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INDIVIDUAL COMBATANT'S WEAPONS FIRING ALGORITHM PHASE I

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14. ABSTRACT Report developed under Small Business Innovation Research contract. This report documents the development of a weapons firing algorithm for individual combatants, including the formal methodology used, an overview of the subject matter experts (SMEs) who developed the methodology and helped to scope the model, the results of the formal data collection process, and a discussion of the data analysis process that yielded the model. The objective was to determine which factors were the most influential and how the priorities of these factors can change over a variety of scenarios. Analyses of the SME responses showed large discrepancies between the SME target selection and the weapon firing mode. The analyses also showed that the largest divergence in the prioritization scheme was a function of the distance to the enemy. As the enemy comes closer, which effectively decreases the time to respond, target prioritization schemes appeared to change significantly. Included in the report are extensive appendices containing an interim progress report, excerpts from pertinent field manuals, open field slides, D MOUT slides, subject questionnaires, sample terrain analysis, open field responses, and MOUT responses.																						
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LIST OF ACRONYMS and ABBREVIATIONS

AAR	After Action Review
BMP	a Threat fighting vehicle
BTR	a Threat vehicle
CGF	Computer Generated Force
FIST	Fire Support Team
FM	Field Manual
FPF	Final Protective Fire
FPL	Final Protective Line
HBR	Human Behavior Representation
HEDP	High-explosive dual-purpose
IC	Individual Combatant
ICT	Institute for Creative Technologies
ICWFA	Individual Combatant Weapon Firing Algorithm
KA	Knowledge Acquisition
LOS	Line of Sight
M	meters
MAW	Medium Anti-tank Weapon
MOUT	Military Operations in Urban Terrain
MG	Machine Gun
PDF	Principle Direction of Fire
RHS	Right Hand Side
ROE	Rules of Engagement
SAF	Semi-Automated Forces
SAW	Squad Automatic Weapon
SME	Subject Matter Expert
SOF	Special Operations Forces
SOP	Standard Operating Procedure
SSCOM	Soldiers System Command
STRICOM	Simulation, Training and Instrumentation Command
TOWS	Tube-launched, optically tracked, wire-guided
TRP	Target Reference Point
WFA	Weapon Firing Algorithm

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EXECUTIVE SUMMARY

Research Objective:

The objective of this research was to develop a weapons firing algorithm (WFA) for individual combatant (IC) entities represented in the Integrated Unit Simulation System (IUSS). IUSS is a force-on-force model used by analysts to make acquisition and materiel design decisions affecting individual soldiers and small units in high-resolution combat and operations other than war. It provides psychological and physiological representation of the individual (e.g., heat, stress, fatigue, load sustainment, hydration, etc.), influenced by environmental factors (e.g., dynamic weather, rough terrain, variable lighting conditions, etc.) and battlefield threats (flame, laser, ballistics, etc.). Although high-level scripted behaviors have been developed for individual combatant (IC) object models in IUSS, improved techniques that provide for more accurate, robust IC weapon firing models are required to adequately support the needs of the analysts. In tune with current trends in human behavior representation (Pew and Mavor, 1998) and consistent with the needs of simulations used in the analysis community, emphasis on this research is placed on the use of human performance data to be able to better understand and model the capabilities and behaviors of the human dynamic as it relates to weapon firing.

Work Accomplished:

- Reviewed existing literature and determined that it lacks sufficient detail to support development of IC-WFA at resolution required by IUSS analysts.
- Developed methodology for empirically capturing weapons firing data from subject matter experts (SMEs)
- Conducted comprehensive data collection effort for weapons firing in Open Field and MOUT combat environments.
- Analyzed data, compiled wide-ranging list of factors influencing weapons firing, and developed rudimentary IC-WFA.
- Developed recommendations for how to proceed with full model development.

Results:

Results clearly demonstrate that:

1. Existing infantry field manuals (FMs) do not adequately detail factors (e.g., threat prioritization, terrain analysis) central to an IC-WFA.
2. Factors such as threat prioritization, target selection, mode of fire, and terrain analysis are subject to differences and preferences in individuals.

As such, IC-WFA developed in this phase and included in this report is presented as a rudimentary algorithm that would generate feasible IC behavior.

Conclusions:

For optimal prediction capabilities, analysis systems such as IUSS require data representative of the population it is used to model. This is a more demanding data requirement than the requirements for data used in a training simulation, where for example, simple, feasible behavior is adequate. Thus, an IC-WFA built from feasible responses, while a good initial prototype, is not the most practical form in which this algorithm can be expressed. Rather, this algorithm should be expressed through weighted distributions developed from data collected from a representative sample of infantrymen. Thus, it is our conclusion that a more useful model developed for IUSS must be based on more data collected from a larger range of SMEs and our recommendation that future work be geared to the collection of these data and development of system to represent these data.

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1 Introduction and Overview

This report documents development of Weapons Firing Algorithm (WFA) for Individual Combatants (IC). Section 1 presents how the methodology was developed, including use of subject matter experts (SMEs) as consultants to develop methodology and help scope model. Section 2 presents the formal methodology used to develop the algorithm. This includes overview of SMEs consulted in development of algorithm, scenarios used to develop algorithm, and a review of the formal data collection process. Section 3 presents the results of the formal data collection process and discusses how the results were analyzed to yield the IC-WFA presented in Section 4. Finally, Section 5 presents the conclusions of the study, including strengths and weaknesses of the approach, plan for full model development, and recommendations for future work.

1.1 Development of Methodology

Development of methodology is discussed in detail in Soar Technology, Inc. (2002), Interim Progress Report (Appendix A). The general approach was to develop algorithm heuristically, through the use of data/knowledge collected through interviews with subject matter experts (SMEs). The decision to approach the algorithm definition as detailed in Appendix A was result of two factors. First, through review of pertinent documentation, it was determined that existing U.S. Army Field Manuals (FMs) for infantry do not describe the weapons firing algorithm in detail sufficient to develop an adequate model for IUSS. Excerpts from pertinent FMs may be seen in Appendix B. These are provided to the reader as a general introduction to issues influencing the weapons firing decisions facing an individual combatant. While these FMs do provide an adequate introduction and high-level overview of the problems, they do not closely examine the ways complex factors affecting the IC weapons firing algorithm can interact. For example, as seen in Appendix B Page 4 FM 7-8 indicates that target priority is assigned to the "most dangerous or threatening target" or as seen in Appendix B Pages 11 and 38, an FM will require IC to perform terrain analysis such as "Determining Dead Space" or Appendix B page 40 "Establishing a Fire Position". Both of these procedures (target prioritization and terrain analysis), as demonstrated in future sections of this report, are critical to the formation of an IC-WFA and both are subject to individual differences. Thus, FMs cannot be used in isolation to develop an adequate algorithm.

The second reason influencing the decision to develop this algorithm through heuristics is because it was determined that comprehensive and formal experimental methods would not be pragmatic for a problem of this scope. For example, merely assuming the following OPFOR factors and levels for determining the threat value of a target:

Smoke: <smoke, no smoke>
Cover and Concealment: <cover, concealment, none>
Posture: <standing, kneeling, prone>
Distance: <near, medium, far>
Aim Point: <at You, at Friendly, none>
Speed: <running, stationary>
Direction: <toward you, toward friendly, to flank>
Placing Fire: <well, not well>
Weapon: <MG, RPG, rifle>
Role: <officer, sniper, soldier>

would yield

$$2*3*3*3*3*2*3*2*3*3 = 17496$$

(1)

combinations for a single target. Then, only assuming a decision constrained by maximum of two Targets at any time would require pairwise comparisons equaling

$$(17496^2)/2 = 153,055,008 \text{ tests} \quad (2)$$

Thus, even for a very constrained set of factors and comparisons, the number of tests required to perform a full-factorial experiment is unwieldy. Further, this is simply for high-level aggregate descriptions of the 10 factors. Realistically, there are many "shades of gray" in between the levels described above. The combinations of these issues justifies the approach of developing the WFA through heuristics and interview data acquired from SMEs; that is, some of the larger but less complicated sections of the state space may be covered by simple heuristics, whereas other more complicated sections may require more detailed heuristics or even empirical comparisons of experimental data. We believe the key to this approach is to acquire the less complicated sections of state space through literature reviews and interviews, and to acquire the more complicated sections through a more objective method. Research has shown, for example, that methods of introspection do not work well for highly complicated decision space (Umanath and Vessy, 1994). Also, research has shown that the way SMEs believe they perform some task is not necessarily congruent with how they actually perform the task (Deutsch, 1993). Lastly, other researchers have shown that modeling human behavior with human performance data results in high fidelity models (Henninger, et al, 2000). This approach is highly recommended by panel experts in human behavior modeling (Pew and Mavor, 1998). Thus, for complicated decision space, we developed a methodology where we query SMEs with help of a visual scenario presented in a slide format. As this methodology matured (in MOUT KA, for example), we actually constrained the time that the SMEs' had to respond. Thus, they were required to respond immediately and instinctively, or else risk losing chance to respond at all. We believe that this method works better for collecting data that would be representative of human behavior (e.g., that required for an analysis system) as opposed to data that simply needs to model one feasible model of behavior (e.g., that required for a training system).

