3.2.2. Detailed Damage Assessment. Detailed damage assessment requires precise reporting, as this data forms the basis for MAOS selection. Depending on the level of damage, detailed damage assessment may be extremely hazardous and therefore time consuming.

3.2.2.1. Predetermined damage assessment routes and checkpoints are normally identified during attack preparation planning to expedite the assessment process and prevent duplication of effort by the different ADATs. These routes are planned to assess airfield priorities as soon as practical.

3.2.2.1.1. ADAT travel routes are normally predetermined to begin at dispersed ADAT personnel shelters, move to the RADR staging area, and then travel toward the more critical aircraft pavements. These routes are updated or altered as required based on initial damage assessment reports. Generally, ADAT travel routes proceed to survey the airfield in the priority order identified in [Table 3.1](#). Each installation should develop specific routes suitable for their airfield.

Table 3.1. Assessment Priorities.

Priority	Airfield Location
1	Takeoff or landing surfaces (e.g., runways, alternate launch or recovery surfaces, and taxiway segments long enough to permit aircraft launch and recovery)
2	Access pavements to takeoff or landing surfaces
3	Aircraft parking areas
4	Infrastructure such as lighting (including Precision Approach Path Indicators [PAPIs], utility lines, signage, etc.)
5	Aircraft arresting systems
6	Aircraft arming and fueling areas
7	Other specified locations as defined in the Facility Prioritization List or as determined by installation leadership

3.2.2.1.2. Predetermined routes may be altered as initial reconnaissance reports are received and analyzed. When applicable, the EOC notifies ADATs of any changes to predetermined routes, including new checkpoints and special instructions necessary to complete their assessment route.

3.2.2.1.3. Upon declaration or ALARM BLACK, Initial Release, ESF 3/5 within the EOC inform the ADATs to begin their routes from their dispersed sheltered locations. The ADATs report the extent and location of damage along their predetermined or modified routes, including damage on the route from their shelter to the airfield.

3.2.2.2. Techniques. Detailed damage assessment may be conducted using one of two possible techniques—mounted (vehicular) or dismounted (on foot).

3.2.2.2.1. Mounted. The mounted technique provides the most speed and protection for the ADAT and is the primary detailed reconnaissance technique. The ADAT composition for the mounted assessment may vary with vehicle capacity, but should generally be the same as the team composition discussed in [paragraph 2.1](#). Ideally, armored vehicles are used to transport ADATs between UXO and pavement damage.

3.2.2.2.2. These vehicles provide protection from UXO blast and fragmentation effects. However, these benefits are not provided without some cost to effectiveness,

visibility from inside the vehicle is restricted by the armor protection. This limitation may contribute to errors in reporting the size, position, and identification of UXO and damage.

3.2.2.2.3. Field tests have proven that with practice, damage assessment teams can estimate short distances (less than 100-feet) and crater diameters with acceptable accuracy without manual measurements, and estimate spall, camouflet, and bomblet numbers within fields without precise counting. The accuracy of this method varies from person to person. Observation distance, weather conditions, time of observation (night or day), and other human factors such as fatigue and fear will affect accuracy.

3.2.2.2.3.1. Armored vehicles, such as the Mine-Resistant Ambush Protected (MRAP) vehicle shown in [Figure 3.1.](#), provide increased protection from explosive hazards in the UXO-laden environment. If an armored vehicle is not available, substitute with hardened dump trucks or other heavy-duty vehicles.

Figure 3.1. Mine-Resistant Ambush Protected (MRAP) vehicle.



3.2.2.2.3.2. Armored vehicles offer varying degrees of protection from UXO. Armored crews can reduce their risk from some but not all UXO threat areas by remaining mounted. When conducting risk assessment, type and size of the potential UXO must be considered. Although some UXO may only immobilize vehicles, others may result in catastrophic injury.

3.2.2.2.3.3. Personnel in non-armored vehicles face nearly the same risk from UXO as dismounted forces because the protection afforded by non-armored vehicles is negligible. The non-armored vehicles are also vulnerable to damage or destruction from UXO.

3.2.2.2.3.4. The best travel route is normally along the pavement centerline. This route gives equal visibility to both sides of the takeoff and landing surface and allows ADAT personnel to visually sweep the area in front and to the sides of the vehicle. Obviously, a meandering path may be required to avoid UXO or pavement damage. When straying from the centerline is necessary, the team must be careful not to miss damage or UXO on the far side of the TOL surface. Team members should remain in the vehicle for protection from explosive hazards except in extreme cases where not dismounting would seriously hamper the assessment effort.

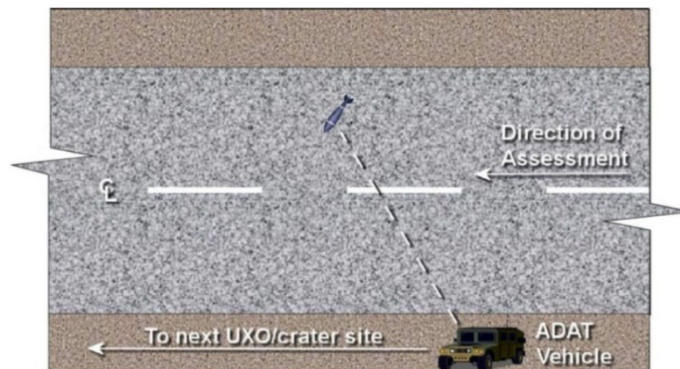
3.2.2.2.3.5. When a large UXO is encountered, the damage assessment vehicle should approach on the far runway shoulder as shown in [Figure 3.2.](#) The ADAT

then stops, records and immediately reports as much of the following information as possible: location, shape, color, markings, fuze type and condition, coordinates, and estimated time to render safe.

Note: Make radio transmissions from a minimum safe distance of a UXO threat of 25-feet for handheld or 100-feet for vehicle mounted radios. UXO are highly susceptible to electromagnetic radiation (EMR) and may explode. This could come from communication and other transmitting devices.

Note: Do not move or remove anything on or near a UXO. A UXO can be extremely sensitive and can cause serious injury or death if disturbed in any way. If a sub-munition is found, there may be many more sub-munitions in the same area. Small size does not diminish the danger of sub-munitions.

Figure 3.2. Single Large UXO Assessment.

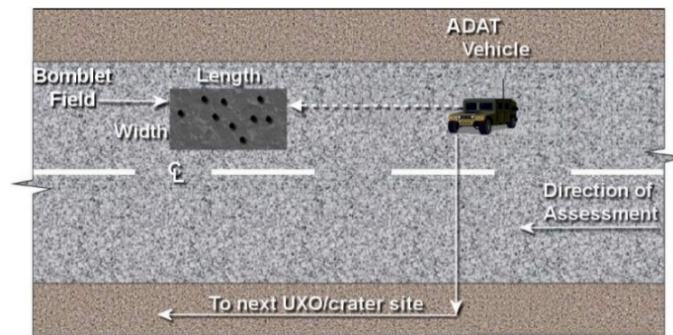


3.2.2.2.3.6. When the ADAT sights a bomblet ([Figure 3.3](#)), or bomblet field, they should approach the closest ordnance ([Figure 3.4](#)) at a safe distance and record the following information: number, shape, location, field width, field length, color, markings, fuze type and condition, and render safe time. After this information is reported to the EOC, the ADAT drives past the field in such a manner as to provide the maximum standoff distance between the bomblet field boundaries and the ADAT vehicle.

Figure 3.3. Bomblet Examples.



Figure 3.4. Bomblet Field Assessment.



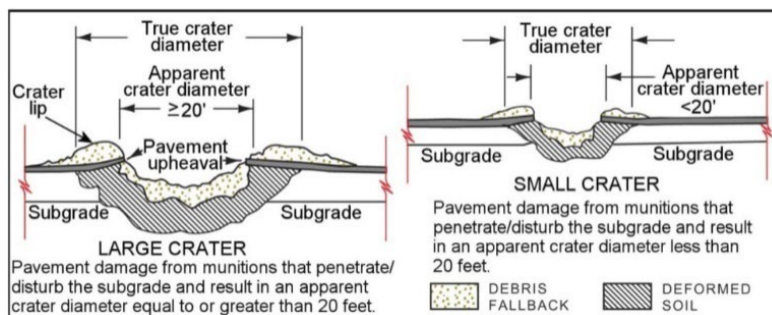
3.2.2.2.3.7. Crater. Craters are generally divided into two broad categories: large or small. Large craters are greater than 20-feet in diameter and small craters are 20-feet in diameter or less ([Figure 3.5](#)). In either case, approach craters with caution. If the surrounding area appears free of UXO, move as close to the crater as possible to assess the damage and to determine if a UXO is in the crater. Record coordinates for the center of each crater and its apparent diameter.

3.2.2.2.3.8. Crater Field. Small craters in close proximity (within an airfield-pavement-slab distance apart) should be reported as a crater field, or mix of a field and individual craters. The decision of which method to use must reflect the balance between speed and accuracy of the picture for the EOC and Crisis Action Team (CAT).

3.2.2.2.3.8.1. 'Speed' should consider whether calling in many grouped small craters individually will consume excessive time and radio frequencies. If the field is too broad or spread out, the MAOS Selection Cell will have insufficient information to make an appropriate MAOS selection. Like single craters, carefully examine crater fields from a distance for the presence of UXO. If no UXO are sighted, the ADAT should move the vehicle into the area.

3.2.2.2.3.8.2. The ADAT should then record the following information: center coordinates for the leading and trailing edges, leading and trailing field widths, number of craters within the field, average crater size, and average crater separation. Be sure to report any UXO or spalls in the field as well. Provide the MAOS plotters with as much detail as possible (e.g., if the field is 100 feet wide, but 80% of the craters are in the left-of-center 50-foot section, state so).

Figure 3.5. Large and Small Crater Profiles.



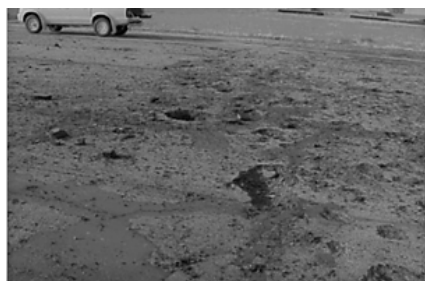
3.2.2.2.3.9. Camouflets. A camouflet is created when a munition punctures the pavement surface and bursts underground, creating a cavity with little to no surface rupturing ([Figure 3.6](#)). Camouflets are considered to be a type of small crater. When camouflets are present, the ADAT should approach the area with caution. If the surrounding area appears free of UXO, move just close enough to the camouflet to assess the damage. Record its coordinates and entry-hole size and report the camouflet to the MAOS Selection Cell. Additionally, estimate the cavity size according to nearby craters (e.g., if the closest craters to the camouflet are 5-feet in diameter, the cavity size would be estimated to be 5-feet). **Note:** It may be difficult to find camouflet fields, especially when an enemy uses flechette munitions.

Figure 3.6. Camouflet in Concrete Surface.



3.2.2.2.3.10. Spall Fields. A spall is pavement damage that does not penetrate through the pavement surface to the underlying soil layers. A spall's damaged area could be up to 5-feet in diameter. The same as bomb craters, spall fields ([Figure 3.7](#)) should be carefully examined from a distance for the presence of UXO. If no UXO is sighted, the ADAT should move the vehicle into the area and record the following information: center coordinates for the leading and trailing edges, leading and trailing field widths, and number of spalls within the field. Because spalls are not highly visible even at close range, spall counts and field dimensions may be difficult to determine, especially since spalls are likely to be covered with debris.