The most important factor in the development of our methodology was the use of three SMEs who had both infantry experience and simulation experience. This helped us to "bridge the gap" between reality and simulation. These SMEs were integral to the development of the scenarios we used for Knowledge Acquisition (KA). They also served as "test" subjects, so we could refine and improve our methodology before doing formal data collection with soldiers at Ft. Benning and United States Military Academy (USMA). For example, after working with consulting SME to define scenarios and questionnaires, we were able to present these scenarios and questionnaires to another consulting SME as a sort of "dry run". In every case, the review by the second SME was able to improve the scenario and/or the questionnaire such that formal KA efforts would be more effective. At the highest level, this cycle of create->review->improve occurred a number of times over four documents. Once in the development of methodology applied to prototype (referenced in Interim Progress Report, Appendix A), a number of times in the development of the SME questionnaire, once in the development of the open field scenario slides, and a couple of times in the development of the MOUT slides. Attacking the development of scenario documentation in this order, we believe that our most effective and efficient KA efforts were performed with MOUT scenarios. This, understandably, was result of experience gained throughout the methodology development process.

1.2 Model Scope

To scope the model, we have made a number of assumptions. Major assumptions are listed below, while other more minor assumptions have been presented in sections where the best fit within the organization of this document. Acknowledging counsel of Mr. Victor Middleton of STI (see Appendix A), the most important assumption we make in defining this model is that the decision to engage has already been made. Thus, the rules of engagement (ROEs) support the

engagement of enemy contact and the analysis to determine to engage has already been made and yielded decision to engage. Lastly, as reviewed in Appendix A, to scope the study, we have assumed that threat targets are dismounted infantry and have not considered light armor. A review of the units, roles, and weapons considered in this effort may also be seen in Appendix A.

As introduced in Appendix A, our consulting SMEs helped us in determining a number of factors that contribute to the "threat level" of a target. In large part, these factors are combinations of the factors presented in Section 1.1. We believe that determining the threat level of a target is the primary driver in developing a weapons firing algorithm. The second driver, we believe, is performing terrain analysis. As stated in the previous section, these two areas are where field manuals break down. That is, often times, field manuals will explain a process up to point of "select target with highest threat value" or "perform terrain analysis". It is these processes that are highly subject to individual preferences and differences, and it is in these processes that a representative sample of behavior is required such that weighted distributions that describe a population can be developed.

Since SMEs were ultimately asked to rank factors that contributed to the threat level of a target, these factors had to be expressed concisely and clearly enough that SMEs could account for all of them. As a result, the factors expressed in Table 1 were generated through the refinement of previous versions of this list. In follow-on KA sessions, many of the SMEs complimented us on the generation of this list, suggesting that we had "hit all the factors". However, through the KA sessions, we discovered even more factors through After Action Reviews (AARs) with the KA SMEs. These additional factors are presented in Results section of this report.

Target's weapon or role in unit
How well is Target placing fire at you?
Distance to Target
Number and proximity of Targets
Speed/direction Target is moving
Visibility/Exposure of Target
Amount/duration of Own's exposure

Table 1. Factors used Formally in Determining Threat Priorities

2 Methodology

In earlier sections we described our approach as being dependent on complexity of the response space. For example, in situations where large areas of the response space can be covered by a single heuristic, we are able to verbally acquire this knowledge from SMEs. In other sections of the response space, where the relationships are more complex, we employed more scientifically appropriate method to empirically collect the data necessary to develop these relationships. Since the focus of this study is to define weapons/target priorities for the unit and IC, and we have learned that a number of factors influence this relationship in complex, highly situational ways, our approach was to study this section of the WFA empirically, to the extent possible. Specifically, designed a methodology that promotes the orderly acquisition of knowledge focused on defining the relationship between the factors expressed in Table 1 and the response variables (e.g., weapons selection, mode of fire, target prioritization).

Using this method, we were able to use computer games to set up the scenario and provide a context, and then present SMEs with a series of slides with scenario variants that helped us prioritize targets. So, for example, two factors that have tradeoff value (e.g., target proximity and target's weapons capability) were examined in one "scene" by presenting a target, TargetA - 100 yards away with rifle and a target, Target-B 300 yards away with a M/G. Experimenting with different combinations of these factors helps us to develop rule for the distance at which IC would prioritize OPFOR weapons capability over OPFOR position. This is just one example of tradeoff for two important factors. Because this study cannot consider pairwise comparisons of all combinations of factors (as demonstrated in Section 1.1), we opted to develop scenarios with SME guidance and input that would help us focus on those factors that can be the most confounding.

2.1 Subject Matter Experts

As part of the formal data collection effort (i.e., KA session), subject questionnaires were distributed to develop demographics of infantrymen participating in this study. Aggregate statistics are presented below. All raw data from the SME questionnaire may be seen in Appendix E.

For the formal KA effort, a total 12 SMEs were used. Of these 12, there were 4 who ranked Captain, 1 who ranked Lieutenant Colonel, 2 who ranked Sergeant First Class, 1 who ranked Major, 3 Civilians (all retired U.S. Army officers with combat experience), and 1 who ranked as Master Sergeant.

Age ranges for the SMEs was fairly evenly distributed with 2 in the 26 - 20 year old group, 3 in the 31 - 36 year old group, 4 in the 37 - 42 year old group, and 3 who were 43 or higher (the three retired civilians).

In all, these SMEs had anywhere from at least 5 to over 20 years of service in the military. Specifically, 3 had 5-to-9 years experience, 2 had 10-to-14 years experience, 4 had 15-to-20 years of experience, and 3 had over 20 years of experience (the three retired civilians).

Of the 12 SMEs interviewed, 9 had served as Platoon Leaders, 5 had served as Squad Leaders, 6 had served as Fireteam Leaders, 4 had served as Platoon Sergeants, 6 had served as riflemen, 2 had served as snipers, 5 had served as Machine Gunners, 4 had served as SAW Gunners, 5 had served as Grenadiers, 3 had served as Company Commanders, 1 had served as Company 1st Sergeant, and 1 had served as an Anti-Tank Gunner. Most of these SMEs had experience in many more than just one of these positions.

Also, of the 12 SMEs interviewed, 8 had participated in the training or evaluation of Infantry Battle Drills within the last two years. 2 had participated in them in the last 2-to-5 years, and 2 had participated in them over 6 years ago. With respect to participation in execution of a Battle Drill (i.e., real fire fight experience), 3 SMEs had been in 10 or more firefights. Of these three, two were retired and one was active duty. 2 SMEs had been in less than 3 firefights. Of these two, one was retired and one was active duty. The remaining 7 SMEs had no actual experience in a real firefight. Of the SMEs who had been in combat, 4 considered their fire fights to be successful and one considered 80% of his firefights successful.

As evidenced in Appendix E, there was a variance in opinions regarding what factors were most important to the efficient and effective execution of an Infantry Battle Drill. When asked to rank the factors: "Quick Response", "Team Work", and "Situational Awareness", opinions were split between the three as to which was the most important. Two SMEs added that another very important factor was experience and training, such that responses became innate. Another SME listed communication as an important factor. There was no clear correlations with real fire fight experience and factors thought to be most important, though of the three SMEs who had experienced more than 10 fire fights, two had ranked "teamwork" as the most important and the third had ranked "teamwork" as the second most important. Also, this third SME had emphasized importance of communications (indicating importance of interacting with fellow teammates).

Mapping of SMEs' demographic data to SME Number assigned in remainder of report is as shown in Table 2.

SME's Number	Appendix Containing SME's Demographic Data
1	Appendix E – Pages 4 to 6
2	Appendix E – Pages 7 to 9
3	Appendix E – Pages 10 to 12
4	Appendix E – Pages 13 to 15
5	Appendix E – Pages 16 to 18
6	Appendix E – Pages 19 to 21
7	Appendix E – Pages 22 to 24
8	Appendix E – Pages 25 to 27
9	Appendix E – Pages 28 to 30
10	Appendix E – Pages 31 to 33
11	Appendix E – Pages 34 to 36
12	Appendix E – Pages 37 to 39

Table 2. Mapping Between SME Identifier and SME Demographic Data in Appendix E

In large, five of the SMEs (2,3,7,8, and 9) were used to develop the algorithm for Open Field combat and six of the SMEs (1,4,5,10,11, and 12) were used to develop the algorithm for MOUT combat. We believe these assignments were optimal, as SMEs 2 and 3 had extensive open field combat and SMEs 1, 4, and 5 had MOUT experience. However, we endeavored to compare heuristics between environment types as much as possible when working with these, most experienced SMEs (1 – 5). So, for example, while SME 1 was predominantly used to develop heuristics for MOUT combat, we still asked him questions about how these heuristics applied to Open Field combat. And, conversely, we still asked SME 2 questions about MOUT combat.

2.2 Formal Data Collection

2.2.2 SME Questionnaires

Most of information from questionnaires was demographic in nature and reported on in the previous section, Section 2.1. However, a few other important pieces of data were acquired through the questionnaire. This includes:

- 1) a number of differences between Open Field combat and MOUT combat that could affect a shooter's selection of targets or weapon preference,
- 2) the practical effective ranges of a variety of weapons under stressful conditions and
- 3) the rankings of factors influencing threat assessment of a target in open field, MOUT urban canyon, and closed-quartered building clearing scenarios.

These data are reported in the following 3 sub-sections, respectively.

2.2.2.1 Questionnaire Responses to Open Field and MOUT Differences

When asked to list differences between open field combat and MOUT urban canyon combat that significantly change the way one would select targets or weapons, SMEs answered with the following bullets in Table 3.

- *Scanning techniques are different - scan higher in MOUT*
- *Exposure time for enemy because they have better cover in MOUT*
- *Weapon selection - choose targets with grenade launchers or RPG because they can defeat your cover*
- *Field - artillery to indirect fire, range estimation training, situational awareness*
- *MOUT - rapid coordination, teamwork, # bodies available, time consuming, more ammunition*
- *Weapons and targets are the same for field combat and urban canyon. The difference is in available firing positions for the offense. The defender posture i.e., target exposures are very similar. Inside the building is a totally different situation.*
- *Types of cover/protection available to the soldier, movement formations*
- *MOUT is 3 dimensional and more stressful. Depending on numbers of non-combatants in a MOUT environment would greatly effect the type of WPN and the rates of fire.(sic)*
- *In MOUT I would engage elevated targets first due to their field of fire advantages and ability to see more.*
- *MOUT is 3 dimensional and more stressful. Depending on numbers of non-combatants in a MOUT environment would greatly effect the type of WPN and the rates of fire.(sic)*
- *In MOUT I would engage elevated targets first due to their field of fire advantages and ability to see more.*
- *Ranges and available cover*
- *OF kills is function of max effective range of weapon and distance, MOUT is close*
- *Arming range for exploding munitions becomes critical in urban environment*
- *Speed of tgt recognition and engagement must be higher in urban environment vice non-urban*
- *In MOUT I would scan for longer periods of time before moving*
- *I would scan vertically as well as horizontally*
- *I would prefer more automatic weapon, and shorter lighter weapons, in MOUT with a few long-range precision weapons, like sniper rifles.*
- *I would fire more automatic weapon rounds at "possible" enemy positions*

- *MOUT is 3-dimensional – must look up*
- *Open field combat is more about speed and MOUT is more about getting to/or finding the proper angle to attack/shoot from*
- *Ranges in MOUT significantly less than open field*
- *MOUT battlefield is three dimensional*
- *Open Field – more practice/experience firing at distant tgts, close air support training, range estimation training. MOUT – More forces to execute, closer battle drill coordination in close quarters combat/room clearing, more flash bangs or grenades, and more ammo.*
- *The differences in possible range encounters in an open environment will preclude the use of pistol caliber type length guns.*
- *In open encounter shooters have an ability/inclination to take time on sighted shooting*
- *Traditional rifle cartridge weapons are as effective in MOUT environment but soldiers prefer shortened weapons in MOUT.*
- *Targets in MOUT environments are not as easily seen therefore their engagement can be somewhat hurried.*
- *Pistol cartridge weapons (pistols/rifles) are very effective in MOUT scenarios.*

Table 3. SME Input on Factors Distinguishing Open Field Combat from MOUT Combat

2.2.2.2 Questionnaire Responses to Effective Ranges of Weapons

When asked to describe the practical effective ranges of a variety of weapons under stressful (combat) and non-stressful (target practice) conditions, answers varied by over an order of magnitude difference. For example, while one SME suggested that an "Easy" shot with an M4 under stress of combat would be 400m, a second SME suggested that an "Easy" shot with an M4 under stress of combat would be 7–25m.

Averages of all SMEs over all weapons (rifle, pistol, SAW, grenade launcher, machine gun, and hand grenade), descriptive terms ("Easy", "Reasonable", and "Difficult"), and scenarios ("Range", "Firefight") are summarized in the Figures 1 – 7 below. Of particular interest in these figures is the tendency for SMEs with combat experience to estimate effective range of weapons more conservatively than SMEs without combat experience. For example, as seen in Figure 1, while a SME with combat experience would describe an "easy rifle shot in combat" as being 42m or less, the average response for SMEs without combat experience 93m. For the most part, this pattern was replicated consistently throughout all of the weapons systems and all of the "fuzzy categories" (e.g., easy, medium, difficult). While this pattern exists graphically, formal statistical tests did not reveal a significant difference in the responses for the two groups. Seemingly, this is a ramification of the small sample size coupled with the large variance in response between group members.

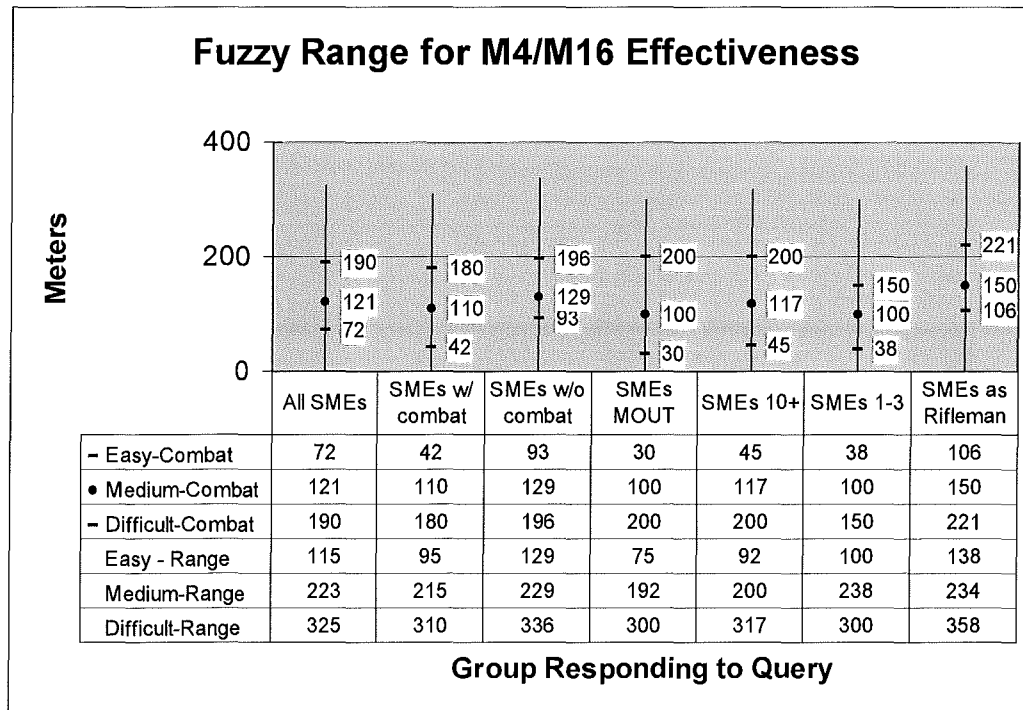


Figure 1. Average of Group Values Assigned to Effective Range of Rifles (M4/M16)

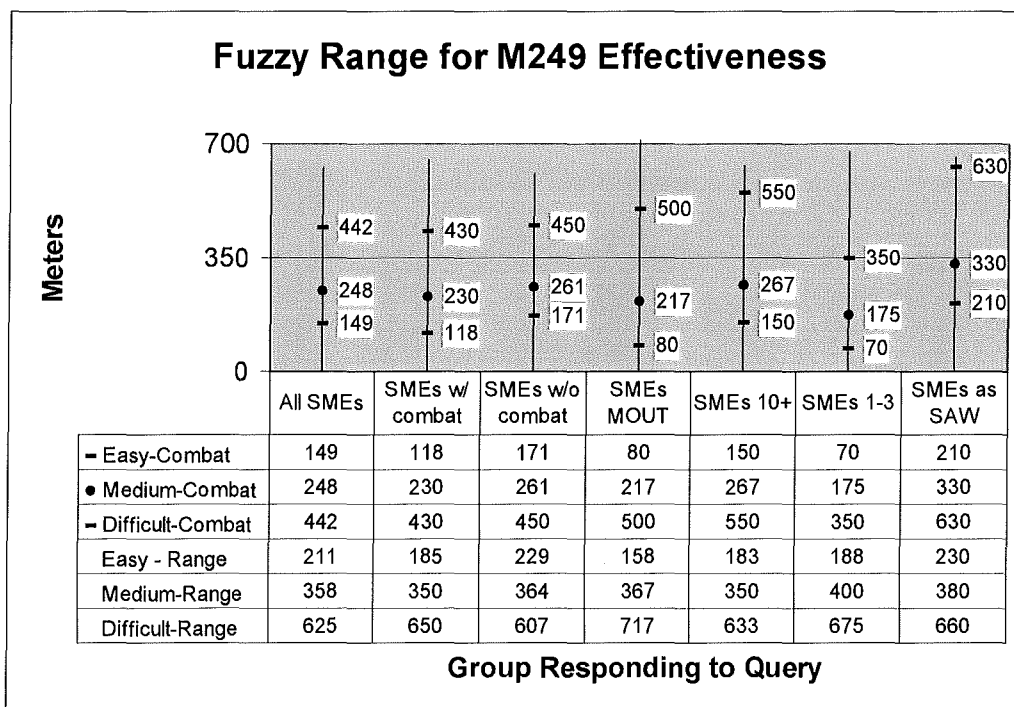


Figure 2. Average of Group Values Assigned to Effective Range of SAW (M249)