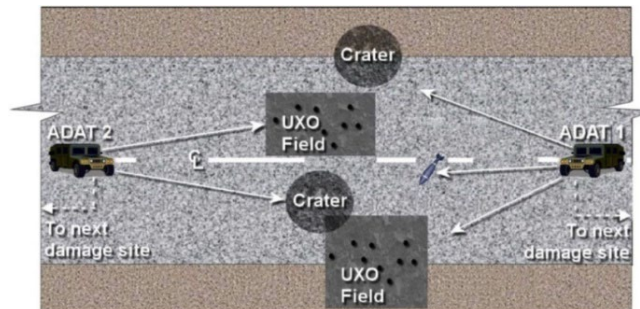
Figure 3.7. Spall Field.



3.2.2.2.3.11. Multiple Ordnance/Damage Sites. It is possible an ADAT will encounter a situation where damage and UXO presence are so severe that continuation of the planned assessment route is impossible. Before attempting to reach the other side of the blocked area, the ADAT should inform the MAOS Selection Cell of the situation. The selection cell may see a pattern developing based on the damage reported, which allows adjustment of travel routes to have a

different ADAT finish assessing the planned route ([Figure 3.8](#)). In this type of situation, both ADATs would assess damage from their respective sides of the blockage and report their findings to the MAOS Selection Cell.

Figure 3.8. Multiple UXO/Damage Assessment.



3.2.2.2.4. Dismounted. Dismounted damage assessment is a slow and hazardous technique that requires the operating airfield surfaces to be surveyed on foot. Although the dismounted technique is the most accurate damage assessment method, it is extremely time consuming and exposes ADAT members to UXO fragmentation and blast hazards.

3.2.2.2.4.1. Damage assessment team members walk specified areas of the airfield operating surface to identify and locate UXO, pavement damage, and damage to support systems. Make distance measurements by visual estimation using the PRMS, MGRS, or pacing, whichever is most appropriate for the situation. In addition, the team should specify if there is adequate pavement for taxiing aircraft around damage so repairs can be delayed until a more opportune time. Actions of the individual team members are outlined in the following paragraphs.

3.2.2.2.4.2. Dismounted forces face the greatest risk from UXO. To reduce this risk, dismounted forces need to be able to identify UXO threats correctly, understand procedures for avoiding and reporting these threats, and be aware of UXO threat areas previously reported.

3.2.2.2.4.3. The senior EOD technician is responsible for safe travel routes through hazardous areas. The EOD member assigns areas or lanes of responsibility to each of the team members. As the team progresses through its area of responsibility, the EOD representative assists in the proper classification of UXO and relays pertinent information to the MAOS Selection Team.

3.2.2.2.4.4. The engineering team member has the overall responsibility for damage assessment. The engineering craftsman may be assisted in damage location and recording by one or more augmentees.

3.2.2.2.4.5. Team members are responsible for following the safe routes identified by the senior EOD member and identifying all pavement damage and UXO locations in the assigned area. Any identification problems are reported to the EOD or engineering representative for resolution. Augmentees may also assist in transmitting information to the MAOS Selection Cell. If communication difficulties are experienced, the augmentees are usually called upon to serve as runners.

3.3. Summary. Airfield damage assessment teams, directed by the EOC, assess airfield pavement damage so repair teams can repair the minimum operational airfield surfaces as quickly as possible. If effective airfield damage assessments are to be realized, ADATs may be comprised of experienced personnel; be provided adequate communications, transport, and protective equipment; and be completely knowledgeable of damage assessment procedures. In addition, a pavement reference marking system, used to identify the locations of damage and UXO on airfield pavements, may be employed if the airfield damage assessment process is to be within the required accuracy. The success of subsequent RADR activities to a large degree hinge upon the accuracy of the airfield damage assessment efforts.

Chapter 4

RECORDING AND REPORTING DAMAGE

4.1. Damage Assessment Data. During damage assessment, ADATs gather two types of information—location and details of pavement damage caused by bombs, rockets, etc., and UXO data.

4.1.1. The following damage information should be included in each report:

4.1.1.1. Damage type (crater; UXO; camouflet; spall, camouflet or bomblet field, etc.);

4.1.1.2. Location (by PMRS for TOL surfaces or MGRS for areas other than the TOL surfaces);

4.1.1.3. Size (crater diameter; crater, camouflet, spall, or bomblet field dimensions; etc.);

4.1.1.4. Number (of craters, spalls, camouflets or bomblets in a field).

4.1.2. Unexploded explosive ordnance must be accurately located, classified, and immediately reported in sufficient detail to the EOD supervisor within the EOC to determine risk to aircraft operations.

4.1.2.1. Immediate reporting not only aids in hastening the MAOS selection process but also serves to keep the ESFs 3/5 and MAOS Selection Cell aware of the team's position on a frequent basis.

4.1.2.1.1. Include the following information in the UXO report:

4.1.2.1.2. Location, quantity, size, shape, color, distinctive markings, and fuze type and condition.

4.1.2.2. All UXO within 300-feet of repair operations or aircraft operating surfaces (marked edges of runways and taxiways) must be identified and reported (and any obvious visible hazard at a greater distance that may threaten RADR operations). Entry holes for subsurface UXO and camouflets must also be reported.

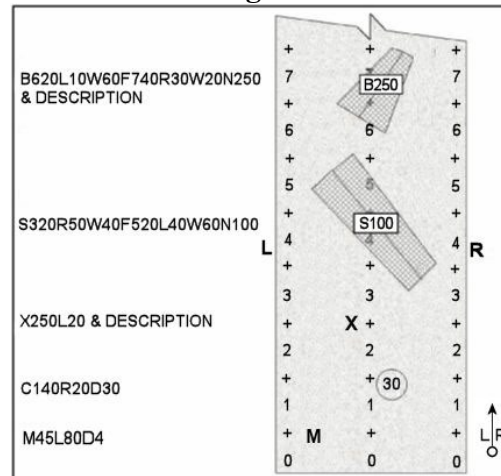
4.2. Recording and Reporting Damage. As damage is assessed, it should be recorded and immediately reported at the end of the route or by zone to the EOC for damage plotting and MAOS selection. Recommend assigning a primary and alternate on the team for radio transmissions as to reduce unnecessary radio chatter or talking over each other while reporting. Speed of reporting depends upon the complete understanding of the information being relayed and strict adherence to radio discipline by both MAOS Selection Cell and ADAT personnel. A written list of reported damage should be kept by each ADAT and provided to the MAOS Selection Cell for verification purposes upon their return. Each damage item is recorded as shown in [Figure A2.1](#) and reported as a series of letters and numbers. An example airfield damage reporting form for copying may be found in [Figure A2.2](#). [Figure 4.1](#) provides an example of how the MAOS Selection Cell plots damage.

4.2.1. Damage Type or UXO. Enter damage/ordnance type using a letter coding of C-(crater), X-(UXO), S-(spall), B-(bomblet field), and M-(camouflet).

4.2.2. Location. Distance from the zero pavement reference point to the center of the crater,

camouflet, UXO, or to the closest leading edge of the spall, camouflet, or bomblet field.

Figure 4.1. Data Report and Plot of Damage.



4.2.3. Left or Right of Centerline. “L” stands for left, and “R” stands for right. They denote the direction from the pavement centerline to the damage/UXO center point.

4.2.4. Distance from Centerline. Distance from the centerline to the center of the crater, UXO, camouflet, or to the center of the leading edge of the spall, camouflet, or bomblet field.

4.2.5. Diameter/Width. For craters or circular spall, camouflet, and bomblet fields, enter the letter “D.” For rectangular spall, camouflet, or bomblet fields, enter the letter “W.”

4.2.6. Size of Diameter or Width. This is the numerical estimation of the apparent diameter or field width for that point along the pavement.

4.2.7. Field Identifier (F). If required, enter the letter “F” to alert the EOC that the following information completes the leading edge description of a spall, small crater, camouflet, or bomblet field. The next alphanumeric group after “F” stands for the same as above and describes the trailing edge of the field.

4.2.8. Number Identifier (N). The letter “N” alerts the EOC the field identifier is completed and the next number is the number of spalls, small craters, camouflets, bomblets, or a mix.

4.2.9. Number of Bomblets, Small Craters, Camouflets, or Spalls. The numerical estimate of the number of bomblets, small craters, camouflets, or spalls in the field previously identified. If it is a mix, show the total number first followed by the breakdown by type. For instance, if the spall field in [Figure 4.1](#) was a mix of 50 small craters, 25 spalls, and 25 UXO, it would be reported as: C320R50W40F520L40W60N100(C50X25S25). The first digit (damage type) is determined by the most prominent type of damage (C).

4.2.10. Description. Record additional information here to help accurately identify pavement damage or describe the UXO.

4.3. Communications. The success of the damage assessment operation depends upon dedicated communication instruments and strict communication procedures to ensure accurate transmission of damage information. The current concept calls for separate EOD and CE radio nets for transmission of this information. The EOD and CE representative on each ADAT will transmit UXO and damage information to the EOC. Typically in the routine aspect of communication it is

one of the two 3E5s' assigned, but often it's the 3E8 that is taking the calls. The CE UCC tends to be the one monitoring all communication traffic on the network. This will be written into the BSP/CRP local installation procedures checklists.

4.3.1. With multiple ADATs passing information to the control center, as well as other CE and EOD personnel around the base, the potential for confusion is great. It is essential to use clear and concise radio transmissions while maintaining strict radio discipline. Unnecessarily keying the mike, transmitting unorganized thoughts, and interrupting other transmissions will necessitate the repeat of transmissions, which results in the delay of MAOS selection and repair operations.

4.3.2. Radio communications are usually quick and generally effective, but can be jammed or intercepted if not secured. If secure communications are unavailable, procedures (such as a runner system) should be preplanned to address these problems. Use locally developed "comm-out" procedures when necessary.

4.3.3. When traditional communications cannot be used during a conflict there are some alternative solutions that can be used. Protocols for various types of alternative communications should be outlined and written into the installation BSP/CRP checklists.

PART 2—RAPID AIRFIELD DAMAGE ASSESSMENT SYSTEM.**Chapter 5****INTRODUCTION**

5.1. Overview. Airfield damage assessment is the process of locating, classifying, and measuring airfield damage and UXO after attack. Airfield damage assessment includes evaluation of runway, taxiway, parking surfaces, and airfield infrastructure such as lighting, aircraft arresting systems, utility lines, signage, etc. Any visual damage to NAVAIDs along routes should also be reported.

5.1.1. The Air Force Civil Engineer Center (AFCEC) has developed updated capabilities to include Rapid Damage Assessment (RDA). The goal of RDA is to expeditiously gather post attack data to determine an optimal recovery strategy of the airfield. The RADAS is a component of RDA, which trims damage assessment times dramatically from hours or even days to within one hour and minimizes the need of ADAT to negotiate potentially hazardous airfield surfaces.

Note: RADAS will continuously be updated until reaching full operating capability. **The information within Part 2 of this publication refers to Spiral 0.5 of RADAS development. Information within will be updated as each spiral of development is fielded.**

5.1.2. The RADAS is postured as the 4F9DA, Damage Assessment Unit Type Code (UTC). It consists of four remotely piloted Small Unmanned Aircraft System (SUAS) kits, three laptop computers, associated loaded software, and all related equipment and wiring required for operation. RADAS is specifically designed to assess damage to an airfield, identify and classify UXO, and expedite MAOS selection.