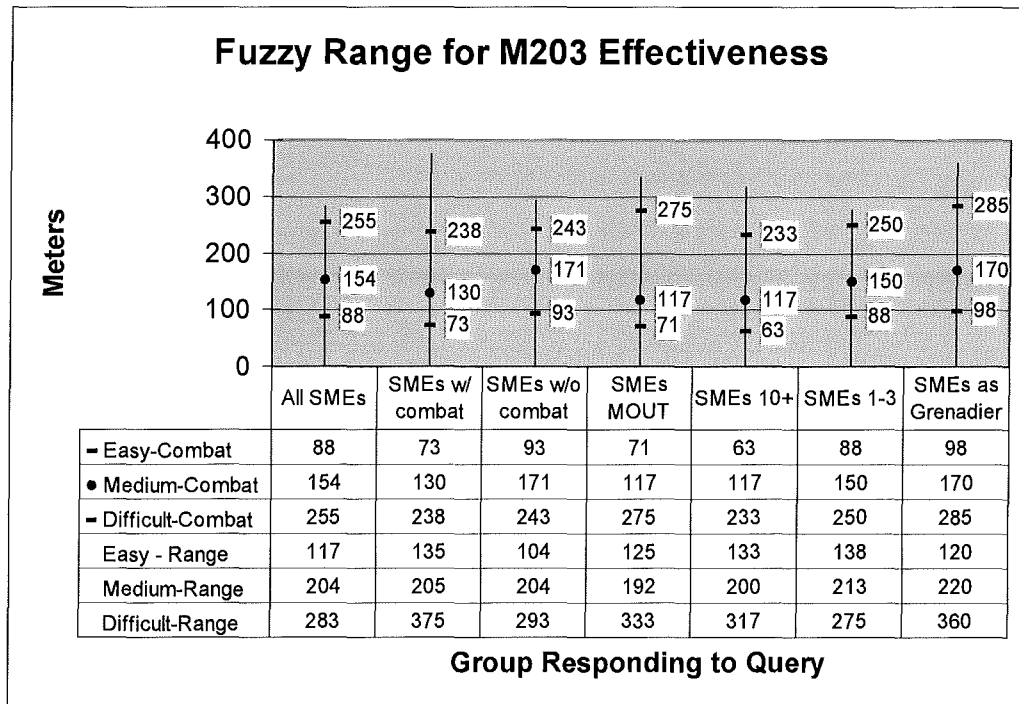


Figure 3. Average of Group Values Assigned to Effective Range of Grenade Launchers (M203)

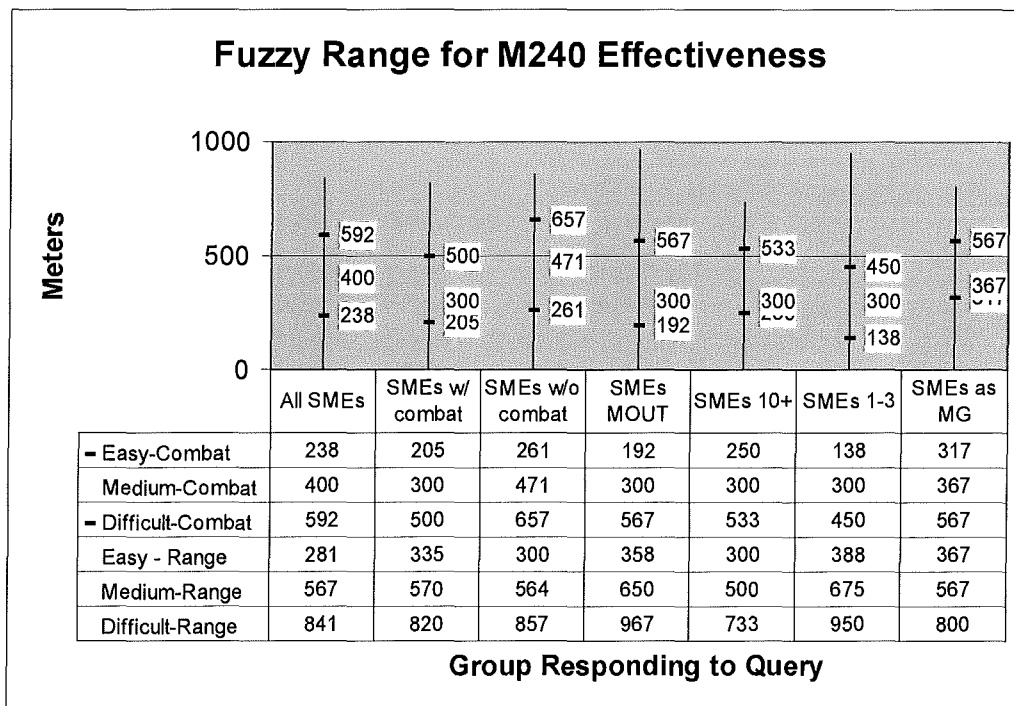


Figure 4. Average of Group Values Assigned to Effective Range of MG (M240)

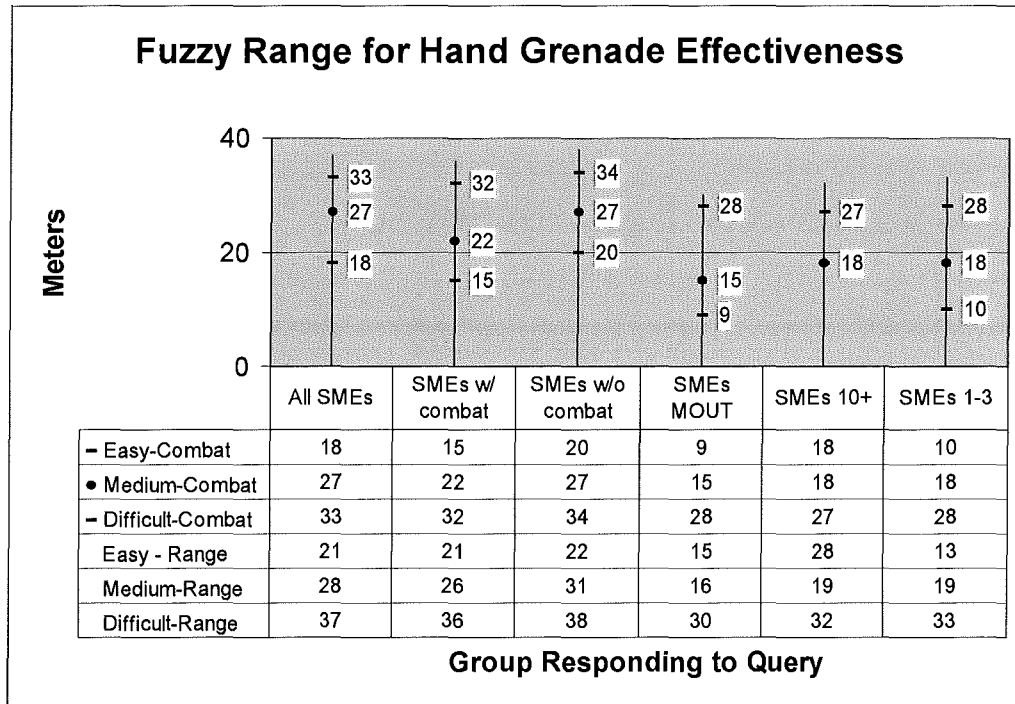


Figure 5. Average of Group Values Assigned to Effective Range of Hand Grenades

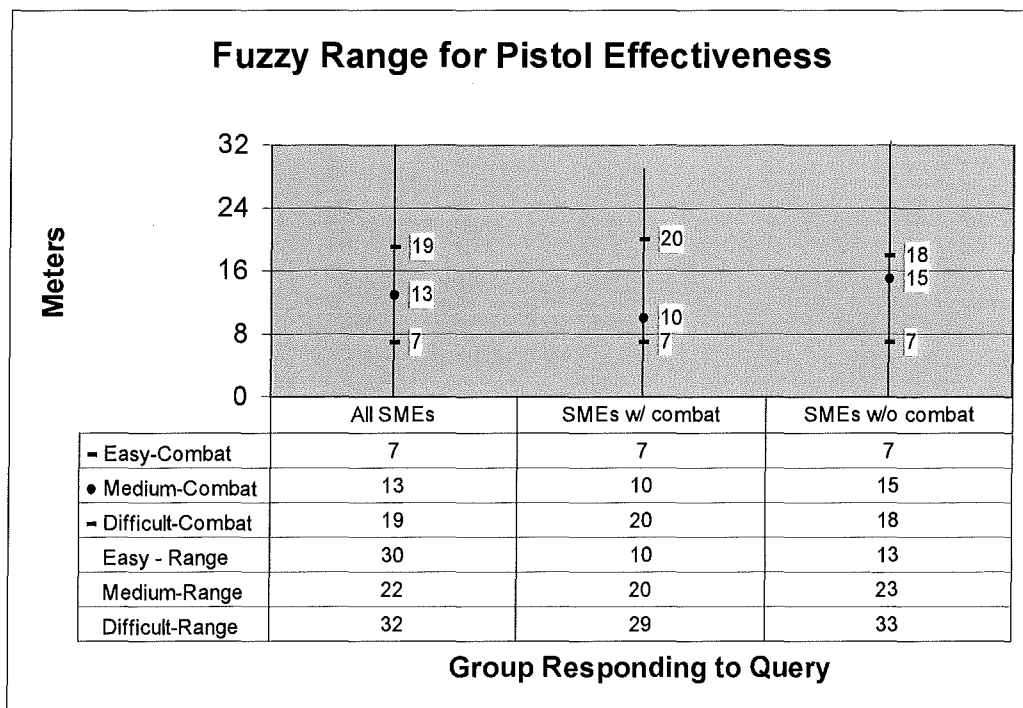


Figure 6. Average of Group Values Assigned to Effective Range of Pistol

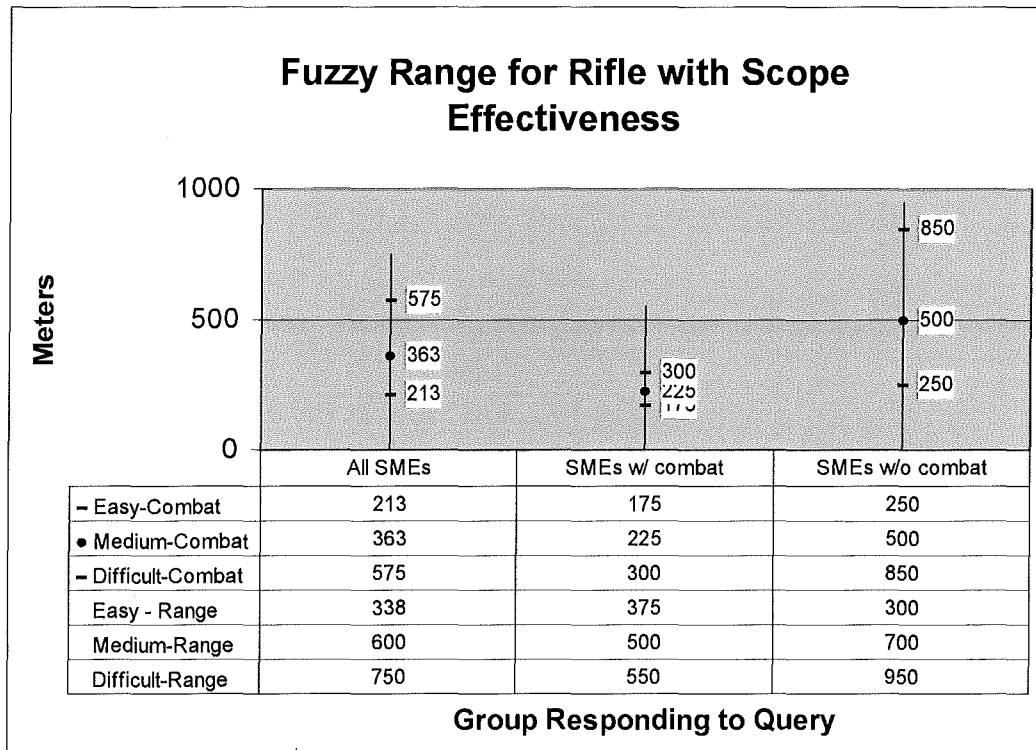


Figure 7. Average of Group Values Assigned to Effective Range of Rifle with a Scope

Regardless of whether the differences between SMEs with combat experience and SMEs without combat experience is significant; in practical terms, these ranges can be used in a fuzzy representation scheme to model effective ranges of weapons.

2.2.2.3 Questionnaire Responses to Factor Rankings

Prior to starting data collection with scenarios, SMEs were asked to rank the factors presented in Table 1 according to the ranking they would be prioritized in a specific combat environment. Generally, this question was designed to help identify differences between Open Field and MOUT target selection priorities. As evidenced in Table 4, When asked to rank the factors influencing threat assessment of a target in open field, MOUT urban canyon, and closed-quartered building clearing scenarios, SMEs tended to agree on what they considered to be the most influential factors. However, correlations in rankings deviated quickly as SMEs considered lower-order factors of influence.

Open Field	Urban Canyon	Close Quarter	
5.1	4.4	3.2	Amount and/or duration of your exposure
2.1	2.7	3.3	Distance to Target
4.8	4.5	4.7	Visibility/Exposure of Target (smoke, dark, cover/concealment)
2.9	3.2	4.7	Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
2.4	2.1	2.5	How well Target is placing fire? Who is Target firing at?
5.0	5.6	5.1	Speed/direction Target is moving
5.7	5.6	4.5	Number and proximity of Targets relative to one another
			Other:

Table 4. Average of Factor Rankings over ALL SMEs

Tables 5 and 6 present the average rankings according to SMEs with combat experience and SMEs without combat experience, respectively.

Open Field	Urban Canyon	Close Quarter	
4.2	4.4	3.4	Amount and/or duration of your exposure
2.4	2.2	3.4	Distance to Target
5.0	5.2	4.6	Visibility/Exposure of Target (smoke, dark, cover/concealment)
3.6	3.4	4.4	Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
1.8	1.9	1.8	How well Target is placing fire? Who is Target firing at?
5.4	5.2	5.2	Speed/direction Target is moving
5.6	5.7	5.2	Number and proximity of Targets relative to one another
			Other:

Table 5. Average over ALL SMEs with Combat Experience

Open Field	Urban Canyon	Close Quarter	
5.7	4.5	3.3	Amount and/or duration of your exposure
1.9	2.9	3.2	Distance to Target
4.8	4.2	4.5	Visibility/Exposure of Target (smoke, dark, cover/concealment)
2.6	3.1	5.1	Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
2.6	2.3	2.9	How well Target is placing fire? Who is Target firing at?
4.9	5.8	4.9	Speed/direction Target is moving
5.6	5.3	4.1	Number and proximity of Targets relative to one another
			Other:

Table 6. Average over ALL SMEs w/o Combat Experience

Again, although no formal statistical test was performed, at a gross level, these rankings do not appear to be significantly difference between SMEs with combat experience and SMEs without combat experience. Both groups rank many of the same factors in their top 3 or 4 in all of the environments, though not in the exact same order. For example, as seen in Table 6, SMEs without combat experience consider "Distance to Target" the most important factor Open Field Combat, while SMEs with combat experience consistently pick "How well Target is placing fire" as the most important factor, regardless of combat type. Another interesting observation from these data suggests that the "Target's weapons or role in unit" becomes less important in CCB type combat. That is, general trends and subsequent interviews reveal that as the battle tends to become closer and more time critical, SMEs consider weapon types to be less important in their target prioritization scheme.

Lastly, factors suggested by SMEs in the "Other" option on this question and designated as include:

- "Can I kill it with my weapon" (for Open Field and Urban Canyon, but not CCB)
- "location of target in the vertical plane" (for Urban Canyon)
- "sector of fire" (for CCB particularly)

Interestingly, a number of SMEs commented that we should have distributed this particular question after the Drill Session (addressed next section, Section 2.2.3). This was because the Drill Session prompted them to recognize inconsistencies between their written responses and their responses to the Drill Session. Also, as Drill Sessions executed, researchers realized that these rankings (in Tables 4, 5, and 6) are highly situational dependent, and that the mere distinction of combat type (i.e., Open Field, Urban Canyon, CCB) was not sufficient for a useful analysis. For example, the ranking of factors in Open Field could change drastically whether the combat was in a close range or at a far distance. Recognizing these shortcomings in the presentation and acquisition of these rankings, researchers consider Tables 4, 5, and 6 only as gross points of information and are reluctant to rely on them as any sort of foundation or constraints in the development of IC-WFA. We believe the Drill Sessions and AAR Sessions are much more appropriate sources for those applications.

2.2.3 Drills and AARs with Scenarios

As mentioned in the previous section, KA using scenarios presented through slides and movies was divided into two groups: Open Field and MOUT. These slides were generated by first person shooter computer games that focus on squad and team combat. While much research has been done in using COTS computer games in training (e.g., Laird, 2000; Pratt and Henninger, 2002), the use of computer games as knowledge acquisition tools is a novel approach, in contrast to traditional KA techniques (Ourston et al, 1995) for HBR. A detailed description of the games used may be found in Appendix A.

Physical copies of the slides used in each of these sessions may be seen in Appendices C and D, respectively. Also, electronic versions of each of these sessions are provided on the enclosed CD-ROM. To convey the methodology we used in the development of the ICWFA, two examples of how we presented each scenario, what types of responses we got from the SMEs, and how we used these results are presented in the following sub-sections.

2.2.3.1 KA Process for Open Field

Initially, in this part of the investigation, we presented SMEs with pictures of terrain and asked them to communicate how they would set up a squad for a Hasty Attack exercise (based on Akroyd et al, 2002). Methods used by SMEs to do this will be presented in future section of this report. After the SMEs had set up their Hasty Attack, we showed them a variety of slides explaining how we set up the Hasty Attack (for example see Appendix F, Page 2) and then proceeded to show them snapshots (slides) of the scenario from that point. All of these slides, as stated earlier, may be seen in Appendix C, and each of these slides was discussed individually and interactively as the KA session proceeded. So, for example, we would show a SME a slide like that seen in Figure 8 and ask the SME to prioritize