5.1.3. RADAS utilizes four SUAS flying preprogrammed routes carrying high definition electro-optical (EO) or Long-Wave Infrared (LWIR) sensors providing real time video feeds to operators on the ground.

5.1.4. The GeoExPT software provides visual representation of data gathered from the RADAS sensors, declared damage and UXO, on a geospatially accurate representation of a specific airfield. GeoExPT operators, an Engineering and an EOD technician, monitor the SUAS's video feed to locate, identify measure, classify, and plot various types of damage (camouflet, crater, or spall) and UXO respectfully. RADAS capitalizes on the GeoExPT ADR Synchronization (GAS) tool that facilitates communication between the many components of RADAS both internal to the system (the SUAS and GeoExPT), and external (the Airfield Damage Repair Simulator and the Installation Recovery After Attack [IRAA] tool).

5.2. General Information. While RADAS is primarily based on latitude and longitude, all coordinates are still translated to the PRMS and MGRS as appropriate. This method facilitates communication with all recovery teams moving about the airfield operating surfaces.

5.2.1. Since major recovery tasks cannot start until damage assessment and MAOS selection are complete, speed and accuracy during damage assessment are essential for the success of subsequent RADR activities.

5.2.2. All damage is entered into GeoExPT for MAOS selection. The MAOS Selection Team within the RADAS Cell must consider damage to all airfield operating surfaces including takeoff or landing surfaces, access taxiways, and aircraft parking areas, convoy routes, and access routes when selecting MAOS candidates. The ESF 3 representatives briefs the MAOS candidates by order of preference to the Installation Commander or Senior Airfield Authority. The Installation Commander or Senior Airfield Authority then selects the preferred MAOS that must be cleared and repaired to launch and recover aircraft.

5.2.3. While RADAS is intended to replace ADATs, legacy airfield damage assessment procedures found in Part 1 of this publication are still the only viable backup to RADAS; legacy skills and procedures should still be exercised. ADATs may be required to augment RADAS personnel when communications are limited.

Chapter 6

RESOURCES

6.1. Team Composition. The small-unmanned aircraft system-operators (SUAS-O) can be from any CE Air Force Specialty Code (AFSC). They are selected by the BCE based on knowledge of the airfield operating surfaces and time remaining on station. Personnel with previous SUAS experience should be considered first. The current RADAS configuration requires two SUAS-Os to operate four aircraft.

6.1.1. The tasks required of the SUAS-O are:

- Setting up SUAS components (aircraft & Ground Control Station [GCS])
- Programming flight plans for assessment runs
- All preflight actions (to include airspace approval)
- All activities associated with flying (including user-level maintenance)
- Transferring data from aircraft to video management system

6.1.2. Engineering Technician (3E5X1) is the team lead and is responsible for:

- Setting up the Ground Control Station
- Advising SUAS-Os of assessment areas of responsibilities and development of flight plans
- Creating GeoExPT scenarios
- Monitoring (GAS)
- Determining MAOS criteria
- Declaring damage (camouflets, craters, and spalls) within GeoExPT
- Tasking SUAS data collection as necessary
- Reconciling damage and UXO data
- Selecting MAOS candidates
- Transfer data to EOC or Civil Engineer-Unit Control Center (CE-UCC)
- Updating GeoExPT during repair process
- Performing data backups
- Resetting system for subsequent attacks

6.1.3. An EOD Technician (3E8X1) is responsible for:

- Advising SUAS-Os of assessment areas of responsibilities and development of flight plans
- Monitoring GAS
- Declaring UXO within GeoExPT
- Tasking SUAS data collection as necessary
- Reconciling damage and UXO data
- Consults on MAOS selection

6.2. Equipment. Each RADAS capability includes everything needed to assess a single installation's airfield operating surfaces ([Table 6.1](#)).

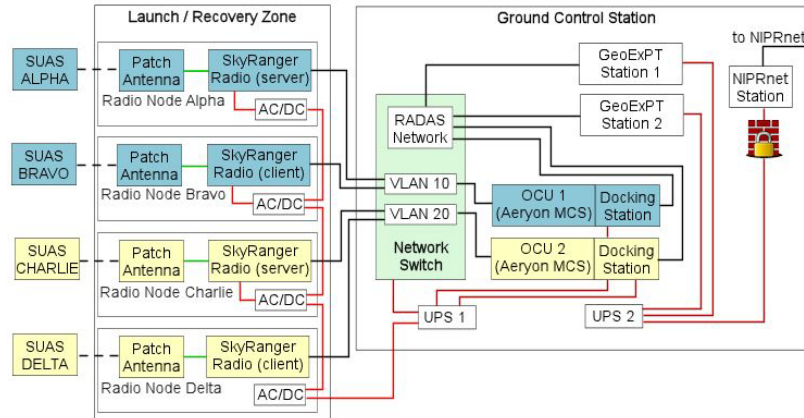
Table 6.1. Basic RADAS Kit Components.

Item	Quantity
SUAS Kits	4
Operator Control Unit (OCU) tablets	4
Propeller Arms	8
Legs	8
EO Camera	1
LWIR Camera	1
Assorted Spare Parts and Accessories	N/A
Battery Charging Case	4
Batteries	12
*Radio w/Antennas each programmed to a SUAS	4
Tripod	1
Uninterruptible Power Supply (UPS)	2
**Laptop Computer	3
Computer Monitor	4
External DVD Writers	3
Network Switch	1
Power Cord with Junction Box	1
Ethernet Cable (reel)	4
Tool Bag with Assorted Hand Tools	1
Blank Digital Versatile Disc (DVD)	100
<p>*One (1) radio and one (1) antenna are contained in a single box labeled to match its corresponding SUAS</p> <p>Note: The radio boxes and SUAS containers, along with the individual SUAS themselves, are labeled Alpha, Bravo, Charlie, or Delta, to help maintain integrity of each of the SUAS systems.</p> <p>** Two computers (Geo-1 and Geo-2) are GeoExPT control stations with each computer monitoring two (2) SUAS through a video player imbedded in GeoExPT. The third computer is provided for data transfer. All computers are preloaded with all necessary software. Also included is a source image disc to restore the computers to their original preloaded state if necessary.</p>	

Chapter 7 SYSTEM SETUP

7.1. Launch and Recovery Zone Setup. The RADAS Launch and Recovery Zone (LRZ) and GCS consists of all components necessary to control and monitor the SUAS and process the data to select the MAOS. Most of the assembly may be accomplished pre-attack, but consideration must be given to keeping assets safe and may have to be rapidly employed post-attack. [Figure 7.1](#) portrays the system architecture.

Figure 7.1. System Architecture.

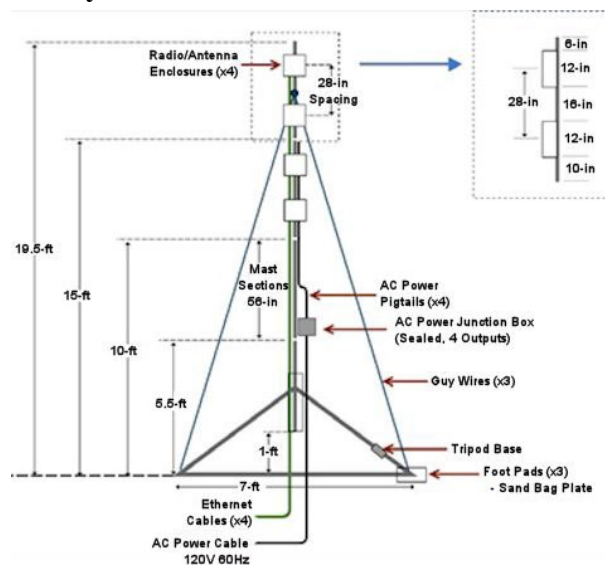


7.1.1. The LRZ requires at least three personnel to assemble and erect the antenna ([Figure 7.2](#)) and radio tripod.

Note: It is the SUAS-O’s responsibility to evaluate the environmental conditions before setting up the tripod. It is the SUAS-O’s responsibility to ensure the tripod is sufficiently secured to avoid tipping in windy conditions. Whenever the tripod mast is left erected, it is the SUAS-O’s responsibility to monitor environmental conditions during this time and to take the antenna mast down if conditions become unsafe.

7.1.1.1. Carry the tripod base to the specified radio location.

Figure 7.2. Antenna Assembly.

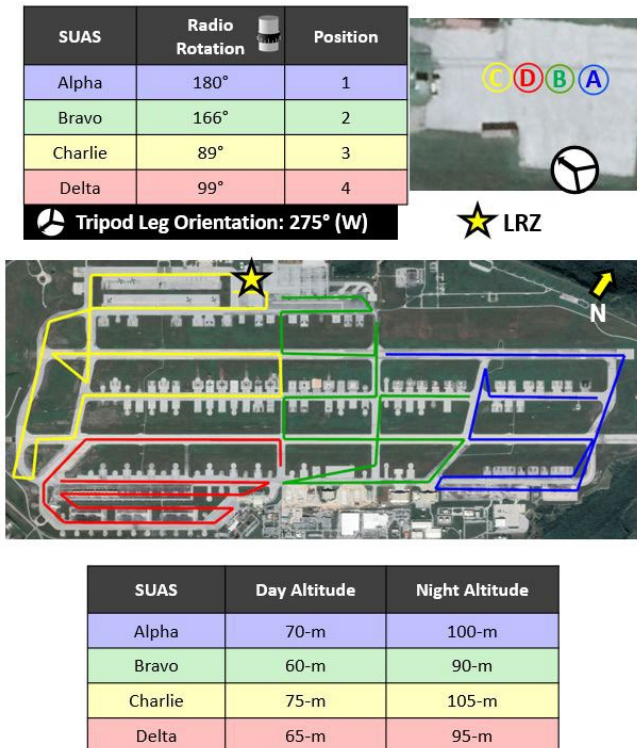


7.1.1.2. Position the tripod using a compass to place the reference (back) leg of the tripod as determined during the RADAS site survey visit and as indicated on the base specific reference card by the arrow symbol ([Figure 7.3](#)). The reference leg placement is a function of the GCS location in relation to the SUAS assessment zones.

7.1.1.3. Loosen the leg screws and extend all three legs so the leg collar rests against the end stop.

7.1.1.4. Use the compass provided and the base specific reference to orient the tripod relative to the airfield.

Figure 7.3. Base Specific Reference Card.



7.1.1.4.1. Insert the compass into the mast hole in the top of tripod base with the flat side facing out.

7.1.1.4.2. Rotate the tripod base until the compass reads the desired orientation angle ([Figure 7.4](#)).

Figure 7.4. Tripod and Antenna Mast Compass.



- 7.1.1.4.3. Check the tripod base to ensure it is plumb and adjust leg locking pins as necessary.
- 7.1.1.4.4. After all adjustments are made; tighten the screws on all three (3) tripod legs.
- 7.1.1.5. Once the tripod is in place, stake the feet ([Figure 7.5](#)) to the ground with two stakes per foot. Sand bags may be placed on the feet for added stability. If sandbags are used in lieu of stakes, the total weight of the sandbags must be at least 50-lbs per tripod foot.

Figure 7.5. Tripod Foot.