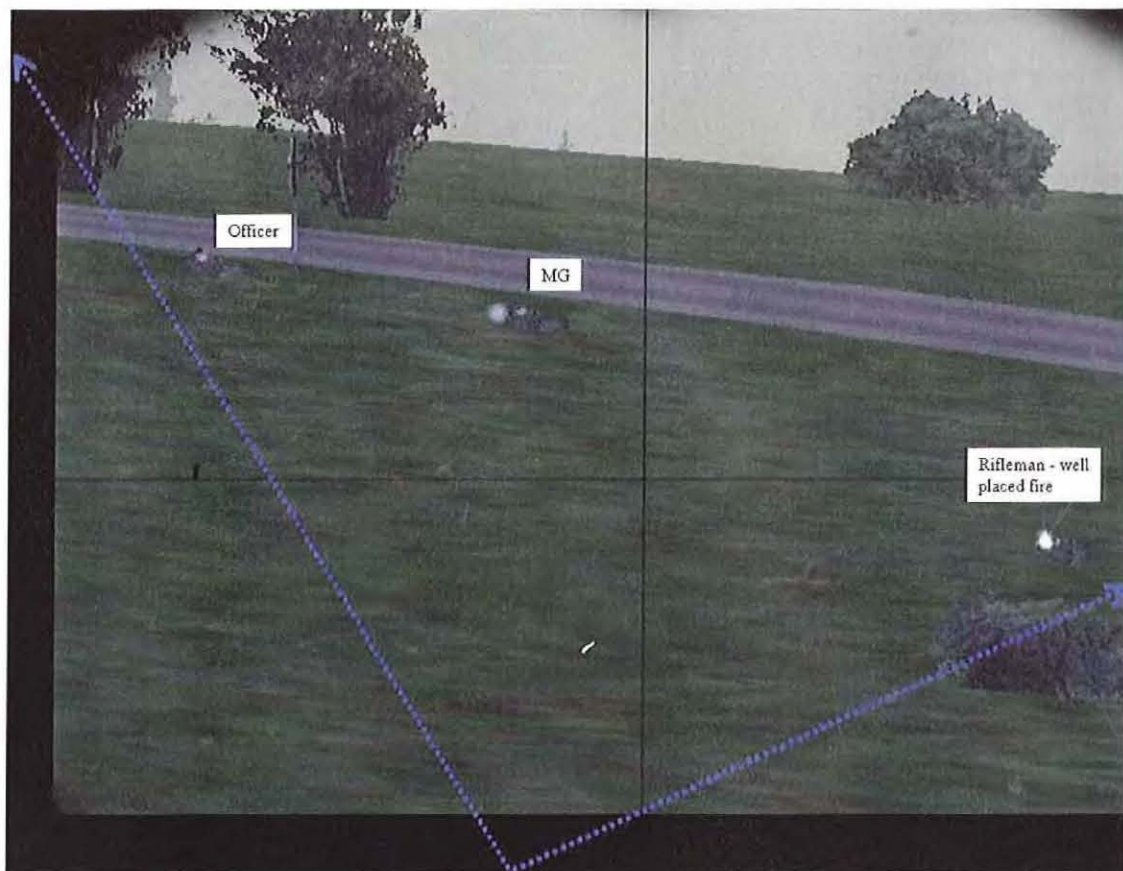


Figure 8. Sample Slide 1 for Open Field Scenario

the targets according to how he would engage the targets. This slide weighs a number of factors including role/weapon (i.e., Officer vs MG vs Rifle), firing/aiming status (i.e., aiming vs firing vs firing well placed fire), position in sector (i.e., left, middle, right), and proximity to concealment (i.e., Rifleman near bush). All targets are in prone firing positions, so posture or movement or intent recognition are not discriminating factors. Also, all targets are approximately the same distance away, so ability to make shot according to distance to Target is not a discriminating factor; however, weapon system lethality of Target as a function of distance may be an influential factor. Lastly, all targets are similarly exposed, so ability to make shot based on Target's exposure is not an influential factor.

When presented with this scenario, the SMEs used in Open Field KA session, responded as seen in Table 7.

SM E	Target Priority	Comments
2	MG, Rifle, Officer	Officer is not as important once firefight has begun because everything is in turmoil
3	MG, Rifle, Officer	MG is biggest threat and Rifle is next closest
7	Rifle, MG, Officer	Since Rifleman is placing fire on me, he's a big threat. MG is next biggest threat, also requires a smaller adjustment to engage him than it does to engage Officer.
8	MG, Rifle, Officer	
9	MG, Rifle, Officer	It's really a toss up. As Tm Leader, I would assign 2 guys on each.

Table 7. SMEs Target Prioritization Responses to Scenario Shown in Figure 8

These target priority responses were fairly consistent among the SMEs. Generally, they considered the MG to be the biggest threat and everybody agreed that the Officer was the least threatening target. For the most part, even the rational (at a gross level) was similar. SMEs tended to prioritize according to who was putting how much fire on them. But, this methodology helped us to acquire additional factors that we had not considered in our initial set. That is, from discussion generated by this single slide, SMEs added the following two factors to our initial set of factors:

- 1) SME 2, mentioned that "Officer is not as important once firefight has begun because everything is in turmoil".
- 2) SME 7 offered rationale for second target as "it requires a smaller adjustment to engage him than it does to engage Officer".

Both of these are important factors that we had not included in our initial set of factors.

As a second example, we would show the SMEs a slide like that seen in Figure 9.

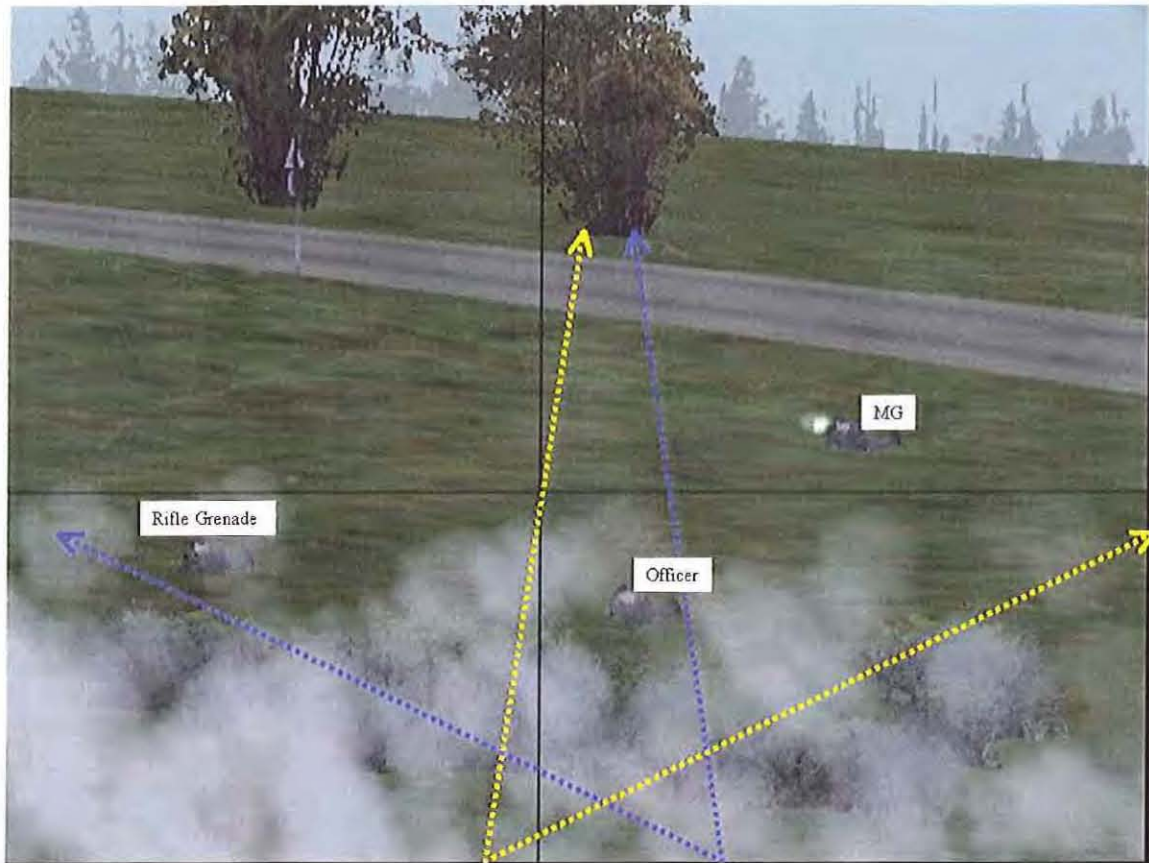


Figure 9. Sample Slide 2 for Open Field Scenario

In this instance, we would ask SME to prioritize targets according to both the Yellow sector and the Blue sector. In the Yellow-sector, factors influencing decision include role (i.e., MG vs Officer), Target's visibility as function of smoke (i.e., MG highly visible, Officer less visible), firing status (firing at teammate, aiming at you), orientation (facing left, facing you), Target's distance (Officer closer, MG further), proximity of Target to Cover and/or Concealment (i.e., Officer is closer to concealment than MG is), and Target's existence in overlapping sector (i.e., Officer is also in blue-sector) or position in Yellow sector (i.e., Officer is closer to boundary of sector than MG is). Blue-sector factors influencing decision include role (i.e., Officer vs Rifle/Grenade), positioning (i.e., left, right), and Target's existence in overlapping sector (i.e., Officer is also in blue-sector). Visibility to both targets is approximately equally obscured and both targets are approximately equally near edges of blue-sector boundary. SME responses in this case are reported in Table 8.