- 7.1.1.6. Next, assemble the mast sections. All four sections of the mast have the same diameter except the top guy wire pole which is slightly smaller. The mast sections are as follows:

- 7.1.1.6.1. The bottom section has a stiffening tube welded to it for the purpose of engaging the tripod base ([Figure 7.6](#)). It also has the instruction sticker.

Figure 7.6. Identification of the Bottom Section with Welded Stiffener Tube.



- 7.1.1.6.2. The next section is where the electrical junction box is mounted.
- 7.1.1.6.3. The top two sections each have two collars to enable alignment of the radio control boxes.
- 7.1.1.6.4. The guy wire insert has the same diameter as the connecting inserts but is longer and has more available mounting holes. The guy wire collar attaches to this

insert at the topmost hole. Ensure the guy wire collar rear leg tab is aligned with the rear leg when the mast is erected ([Figure 7.7](#)).

7.1.1.7. The sections are joined with connecting inserts that fit inside the main tube. Align the bolt holes and use the supplied bolts and wrenches to install them. When connecting the top two sections, ensure the locator rings are aligned with each other (0° on the top section should be oriented with 0° on the lower section).

Figure 7.7. Rear Leg Tab.



7.1.1.8. Each of the four SUAS radios and antennae are combined in a single enclosure. These radio boxes are mounted to the tripod mast in a fixed orientation so they point in specific directions once the mast is erected. Proper orientation of each radio box relative to the airfield is required to maintain the designed radio coverage and range at the site. The radio faces the SUAS sector and covers a 145° wedge, centered normal to the face of the radio box.

7.1.2. The radio boxes are mounted and aligned with the mast assembled and while it is still on the ground.

7.1.2.1. Refer to the quick-reference card for the “position” number (position 1 is the top-most radio box and position 4 is bottom-most radio box).

7.1.2.2. Loosely attach the respective radio box directly above the locator ring at the specified position. The radio box is oriented with the two cable connection plugs facing down on the same side as the locator ring.

7.1.2.3. The angle is set relative to the reference (back) leg of the tripod using the reference card to obtain the correct angle ([Figure 7.8](#)).

7.1.2.4. Rotate the radio box to align the notch in the center of the box to the specified angle on the locator ring ([Figure 7.9](#)).

7.1.2.5. Once aligned, tighten the quick-release clamp on the mast.

7.1.2.6. Connect the electrical and Ethernet cables to the radio box.

Figure 7.8. Setting Angle Relative to the Tripod Reference Leg.

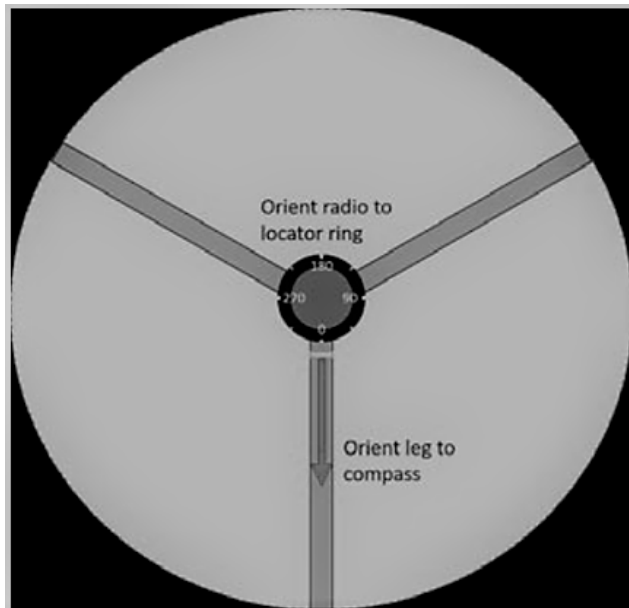


Figure 7.9. Locator Ring.



7.1.2.7. Repeat this process for all the radio boxes.

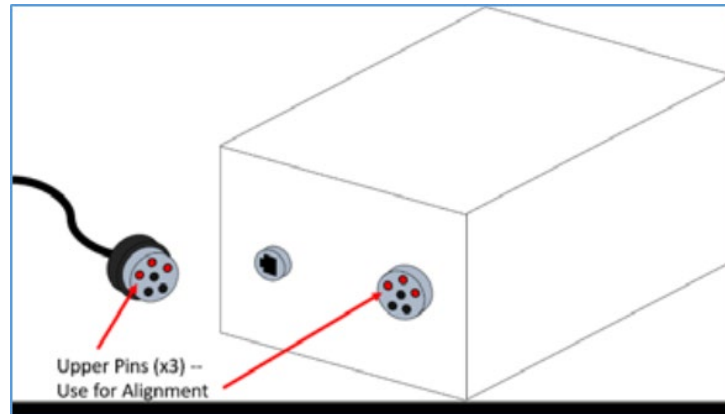
7.1.2.8. Power is supplied to the four radio boxes via the junction box on the bottom of the mast. The junction box has four electrical pigtails, each with sealed power connectors that mate with the radio boxes.

7.1.2.8.1. Mount the electrical junction box to the section of the mast below the two upper (radio box) sections.

7.1.2.8.2. Leave the main power to the junction box unplugged while completing these steps.

7.1.2.8.3. Stretch out the cables and reserve the Velcro® straps for a later step.

7.1.2.8.4. For each radio box, align the power connector. The connector has three pins along its top and two pins along its bottom ([Figure 7.10](#)).

Figure 7.10. Connector Pin Alignment.

7.1.2.8.5. Insert the power connector into the radio box and twist the collar clockwise to lock it. Ensure the twist lock has engaged properly; an inadvertent disconnection will cause loss of communication to SUAS during the RADAS mission.

7.1.2.9. Connect each radio box to its Ethernet spool before raising the mast. It is important to match the correct cable with the correct radio.

7.1.2.9.1. Identify the Ethernet cable for each of the four radio enclosures. All cables are labeled on both ends with ALPHA, BRAVO, etc.

7.1.2.9.2. Place the spools near the base of the radio tripod.

Note: Cables are run from the GCS before unspooling cable from the outside of the reel.

7.1.2.9.3. Unspool the 25-foot length of cable from the outside of each spool.

7.1.2.9.4. Identify the corresponding radio by its painted label (A, B, etc.).

7.1.2.9.5. Carefully insert the plug connector into the Ethernet receptacle on the radio box. To prevent damage to the connectors, do not force the connections.

7.1.2.9.6. Apply slight pressure on the plug while tightening the connector nut.

7.1.2.9.7. Repeat these procedures for each radio box.

7.1.2.9.8. Run the power and Ethernet cables behind the radio boxes.

7.1.2.9.9. Use the Velcro® straps (retained from the electrical junction box) to secure the cables to the mast at multiple points.

7.1.2.10. After assembling the mast and connecting the cables, use the hinged feature to raise the mast. This operation is performed by three personnel with no special equipment required.

7.1.2.10.1. Ensure the tripod is secured with stakes or by sandbags.

7.1.2.10.2. Insert the bottom section of the mast into the base of the tripod.

7.1.2.10.3. Align the lower hole in the bottom mast with the lower of the two L-shaped holes in the tripod base. Ensure the 0° mark on the locator ring is pointed up.

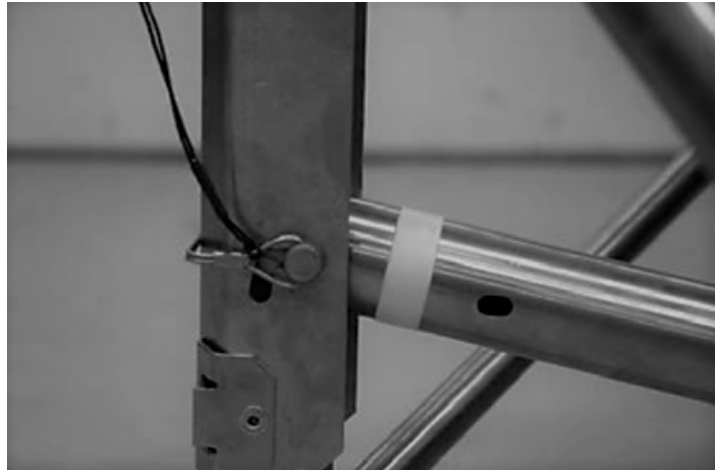
7.1.2.10.4. Insert the retaining pin through the L-shaped hole and the bottom mast section ([Figure 7.11](#)).

7.1.2.10.5. Ensure the retaining pin is in the upper part of the L-shaped hole before raising mast.

Note: Attempting to hinge the mast in any other position may result in damage to the bottom mast section.

7.1.2.10.6. Hinge the mast upward.

Figure 7.11. Retaining Pin Inserted Through L-Shaped Hole.



7.1.2.10.7. Once the mast is vertical, let the retaining pin lower into the bottom part of the L-shaped slot to secure the mast into place.

7.1.2.10.8. Close and lock the quick release clamp around the mast ([Figure 7.12](#)).

Figure 7.12. Quick Release Clamp Closed and Locked.



7.1.2.12. After raising the mast, connect the guy wires on the guy wire collar to the tripod feet. Proper completion of this step is required for stability.

7.1.2.12.1. Route guy wires so they are free of cables and radio boxes. Guy wires should be routed behind or to the sides of radio boxes, never in front of them.

7.1.2.12.2. Fully loosen the turnbuckle and clip the hook into the corresponding tripod leg.

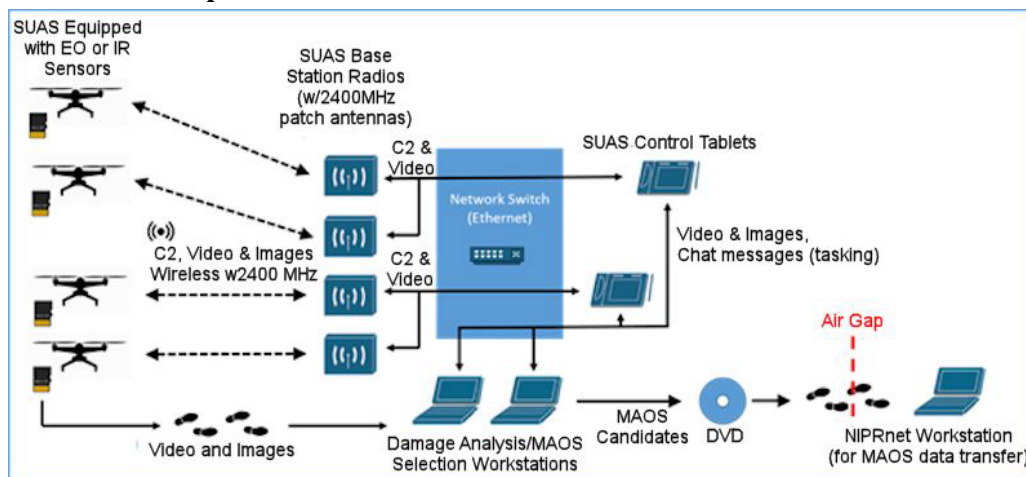
7.1.2.12.3. Tighten the turnbuckles evenly on each wire.

7.1.2.12.4. Inspect the wires for tightness. Each guy wire should have a light level of tension, and the mast should be plumb.