In this case, the SMEs' answers were not as consistent as seen in the previous case. Between the three SMEs who assumed roles (3, 8, and 9) and the two who qualified them (2 and 7), 1 picked Rifle/Grenade, 3 picked Officer and 1 picked "whoever you see first" for Blue sector and everybody picked MG for Yellow sector. The Blue sector choice didn't change if roles were unknown; but if the Yellow sector roles were unknown, the 2 SMEs who considered this case (i.e., not knowing roles) would have prioritized the Officer target over the M/G target (identified by weapon/role type, but preference not dependent on weapon or role). This demonstrated tradeoff between weapon/role and distance. In other words, even though the MG target was further away than the officer, SMEs would assign it higher priority. As in the previous example, this scenario could be used to generate further information. For example, SME 3 offered a

number of methods one could use to try and identify the leader in a group. SME 9 offered a general rule of thumb that

SM E	Target Priority	Comments
2	If know roles/weapons Blue: R/G, Officer Yellow: MG, Officer Else Yellow: Officer, MG	
3	Yellow: MG Blue: Officer	Automatic weapon is priority target in Yellow. Ways to detect leader include commands, signals, directing, radio, guy next to radio operator, uniform, sometimes not firing.
7	If know roles/weapons Blue: Officer, Rifle/Grenade Yellow: MG, Officer Else Yellow: Officer, MG	Officer is closest in Blue.
8	Blue: whoever you see first Yellow: MG, Leader	MG is in open in Yellow
9	Blue: Officer, Yellow: MG	Blue targets equally dangerous, but Officer is a little closer.

Table 8. SMEs Target Prioritization Responses to Scenario Shown in Figure 9

if "all things are equal, go for the closer target". This philosophy, interestingly, was repeated almost verbatim by a SME in the MOUT sessions.

What these slides revealed were general priorities and tradeoffs amongst some of the factors. What these slides did not reveal was precisely at what point those tradeoffs occur. For example, just how much further away would the MG have to be, before the SMEs would still prefer the Officer target to the MG target? A slide like that seen in Figure 10, would demonstrate this concept, as in this case 2 of the SMEs preferred the Leader and 2 of the SMEs preferred the MG. However, no distances are assigned to slide, so it difficult to perform sensitivity analyses with data acquired from these slides.

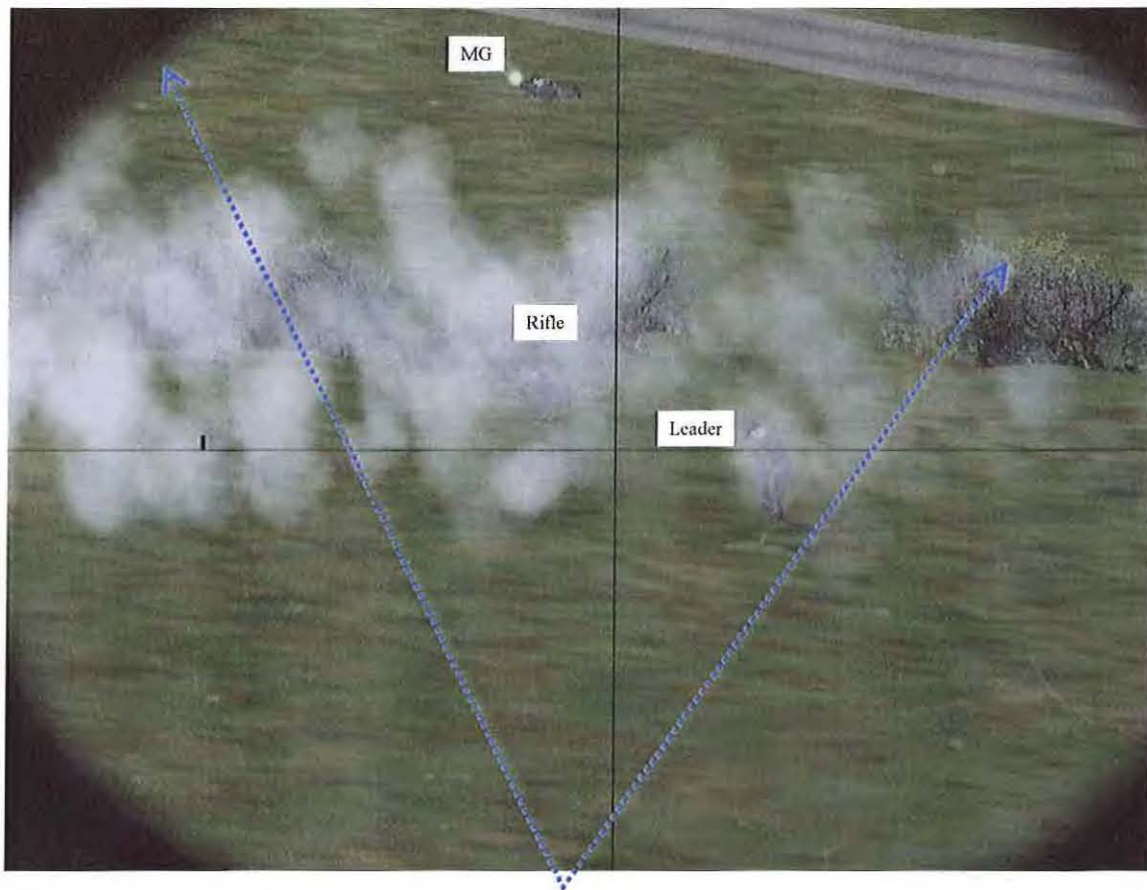


Figure 10. Sample Slide 3 for Open Field Scenario

2.2.3.2 KA Process for MOUT

From experience gained through Open Field KA exercises, we refined our methodology for MOUT KA sessions. Essentially we had identified two flaws that could be improved. The first flaw was that we were giving the SMEs too much time to analyze the scenario. SMEs with combat experience expressed the immediacy with which one under the stress of combat will react. This wasn't realistically or even remotely considered in our previous methodology. Secondly, as seen in the responses of the SMEs in the Open Field scenarios, SMEs didn't buy into the concept that they would know which targets were shooting which weapons. They indicated that sometimes a soldier would be able to distinguish this, but it obviously wasn't as simple as indicating it in a text box, like we did in our Open Field slides. With this information, we improved our approach prior to beginning the MOUT KA portion of our investigation.

In the MOUT KA sessions, we continued to use scenarios presented in slides, but this time we presented the slides in a rapid drill fashion. In other words, a SME was given 4 seconds to select a target, at which time the slide show would progress to the next scenario in the sequence. This definitely better represented the immediacy of response required by SME and added a little stress to the task. Also, in this drill session, we did not provide the SMEs additional information on targets' weapons or roles. We simply asked the SME to select a target based on the visual cues available in the graphic. To give the SME a way to respond quickly, we annotated the targets with colored arrows and asked the SME to indicate the preferred target by its associated arrow color. Again, as stated earlier, all of these slides may be seen in Appendix

D. Also, the exact slide show presented to the MOUT SMEs, in rapid drill form, may be viewed in the Power Point file (MOUT_KA_Drill_Slides.ppt) found on the enclosed CD-ROM. One example of the drill slide just described may be seen in Figure 11.



Figure 11. Sample Drill Slide 1 for MOUT Scenario

In this slide of the drill, the SME was asked to prioritize targets as shown. Factors expected to influence this decision include: Targets' distance (i.e., Orange closest, Green next closest, Yellow furthest), Targets' actions/firing status (i.e., Yellow prepared to fire, Green not poised to fire, Orange not poised to fire), and perhaps visibility of the targets due to camouflage, lighting, and distance (i.e., Orange and Green easier to see than Yellow). SME responses in this case are reported in Table 9

SME	Target Selected in Drill	AAR/Comments/Target Selection Rationale
1	ORANGE	nearest threat; would shoot near to far (Orange, Green, Yellow). Weapon of choice would be a pistol caliber type long gun (e.g., M5) or rifle cartridge short gun (e.g., FP90 or M-16).
4	YELLOW	is firing and Orange and Green are reloading
5	YELLOW	Yellow is about to engage, then target Orange, then Green. Would prefer to have SAW, but if had rifle, would use double tap mode. Would re-engage target until he goes down.
10	YELLOW	looking at me, prepared to fire
11	ORANGE	closest and can't see that Yellow is a threat.
12	GREEN	saw Green first. probably should have picked Yellow, as weapon is up and engaged.

Table 9. SMEs Target Prioritization Responses to Scenario Shown in Figure 11

This slide best illustrates the need for approaching the development of this model through the use of weighted probability distributions. Of the three targets available (Orange, Yellow, and Green) two SMEs picked Orange, 3 SMEs picked Yellow, and 1 SME picked Green. Of interest in this last case was the fact that upon review of his actions (i.e., in the AAR for the drill), the SME who had picked the Green target suggested that he should have selected the Yellow target. So, not only does this slide illustrate that SMEs don't always pick the same targets, but also it illustrates that they may not even pick what they consider to be the "best" target. That is, since there is some stress built into the target selection exercise and the SMEs don't have an unusually long time to deliberate about their response (like they did in the Open Field KA exercise), the responses seem to be a better representation of actual behavior (even though true behavior may not be the optimal response).

Another slide that was presented in the drill may be seen in Figure 12. So, to review the format of the drill, a slide such as Figure 11 would display for four seconds, the SME would indicate which color arrow was associated with his highest priority target, and then the next slide in the sequence (e.g., Figure 12) would be presented to the SME, and the process would iterate over all 33 slides in the drill. As seen in Appendix D, slides were grouped according to scenario from which they were generated.

In Figure 12, factors influencing target prioritization include proximity to cover/concealment (Green closer to bus than Orange), and visibility of Targets as a function of lighting and camouflage with environment (Orange slightly more visible than Green), and firing status/action of Targets (Orange prepared to fire at IC, Green's actions less discernible due to visibility). In this case, however, and in contrast to case presented in Figure 11, all SMEs consistently picked the same target (i.e., Orange). However reasons for picking this target, see Table 10 varied slightly.