7.2. GCS Setup. After setting up the radio/antenna tripod during the pre-attack phase, the SUAS and GeoExPT Operators work together to set up the GCS ([Figure 7.13](#)). All GCS components are collocated indoors at the location determined during the site survey. The optimum GCS location is centralized and directly accessible to the airfield operating surfaces, within 300-feet of the LRZ, away from radars and other frequency generation sites, and has connection to the installation Non-Secure Internet Protocol Router (NIPR) Net.

7.2.1. The average setup time takes the team 45-to 60-minutes in the anticipation pre-attack phase for set up of the entire kit from packaging. Aside from the radio boxes, the system can stay set up. The radio boxes, however, can only be exposed to weather for less than 30-days. See RADAS Concept of Operation (CONOP) for the detailed guidance on who does what function and when and ties the actions to the appropriate alarm conditions.

Figure 7.13. GCS Components.



7.2.2. First, connect the central power and networking. All RADAS GCS components are powered through the two UPS units. Only plug RADAS components into the UPS; otherwise, it shortens the reserve power. Only the UPS units are to be connected to the facility's power supply.

7.2.2.1. Plug in the battery connector in the back of the UPS (disconnected for shipment).

7.2.2.2. Plug in the input of the UPS to AC line power of the GCS facility.

7.2.2.3. Press and hold the power button on the front of the UPS to turn it on.

7.2.2.4. Plug a power strip (supplied with the RADAS hardware) into the back of each UPS. All components connect to power via these power strips (instead of directly into the UPS).

7.2.3. The RADAS is supplied with a Cisco Catalyst 3850 network switch pre-configured specifically for the system architecture.

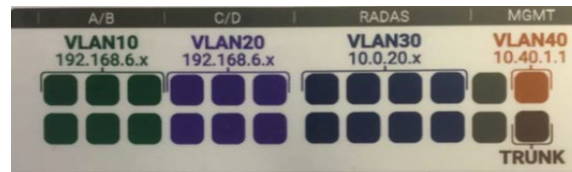
7.2.3.1. Insert the switch power supply into the back of the network switch.

7.2.3.2. Plug in the Cisco power cable supplied with the switch. Plug the input end of the cable into UPS 1 via the power strip.

7.2.3.3. The switch automatically boots when power is applied; however, it may take approximately five minutes to boot.

7.2.3.4. The RADAS switch configuration is designed specifically for the RADAS mission ([Figure 7.14](#)). Specific ports on the front of the switch are separated on three Virtual Local Area Network (VLAN). For maintenance and troubleshooting, the right-most ports are configured as Management and Trunk Ports; therefore, no RADAS equipment is connected to these ports.

Figure 7.14. Network Switch Color Coding.



7.2.4. The SUAS-O Station is comprised of two tablet PCs, docking stations, and supporting hardware.

7.2.4.1. The SUAS control tablet has two Ethernet connections, one to the main RADAS network and one to the SUAS base station radio.

7.2.4.2. Each SkyRanger™ kit comes with a tablet PC and power adapter, there are four tablets in the RADAS equipment kit, but only two are required for the mission. Each SUAS-O chooses one tablet for the mission (each pair of tablets is configured identically).

7.2.4.2.1. Operator 1: Tablet Alpha or Bravo (both tablets are paired with Docking Station 1).

7.2.4.2.2. Operator 2: Tablet Charlie or Delta (both tablets are paired with Docking Station 2).

7.2.4.2.3. Unpack docking station and insert tablet PC. Both docking stations are labeled.

7.2.4.2.3.1. SUAS-O 1: Docking Station 1.

7.2.4.2.3.2. SUAS-O 2: Docking Station 2.

7.2.4.2.3.3. Connect power to the tablet and monitors.

7.2.4.2.3.4. Connect the power adapter (from the SkyRanger™ mission case) to the back of the docking station.

7.2.4.2.3.5. Connect the input of the power adapter to UPS 1 (via the power strip).

7.2.4.2.3.6. Connect keyboard and mouse to USB ports on the back of the docking station.

7.2.4.2.3.7. Use the supplied High Definition Multimedia Interface (HDMI) to Digital Visual Interface (DVI) cable (in the monitor box) to connect the tablet PC to the second monitor.

Note: Make this connection directly from the HDMI port on the side of the tablet, not the docking station. A connection to the docking station may result in poor display performance.

7.2.4.2.4. Each SUAS-O performs the following steps to make Ethernet connections to the SUAS control tablet. All Ethernet cables are pre-labeled and provided as part of

the RADAS system kit. During this step, it is important to follow the labeling of each cable and to connect to the correct ports on the central network switch.

7.2.4.2.4.1. Connect the Ethernet cable between the tablet and the SUAS VLAN.

7.2.4.2.4.2. Connect the cable labeled “Mission Control Software (MCS) Tablet [X] Top” to the jack on top of the tablet.

7.2.4.2.4.3. Connect the other end of the cable (“MCS Tablet [X] Switch VLAN [X0]”) to the correct port on the network switch.

7.2.4.2.4.4. Connect the Ethernet cable between the tablet and the RADAS network VLAN.

7.2.4.2.4.5. Connect the cable labeled “MCS Tablet [X] Dock” to the jack on the back of the docking station.

7.2.4.2.4.6. Connect the other end of the cable (“MCS Tablet [X] Switch RADASnet”) to the correct port on the network switch.

7.2.4.2.5. The GeoExPT Operator Station is comprised of two laptop PCs, docking stations, and supporting hardware.

7.2.4.2.6. Connect the power supply to the GeoExPT docking station and connect the input end to UPS 2 (via power strip).

7.2.4.2.7. Connect the power cables to the extra monitors (one for each GeoExPT computer and connect the input end to UPS 2 (via power strip).

7.2.4.2.8. Connect mouse and disc reader to the USB ports on each of the GeoExPT docking stations.

7.2.4.2.9. Each GeoExPT computer has a single Ethernet connection to the RADAS network. Each GeoExPT Operator performs the following steps to make the proper Ethernet connections. All Ethernet cables are pre-labeled and provided as part of the RADAS system kit. During this step, it is important to follow the labeling of each cable and to connect to the correct ports on the central network switch.

7.2.4.2.10. Connect the cable labeled “GeoStation [X]” to the jack on the docking station.

7.2.4.2.11. Connect the other end of the cable (“GeoStation [X] Switch RADASnet”) to the correct port on the network switch ([Figure 7.15](#)).

Figure 7.15. Network Switch.



7.2.5. The Ethernet and power connections to the antenna/radio subsystem are made inside the GCS. The RADAS system uses pass-throughs to connect power and data between the

GCS and the radio boxes. To use the cable pass-throughs, simply open the pass-through cover and feed the switch end (inside-use connector) into the GCS. Once the cable lengths have been adjusted properly, be sure to strain-relief the cables outside with a sand bag or equivalent.

7.2.5.1. The SkyRanger™ base station radios are powered via a single AC electrical connection made to the UPS inside of the GCS. The UPS provides a continuous source of power to the radios.

7.2.5.2. Connect the radio power cable (labeled “Radio Power”) to UPS 1.

Note: If this cable is unplugged, the radios will turn off and the operators will lose connection to the aircraft. The radios will reboot when the cable is plugged back in after 2-3 minutes.

7.2.5.3. Each radio has an independent Ethernet connection. Connect the four Ethernet cables to the network switch. All Ethernet cables are pre-labeled and provided as part of the RADAS system kit. During this step, it is important to follow the labeling of each cable and to connect to the correct ports on the central network switch.

7.2.5.4. Connect the four radio Ethernet cables to the central network switch according to the [Table 7.1](#).

Table 7.1. Cable Connection Matrix.

Cable	Label	Connection
Alpha SUAS	ALPHA SW VLAN 10	Ports 1-6
Bravo SUAS	BRAVO SW VLAN 10	Ports 1-6
Charlie SUAS	CHARLIE SW VLAN 20	Ports 7-12
Delta SUAS	DELTA SW VLAN 20	Ports 7-12

7.2.6. The primary system components of RADAS are “air gapped” and not allowed to be connected to the Air Force network. Each RADAS system comes with a third laptop PC for connection to NIPRnet. This laptop is labeled “NIPRnet PC” and is equipped with a mouse but no second monitor.

7.2.6.1. Connect the power adapter to the back of the NIPRnet laptop docking station and connect the input end of the power adapter to UPS 2 (via the power strip).

7.2.6.2. Connect the mouse and disc reader to USB ports on the NIPRnet docking station.

7.2.6.3. Connect an Ethernet cable between the NIPRnet docking station and an active NIPRnet port (either from RADAS extra cables or supplied locally).

Note: Data is transferred between the GeoExPT laptops and the NIPRnet computer via DVD drive/disc. No RADAS hardware should be connected to the NIPRnet other than the NIPRnet computer.

7.3. Charging Batteries. Ensure SUAS batteries are fully charged prior to use. Do this by placing the batteries in the charging ports of the case ([Figure 7.16](#)) and connecting the case to a 120-vac outlet using the power cord provided. Once the battery is fully charged, use the battery

button on the top to check battery charge status. Prior to flying the SUAS, connect the battery to the top of the SUAS body.

Figure 7.16. Battery Charging Case.



7.4. FLIR SkyRanger™ Setup. Before operation, the FLIR SkyRanger™ SUAS ([Figure 7.17](#)) requires assembly.

Figure 7.17. FLIR SkyRanger™.



7.4.1. The kit comes with eight legs, two of which are antenna legs that can be identified by a small wire connector used to plug into the SUAS body ([Figure 7.18](#)). Connect one antenna and three non-antenna legs to the SUAS body. There is only one antenna leg plug-in on the SUAS body. If the antenna leg is installed in the wrong spot, swap it with a misplaced non-antenna leg. Only four of the legs are used. There are three non-antenna legs and one antenna leg spare.

Figure 7.18. Non-Antenna and Antenna Legs.



7.4.2. There are eight propeller arms. The arms are color-coded, four black and four white ([Figure 7.19](#)), to correspond with placement on the SUAS body. Connect two black and two white arms to the SUAS body, paying attention to the color-coding. Only four of the eight arms are used. There are two spares of each color.

Figure 7.19. Propeller Arms.

7.4.3. Remove the programming payload from the bottom of the SUAS body by turning the locking lever.

7.4.4. Connect either the EO or the LWIR camera to the bottom of the SUAS body and lock in place by turning the locking lever. The EO camera is typically used when visibility is good while the LWIR camera is utilized in low visibility environments. Ensure the sensor has a blank SD card installed (as appropriate per sensor).

7.4.5. Prior to flight, connect a battery to the SUAS in the allocated spot on top of the SUAS ([Figure 7.20](#)).

7.4.6. Ensure a blank SD card is installed in the bottom of the SUAS. The SD card is the only way to get high-resolution mission photos; the files passed by MCS are not much more than thumbnails. When the aircraft lands, either the SUAS-O or the GeoExPT operators should transfer the photos into the media folder on Geo1 (there are SD readers on all the machines).

7.4.7. Ensure all data is downloaded from the SD card after each mission is over and a new card is used for each mission. Enough cards are fielded to swap them out and transfer the files during the mission.

Note: SUAS operations are to be performed by a trained and certified (SUAS-O) only. Instructions provided in this TTP are provided for any potential assistance to the SUAS-O in assembly of the aircraft and its supporting equipment. There are additional operational checks not included in this TTP, which are covered in the SUAS-O training slides, operator's manual, and checklists.

Figure 7.20. Connecting Battery.



Chapter 8 GeoExPT RADAS OPERATIONS

8.1. GeoExPT. The following paragraphs describe specific GeoExPT operations as they apply to RADAS. For basic instruction, a GeoExPT Users Guide is available on the Expeditionary Engineering SharePoint™ at <https://usaf.dps.mil/sites/13072/SitePages/Homepage.aspx>.

8.1.1. Double click the GeoExPT icon on the Geo-1 and -2's desktop to open GeoExPT.

Note: Do not use the AutoCAD® Map3D icon to access the program, doing so does not enable GeoExPT functionality. Conversely, opening the program with the GeoExPT icon enables all GeoExPT as well as all Map3D functionality.

8.1.2. Open the installation GeoExPT Scenario.

8.1.3. In the ADR Sync tab, connect the Geo-2 computer to GAS by clicking on the Connect button.

Note: GAS is initiated automatically on Geo-1 during start-up. Geo-2 is required to connect to GAS to have any RADAS functionality. Once all operators, Geo-1, Geo-2, SUAS Station Alpha-Bravo, and Charlie-Delta send the test message via the chat function to ensure connectivity of all systems and confirmed by the team lead. Once all operators (Geo-1, Geo-2, and SUAS Stations Alpha-Bravo and Charlie-Delta) send a test message, the team lead reports mission ready status to the EOC.

8.1.4. In the ADR Sync tab on both the Geo-1 and -2 computers, turn on the chat feature by clicking on the Chat button. This function provides a communication feature common to all GAS connected devices, both Geo computers and SUAS control tablets.

8.1.5. Enable video rotation by clicking the GeoExPT Settings button in the View tab.

8.1.5.1. Select “media” from the menu on the right-hand side.

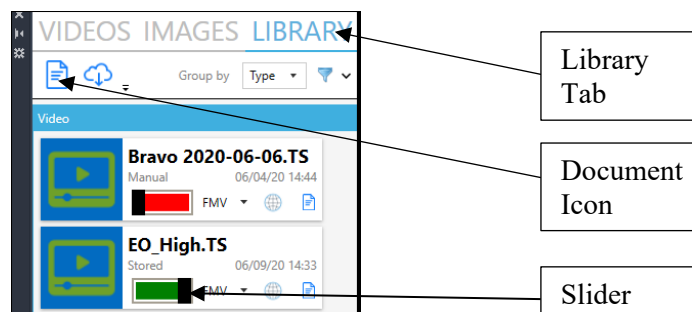
8.1.5.2. Click-on the Show Video Rotation Slider and close the dialog box.

8.1.6. In the View tab, open Media Panel in the Panes group. This opens the video control window.

8.1.7. To open the SUAS video feed, click on the library tab and then the Document icon ([Figure 8.1](#)).

8.1.7.1. Once the dialog box opens, click the folder icon to browse the SUAS media folder. The SUAS-O needs to establish the video feed in order to be viewed in GeoExPT.

Figure 8.1. Media Panel.



8.1.7.2. Double click on the video file or highlight the file and press enter to view and manipulate the video in GeoExPT. If there are multiple videos in the file, the live video does not have a time associated with them. Once a live feed has ended and is saved, the date and time is displayed, making them easily identifiable as older videos.

8.1.7.3. Repeat this process to view and manipulate additional video feeds.

8.1.7.4. The Geo-1 computer's GeoExPT operator monitors two SUAS operations; SUAS Alpha and Bravo feeds are monitored on Geo-1 computer while Charlie and Delta are on Geo-2.

8.1.8. To activate the video, click the slider bar below the video thumbnail.

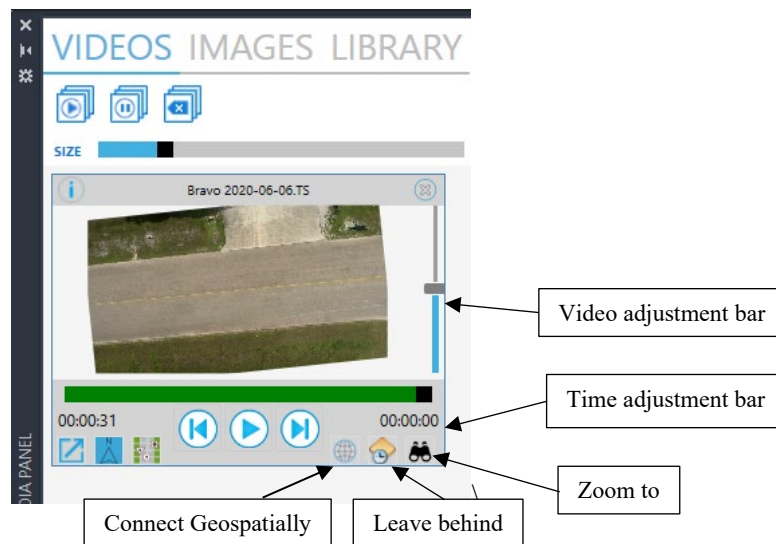
8.1.9. Click on the video tab in the Media Panel ([Figure 8.2](#)) to view the thumbnails of the video feeds.

8.1.10. Double click on the video to expand (pop out) the video to allow better viewing of the video stream. More importantly, the video feed must be expanded and geospatially connected for feature, UXO, craters and crater fields, spalls and spall fields, etc., placement.

8.1.11. Click on the Globe icon below the video to place the video on the map geospatially.

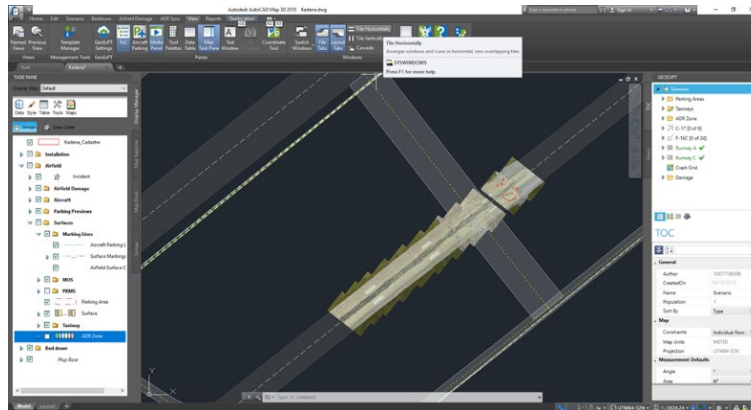
8.1.11.1. The slider bar beneath the video indicates position of the video relative to time. Sliding the bar to the far right brings the video to real time.

Figure 8.2. Media Panel.



8.1.11.2. The “Leave Behind” icon to the bottom right of the video shows leave behinds of the video. Leave behinds are single images with a 10% overlap creating a very rudimentary mosaic ([Figure 8.3](#)). The “leave behinds” only show about one minute worth of images.

Figure 8.3. GeoExPT with Leave Behinds.



8.1.11.3. Clicking on the binocular icon zooms to the video feed on the map.

8.1.11.4. Moving the video rotation adjustment bar on the right of video player rotates the video/leave behinds. Ideally, the collection should be parallel to the surface's centerline. Adjusting the view does not change the video feed; it only adjusts the view of the GeoExPT operator. Failure to adjust the video could skew the geospatial digitization results. It is recommended this adjustment be applied for each surface collection.

8.1.12. Digitize damage and UXO on the video while the video is playing or paused using the same steps as GeoExPT without RADAS connected. Users may also digitize damage or UXO on the map itself ([Figure 8.4](#)).

8.1.12.1. Damage placed is seen by both GeoExPT operators. If digitizing damage in the video panel, it is best to digitize in the center of the view ([Figure 8.5](#)). The video panel does not have zoom capability, therefore digitize in the main map view for best accuracy.

Figure 8.4. Video Editor with Damage Plotted.

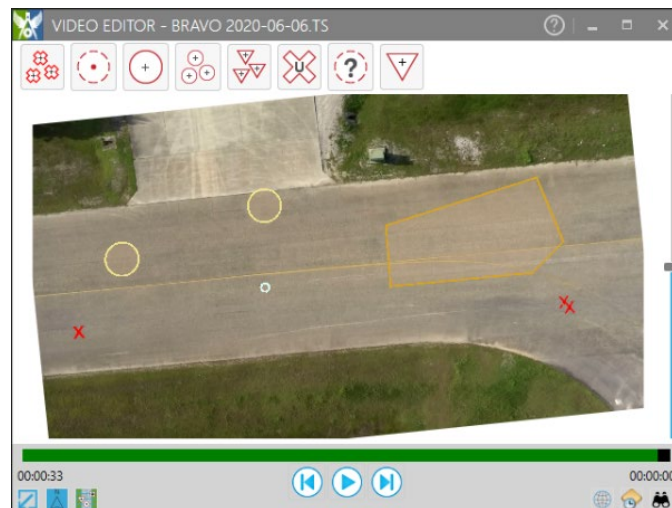
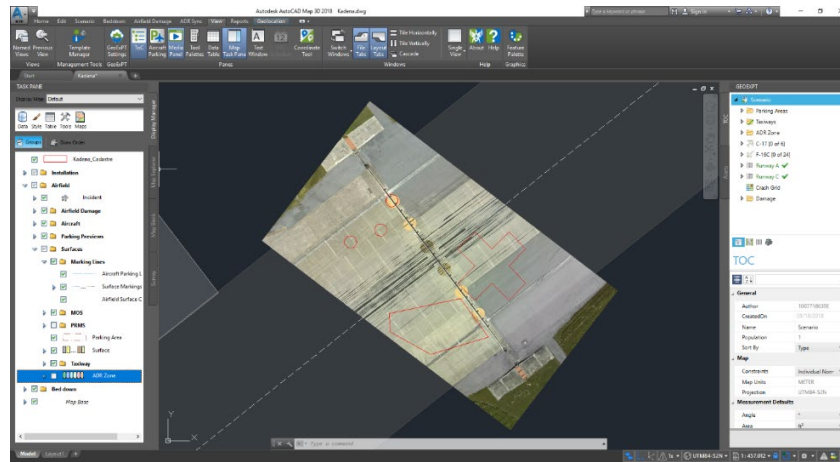


Figure 8.5. GeoExPT with Damage Plotted.



8.1.12.2. Once the initial assessment run is complete, the SUAS-O sends the SUAS back to these identified points with a fresh battery and SD-Card at a lower elevation, enabling a high resolution or oblique inspections.

8.1.13. Once the damage and UXO are identified, MAOS candidates are identified and a MAOS candidate report is generated. The steps for MAOS selection in GeoExPT have not changed and can be found in the GeoExPT User Guide.

8.1.13.1. The report is generated in GeoExPT by selecting the Minimum Operating Strip (MOS) Candidate Selection button in the Reports Tab.

8.1.13.2. Once the MOS Candidate Selection Report dialog is displayed, select “print” to generate the report as an Excel spreadsheet.

8.1.13.3. Save the report and copy it onto a writable DVD.

8.1.13.4. Send the report to the EOC via the NIPR computer for the MAOS selection briefing.

8.2. Archiving and Troubleshooting. All RADAS data is stored on the GeoExPT stations in the C:\RADAS\SUAS-Data folder. Before each mission, old media files should be archived to prevent confusion. Asset Interface regenerates folders for the aircraft to store videos, so the entire SUAS Data\Videos folder can be archived.

8.2.1. To archive video files:

8.2.1.1. Verify Asset Interface is not running on the SUAS Control Station.

8.2.1.2. Create new folder in C:\RADAS\SUAS-Data\Videos called [YYYY]-[MM]-[DD] VideoArchive (for example, ‘2020-01-01_VideoArchive’ for footage filmed on January 1, 2020).

8.2.1.3. Highlight folders Alpha through Delta.

8.2.1.4. Drag folders to new archive folder.

8.2.2. To archive images:

8.2.2.1. Verify Asset Interface is not running on the SUAS Control Station.

8.2.2.2. Create new folder in C:\RADAS\SUAS-Data\Images called YYYY-MM-DD_ImageArchive.

8.2.2.3. Drag all image folders to new archive folder.

8.2.3. It is the GeoExPT operator's responsibility to manage hard drive space on the Geo Station laptops. It is recommended the operators archive video and image data to an external repository after each major exercise.

8.2.4. The SkyRanger™ automatically downloads logs to MCS after each flight. It is recommended the SUAS-O allow log downloads to complete after each set of missions (e.g., once or twice per day of operating). These logs are compiled as part of the log compilation steps below.

8.2.4.1. MCS and Asset Interface also generate log files during operation. It is recommended the SUAS-Os archive log files after each major exercise. To perform this function, MCS control tablets are pre-configured with a log compilation script. This script compresses and copies SUAS, MCS, and Asset Interface logs to an archive directory in C:\RADAS\Logs. To create a compressed log archive, perform the following steps.

8.2.4.1.1. Navigate to C:\RADAS\Software\Bin\AssetInterfaceLaunchers.

8.2.4.1.2. Run GetLogFiles.bat (double-click).

8.2.4.1.3. A compressed folder is generated in C:\RADAS\Logs with the timestamp of when the archive is created.

8.2.4.2. The primary log-generating software on the Geo Station laptops is GeoExPT. Logs are generated in the following folder:

C:\Dynamic Software Solutions\GeoExPT Plugin \[Version]\GeoExPTPlugin.
bundle\Contents\Logs

8.2.5. If problems arise that cannot be resolved through normal GeoExPT/ AutoCAD® Map 3D troubleshooting measures, a system restoration disc is supplied that resets the computer to its original state. Any data captured after initial delivery of the system will be lost. In addition, the AFCEC Reachback Center can provide assistance. Their contact information is as follows:

Air Force Civil Engineer Center
Reachback Center
Through CE DASH,
NIPR: afcec.rbc@us.af.mil,
SIPR: usaf.tyndall.afcec.mbx.afcec@mail.smil.mil
DSN 523-6995,
Commercial 850 283-6695/888-232-3721

Chapter 9 ASSESSMENT PROCESS

9.1. Assessment Methodologies. The SUAS fly on preprogrammed flight plans designed to optimize aircraft performance, predominate environmental conditions, and coverage of the airfield operating surfaces. These are not the same routes utilized by the ADATs. Generally, the data collection is based on the priority order listed in [Table 9.1](#).

Table 9.1. Assessment Priorities.

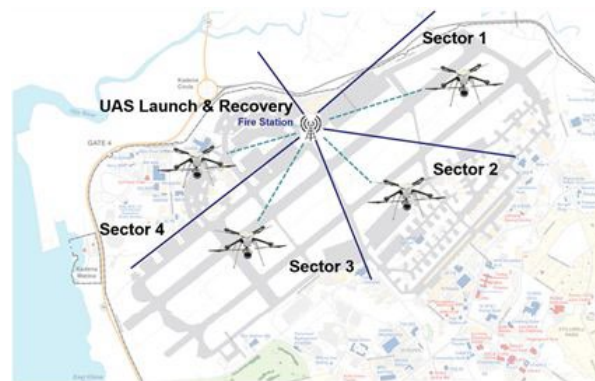
Priority	Airfield Location
1	Takeoff or landing surfaces (e.g., runways, alternate launch and recovery surfaces, and taxiway segments long enough to permit aircraft launch and recovery)
2	Access pavements to takeoff or landing surfaces
3	Aircraft parking areas
4	Infrastructure such as lighting (including [PAPIs], utility lines, signage, etc.)
5	Aircraft arresting systems
6	Aircraft rearming and refueling areas
7	Other specified locations as defined in the Facility Prioritization List or as determined by installation leadership

9.2. Installation Sectors. Due to amount of pavement to be assessed, the installation is divided into four sectors. These sectors are determined based on radio performance from the centralized GCS, and attempts to equalize the data collection times for each sector. Expect this process to take 15-20 minutes. [Figure 9.1](#) represents the installation divided into sectors.

9.3. Flight Profiles. There are four basic SUAS flight profiles to perform damage assessment as listed below.

9.3.1. Visual Inspection of the Airfield Operating Surfaces. Visual Inspection entails launching the SUAS on a preprogrammed path over the airfield operating surfaces to collect video data of the surfaces. Data is stored on board the aircraft and streamed in real-time to the GCS (two GeoExPT stations). This replicates ADATs driving the airfield operating surfaces. The 3E5X1 and 3E8X1 technicians are able to digitize damage and UXO features on the live video and mark areas of concern for further investigation. GeoExPT provides the ability to pause and rewind videos to give technicians time to fully analyze video streams.

Figure 9.1. Installation Sector Zones.



9.3.2. Interrogation of an Area of Interest (AOI). The second and third SUAS missions are to further investigate the identified areas of concern. They have the ability to fly at different elevations (to improve the ground pixel resolution), fly at different oblique angles, and take photos or more video for further inspection.

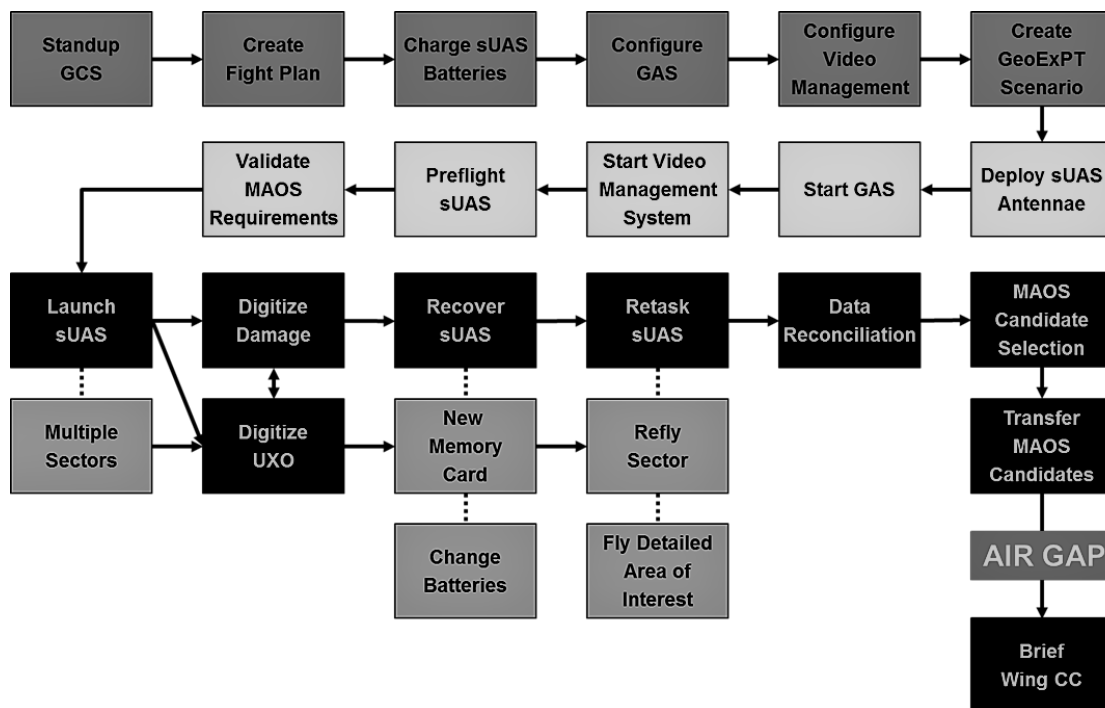
9.3.2.1. Still Photos. Still photos entail launching the SUAS to a designated coordinate, hovering at a lower elevation, and collecting still pictures (at NADIR or oblique) of an item of interest.

9.3.2.2. Video. This entails launching the SUAS to a designated coordinate, circling the AOI at a lower elevation, and capturing video (at NADIR or oblique) of the AOI.

9.3.3. Data Transfer. Data is streamed in real-time from the SUAS to GeoExPT in the GCS. If a technical difficulty prevents the SUAS from stream data in real-time, the SUAS is landed near the GCS after the route is complete and the memory card extracted for delivery to the GCS. The MAOS Selection Team imports data from the memory card into GeoExPT. The MAOS Selection Cell analyses and selects at least three MAOS candidates. Once the MAOS candidates are created, the GeoExPT MAOS candidate report is copied to a DVD to transfer data to the NIPR computer located in the GCS. The information is then fed into the EOC to brief the Installation Commander for final MAOS selection.

9.4. RADAS Workflow. RADAS follows the traditional assessment workflow, which is directly tied the USAF Alarm Conditions. [Figure 9.2](#) reflects major RADAS tasks associated with each alarm Condition.

Figure 9.2. RADAS Workflow.



WARREN D. BERRY
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 DCS/Logistics, Engineering & Force Protection

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

Air Force Doctrine Annex 3-34, *Engineer Operations*, 17 December 2018

AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 9 July 2019

AFI 10-209, *RED HORSE Program*, 11 June 2019

AFI 33-322, *Records Management and Information Governance Program*, 23 March 2020

AFPAM 10-219, Volume 3, *Civil Engineer Contingency Response and Recovery Procedures*, 7 May 2015

AFPAM 10-219, Volume 4, *Airfield Damage Repair Operations*, 28 May 2008

AFTTP 3-32.5, Volume 6, *Explosive Ordnance Disposal (EOD) UXO Operations*, 28 April 2015

JP 3-30, *Joint Air Operations*, 25 July 2019

Prescribed Forms

No prescribed forms are implemented in this publication.

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

ADAT—Airfield Damage Assessment Team

ADR—Airfield Damage Repair

AFI—Air Force Instruction

AFPAM—Air Force Pamphlet

AFTTP—Air Force Tactics, Techniques, and Procedures

CAT—Crisis Action Team

CE—Civil Engineer

DVD—digital versatile disc

DVI—Digital Visual Interface

EOC—Emergency Operations Center

EOD—explosive ordnance disposal

GAS—GeoExPT ADR Synchronization

GCS—Ground Control System

GeoExPT—Geospatial Expeditionary Planning Tool

HDMI—High-Definition Multimedia Interface

JP—Joint Publication

MAOS—minimum airfield operating surface

MCS—Mission Control Software

MGRS—Military Grid Reference System

MOS—Minimum Operating Strip

NIPR—Non-Secure Internet Protocol Router

OPR—office of primary responsibility

PRMS—Pavement Reference Marking System

RADAS—Rapid Airfield Damage Assessment System

RADR—Rapid Airfield Damage Recovery

SUAS—Small Unmanned Aircraft System

SUAS-O—SUAS Operator

TOL—takeoff or landing

TTP—tactics, techniques, and procedures

UXO—unexploded explosive ordnance

VLAN—Virtual Local Area Network

Terms

Access route—The route aircraft must take from the parking area/shelter to a TOL surface. Typically the route meanders to avoid damage. The time to clear or repair the access route is a consideration in MAOS selection. The terms “transition path, taxiway, and transition route” are sometimes used to indicate an access route on a launch or recovery surface.

Actual crater diameter—The actual crater diameter is the diameter across the crater after the heaved pavement has been removed; in other words, the actual size of the required repair, in most cases is significantly larger than the apparent diameter.

Airfield—An area prepared for the accommodation (including any buildings, installations, and equipment), landing, or takeoff of aircraft.

Air tasking order (ATO)—A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions. Normally provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Source: Joint Publication (JP) 3-30, *Joint Air Operations*.

Airfield damage assessment—Locating, classifying, and measuring the damage (camouflet, crater, spall, and UXO) on the airfield operating surfaces.

Airfield Damage Assessment Team (ADAT)—An airfield recovery team, typically located in or near the EOC and directed by the ESF 3, used to identify and locate airfield damage and UXO following an attack. Their initial efforts are normally targeted towards the airfield proper; but can also be employed elsewhere as deemed necessary. The ADAT usually consists of one

engineering technician and two EOD technicians. A CE member trained as an EOD assistant may replace one of the EOD technicians when two are unavailable for ADAT. The ADAT should be equipped with an armored vehicle and communications enabling them to report their observations to the MAOS Selection Cell. The ADAT damage reports must be accurate, as this information is used in MAOS selection.

Alarm black—An alert condition signifying the attack is over, but post attack hazards are likely present. Personnel should follow the directions from the EOC and CAT in regards to movement, personal protective equipment, and individual protective equipment.

Apparent crater diameter—The visible diameter of the crater, inside edge to inside edge, at the original surface level prior to debris being removed. In actual practice, this can be measured from pavement edge to pavement edge. Apparent diameter is the information forwarded to the MAOS Selection Cell by the ADATs.

Apron/ramp—A defined area on an airfield intended to accommodate aircraft for the purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance.

Bomblet field—A cluster of sub-munitions within a defined area.

Camouflet—Craters with relatively small apparent diameters, but deep penetration and subsurface voids created by the munition puncturing through the pavement surface and exploding in the base material. **Note:** Munitions that penetrate the surface but do not explode are also treated as a camouflets.

Camouflet field—A cluster of spalls within a defined area.

Crater—The pit, depression, or cavity formed in the surface of the earth by an explosion. It may range from saucer-shaped to conical, depending largely on the depth of burst.

Crater field—A cluster of small craters (less than two feet apart) where their upheaval joins the neighboring crater within a defined area.

Damage assessment—1. The determination of the effects attacks have on targets. 2. (AF/CE) The process of identifying and locating damage and UXO following an attack. Damage assessment activities generally are separated into two categories: airfield pavements and facility/utility.

Emergency Operations Center—A temporary or permanent facility where the coordination of information and resources to support domestic incident management activities normally takes place.

Explosive hazard—Any hazard containing an explosive component to include unexploded explosive ordnance (including land mines), booby traps (some booby traps are nonexplosive), improvised explosive devices (which are an improvised type of booby trap), captured enemy ammunition, and bulk explosives.

Explosive ordnance—All munitions containing explosives, nuclear fission or fusion materials, and biological and chemical agents.

Explosive ordnance disposal (EOD)—The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance which has become hazardous by damage or deterioration.

Initial reconnaissance—The initial, long-range damage assessment conducted from observation

posts, control towers, airbase point defense positions, and other airfield vantage points.

MAOS selection—The process of plotting damage and UXO locations on an airbase runway map and using this information to select a portion of the damaged runway which can be repaired most quickly to support aircraft operations.

Minimum airfield operating surface (MAOS)—The combined requirement for airfield surfaces for both runway and access routes. The MOS is a component of the MAOS.

Minimum operating strip (MOS)—1. A runway, which meets the minimum requirements for operating assigned and/or allocated aircraft, types on a particular airfield at maximum or combat gross weight. 2. The MOS is the smallest amount of area to be repaired to launch or recover aircraft after an attack. Selection of this MOS depends upon mission requirements, taxi access, resources available and estimated time to repair. For fighter aircraft, the typically accepted dimensions are 5,000 feet long by 50 feet wide.

NADIR—Camera axis (in the direction of the lens) perpendicular to the ground/object.

Ordnance—Explosives, chemicals, pyrotechnics, and similar stores, e.g., bombs, guns and ammunition, flares, smoke, or napalm.

Personnel—Those individuals required in either a military or civilian capacity to accomplish the assigned mission.

Procedures—Standard, detailed steps that prescribe how to perform specific tasks.

Ramp—see “apron.”

Rapid Airfield Damage Assessment System (RADAS)—A remotely operated system to rapidly assess airfield damage and UXO after an attack and provides data necessary to rapidly repair the airfield to meet Combatant Commander ATO requirements.

RED HORSE—Air Force units wartime-structured to provide a heavy engineer capability that are mobile, rapidly deployable, and largely self-sufficient for limited periods of time.

Reconnaissance—A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or adversary, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area.

Render safe procedures—The portion of the explosive ordnance disposal procedures involving the application of special explosive ordnance disposal methods and tools to provide for the interruption of functions or separation of essential components of unexploded explosive ordnance to prevent an unacceptable detonation.

Runway—A defined rectangular area of an airfield, prepared for the landing or takeoff run of aircraft along its length. A runway is measured from the outer edge of the thresholds from one end of the runway to the others. The width of the runway is typically measured from the outer edge of the load-bearing pavement on one side to the outer edge of the load-bearing pavement on the other side. In some cases, the runway may be measured from the outside edge of the runway marking line on one side to the outside edge of the marking line on the other side and any remaining load bearing pavement is considered shoulder.

Spall—Pavement damage that does not penetrate through the pavement surface to the underlying soil layers. A spall damage area could be up to 5 feet in diameter.

Spall field—A cluster of spalls within a defined area.

Taxiway—A specially-prepared or designated path on an airfield or heliport, other than apron areas, on which aircraft move under their own power to and from landing, takeoff, service, and parking areas.

Techniques—Non-prescriptive ways or methods use to perform missions, functions, or tasks.

Transition route—See access route.

Unexploded Ordnance (UXO)—Explosive ordnance which has been primed, fuzed, armed, or otherwise prepared for action, and which has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material, and remains unexploded either by malfunction or design.

Attachment 2 AIRFIELD DAMAGE RECORDING FORM

Figure A2.1. Example of Recording Airfield Damage.

Item	Mandatory Entries				*C = Crater		X = UXO		S = Spall		B = Bomblet		M = Camouflet		15. Description / Info
	1. Damage Type or UXO *(C, X, S, B)	2. Location	3. Left or Right of C/L	4. Distance from C/L	5. Diameter / Width	6. Size of D / W	7. Field Identifier (F)	8. End of Field Location	9. Left or Right of C/L	10. Distance from C/L	11. Width Identifier (W)	12. Width Size	13. Number Identifier (N)	14. Number of Spall/UXO/ Crater/Bomblet	
1	B	620	L	10	W	60	F	740	R	30	W	20	N	250	E13
2	S	320	R	50	W	40	F	520	L	40	W	60	N	100	
3	X	250	R	20											B2, 8-ft L, 6-in D, silver, intact
4	C	140	R	20	D	30									
5	M	45	L	80	D	4									Est. cavity diameter
6															
7															
8															
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1. Damage Type or UXO: C=crater, X=UXO, S=spall, B=bomblet field, and M=camouflet (field)
2. Location: Distance from 0 point of pavement reference marking system (PRMS) to center of crater, UXO or to closest leading edge of spall, camouflet or bomblet field.
3. Left or Right of C/L (L, R): Denotes direction from C/L to damage / UXO center point.
4. Distance from C/L: Numerical distance left or right from C/L expressed in feet.
5. Diameter / Width: **D** for craters or circular spall, camouflet or bomblet fields; **W** for rectangular spall, camouflet or bomblet fields.
6. Size of D/W: Estimation of apparent diameter of field width.
7. Field Identifier (F): If required, enter "F" to alert MAOS Selection Team that following info completes spall, small crater camouflet, or bomblet field description.
8. End of Field Location: Distance from 0 point of PRMS to center of fields trailing edge.
9. Left or Right of C/L: Denotes direction from centerline to center of field's trailing edge.
10. Distance from C/L: Numerical distance field is left or right of centerline.
11. Width Identifier (W): Denotes next number is width of field's trailing edge.
12. Width Size: Numerical estimation of apparent field's trailing edge width.
13. Number Identifier (N): "N" alerts MAOS Selection Team that field identifier is complete and next munber is number of spalls, small craters, camouflets, bomblets, or a mix.
14. Number of Spall / UXO: Estimate number of bomblets, small craters, camouflets or spalls in field. If mixed, show total number first followed by breakdown by type. For instance, if field was a mix of 50 small craters, 25 spalls, and 25 UXO, it is reported as: N100(C50S25X25). Column 1 identifies the more challenging problem of craters.
15. Description / Info: Record additional info that may assist in identifying pavement damage (e.g. crater depth, camouflet) or ordnance (e.g. color, shape, bands, size, features).

Figure A2.2. Example Airfield Damage Recording Form for Copying.

Item	Mandatory Entries				*C = Crater			X = UXO			S = Spall		B = Bomblet		M = Camouflet	
	1. Damage Type or UXO *(C, X, S, B, M)	2. Location	3. Left or Right of C/L	4. Distance from C/L	5. Diameter / Width	6. Size of D / W	7. Field Identifier (F)	8. End of Field Location	9. Left or Right of C/L	10. Distance from C/L	11. Width Identifier (W)	12. Width Size	13. Number Identifier (N)	14. Number of Spalls/UXO/ Craters/Bomblet	15. Description / Info	
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1. Damage Type or UXO: C=crater, X=UXO, S=spall, B=bomblet field, and M=camouflet (field)
 2. Location: Distance from 0 point of pavement reference marking system (PRMS) to center of crater, UXO or to closest leading edge of spall, camouflet or bomblet field.
 3. Left or Right of C/L (L, R): Denotes direction from C/L to damage / UXO center point.
 4. Distance from C/L: Numerical distance left or right from C/L expressed in feet.
 5. Diameter / Width: D for craters or circular spall, camouflet or bomblet fields; W for rectangular spall, camouflet or bomblet fields.
 6. Size of D/W: Estimation of apparent diameter of field width.
 7. Field Identifier (F): If required, enter "F" to alert MAOS Selection Team that following info completes spall, small crater camouflet, or bomblet field description.
 8. End of Field Location: Distance from 0 point of PRMS to center of fields trailing edge.
 9. Left or Right of C/L: Denotes direction from centerline to center of field's trailing edge.
 10. Distance from C/L: Numerical distance field is left or right of centerline.
 11. Width Identifier (W): Denotes next number is width of field's trailing edge.
 12. Width Size: Numerical estimation of apparent field's trailing edge width.
 13. Number Identifier (N): "N" alerts MAOS Selection Team that field identifier is complete and next number is number of spalls, small craters, camouflets, bomblets, or a mix.
 14. Number of Spall / UXO: Estimate number of bomblets, small craters, camouflets or spalls in field. If mixed, show total number first followed by breakdown by type. For instance, if field was a mix of 50 small craters, 25 spalls, and 25 UXO, it is reported as: N100(C50S25X25). Column 1 identifies the more challenging problem of craters.
 15. Description / Info: Record additional info that may assist in identifying pavement damage (e.g. crater depth, camouflet or ordnance (e.g. color, shape, bands, size, features).