Figure 12. Sample Drill Slide 2 for MOUT Scenario

SME	Target Selected in Drill	AAR/Comments/Target Selection Rationale
1	ORANGE	Would engage right to left out of habit/training
4	ORANGE	Stands out more, other guy doesn't seem to be pointing gun
5	ORANGE	More visible
10	ORANGE	Pointing at me
11	ORANGE	Green is looking to right and Orange is look and pointing at me
12	ORANGE	Pointing at me

Table 10. SMEs Target Prioritization Responses to Scenario Shown in Figure 12

The rationale motivating the SME's selection of a target would be discussed in the AAR section of the KA session. So, in the initial rapid drill, SMEs would merely respond with the selection of a target for each scenario presented to them. In all, this part of the KA session lasted about 33 (number of slides in drill) * 4 (seconds per slide) = 2 minutes and 12 seconds. Then, the AAR would review the SMEs' selections and rationale for each of the slides. Depending on the scenario, the AAR would also consider weapons selection, sector assignments for room clearing, mode of weapon firing (e.g., double tap, single shot, controlled pairs, etc). Sometimes this additional knowledge was acquired verbally and other times it was presented as a specific

alteration to the scenario and discussed as part of AAR. So for example, in AAR associated with Figure 12, SMEs also added weapons firing information such as:

SME	AAR/Comments on Weapons Selection and Mode of Fire
5	Would prefer to have SAW here, but if using M4 would fire with double tap on both targets
11	Would fire using 3-round burst because M4s not always effective in generating kills

Table 11. SMEs Weapon Selection Responses to Scenario Shown in Figure 12

Then as follow up to the SME's explanation, we could alter the scenario as demonstrated in Figure 13.

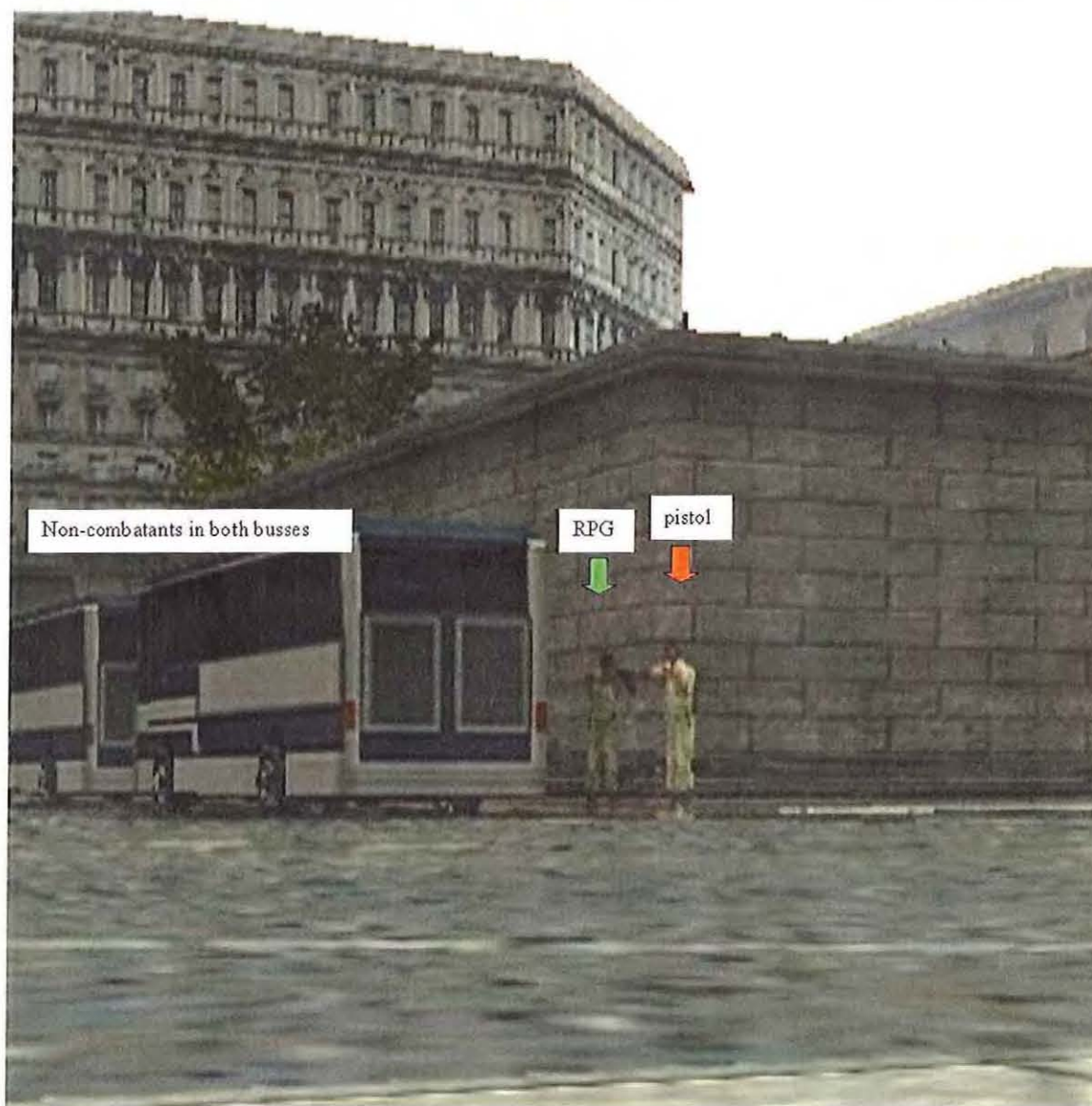


Figure 13. Sample AAR Slide for Figure 12 ("Sample Drill Slide 2 for MOUT Scenario")

Thus we could complicate the scenario to see how reactions would change as a result of this new information. Since this was part of the AAR, it wasn't time-stressed, as in the drill; but it still proved to be a valuable technique for acquiring new knowledge. In this scenario, for instance, additional knowledge acquired from the SMEs is shown in Table 12.

SME	Target Selected in Drill (Figure 12)	Target Selected in AAR (Figure 13)	AAR/Comments/NEW Target Selection Rationale
1	ORANGE	ORANGE	Would still shoot Orange first. But if I was in a building (or similar type cover that could be defeated by the RPG), then I would shoot RPG first.
4	ORANGE	ORANGE	Would still shoot Orange first since distance is close enough for pistol to be effective.
5	ORANGE	ORANGE	Would still pick Orange as first target. But, because on non-combatants in bus, would definitely not want to use SAW, like before. But, if I was using an M4, I would still shoot double taps.
10	ORANGE	GREEN	RPG becomes priority. Would fire rifle with single shots, since non-combatants near-by.
11	ORANGE	GREEN	Since non-combatants in busses, would use single, well-aimed shots. RPG is higher priority because at this range, Orange (pistol) is not as much of a threat. If there were no civilians in busses, I could assign a 203 gunner to both targets.
12	ORANGE	GREEN	If he's pointing at me with RPG, Green would be my priority. But, if Green is not pointed at me, I would still shoot Orange. Also, if I'm in cover (that could be defeated by RPG), the I would assign first priority to Green (even if Green was not pointing at me).

Table 12. Target Selection as Function of Changes Shown in Slide 13

Thus, just by the addition of a small amount of information, the SMEs responses can change; and, this change in response can be directly attributed to the specific change in a factor setting. This proved to be an efficient method for acquiring a lot of usable knowledge from SMEs in a limited amount of time.

3 Results and Analysis

Appendix G and H present the verbal responses of SMEs for the Open Field exercises and the MOUT Drill/AAR exercises, respectively. Also, audio formats of these interviews are available on the enclosed CD. Lastly, slides identified as being "movies" are available on the enclosed CD in mpeg format. Table 13 presents a summary of the initial responses collected from SMEs in the MOUT drill exercise. These responses represent the SMEs' selection of the target they would engage first.

Drill Number in Slide Show and Possible Targets	SME					
	1	4	5	10	11	12
1. Green, Orange, Yellow	Orange	Green	Green	Green	Green	Green
2. Green, Yellow	Green	Green	Green	Green	Green	Green
3. Green, Orange, Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
4. Green, Orange, Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow
5. Green, Orange, Yellow	Yellow	Green	Yellow	Yellow	Green	Yellow
6. Orange, Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
7. Orange, Yellow	Orange	Orange	Orange	Orange	Orange	Orange
8. Orange, Yellow	Orange	Yellow	Yellow	Orange	Yellow	Orange
9. Left, Center, Right (movie)	Left	Left	Right	Left	Left	Right
10. Orange, Yellow, Green	Orange	Yellow	Yellow	Yellow	Orange	Green
11. Green, Orange	Green	Green	Green	Green	Green	Green
12. Orange, Yellow	Yellow	Yellow	Yellow	Orange	Yellow	Orange
13. Left, Prone (movie)	Prone	Prone	Prone	N/A	Left	miss
14. Left, Prone (movie)	Prone	Prone	Prone	Left	Prone	Prone
15. Green, Pink, Yellow	Pink	Pink	Pink	Pink	Yellow	miss
16. Green, Pink, Yellow	Yellow	Yellow	Green	Green	Yellow	Yellow
17. Green, Orange, Yellow	Green	Green	Green	Green	Green	Green
18. Green, Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
19. Far St, Near St, Window	Near St	miss	Near St	Near St	Far St	Near St
20. Green, Orange	Orange	Orange	Orange	Orange	Orange	Orange
21. Green, Orange, Pink	Pink	Green	Green	Green	Green	Green
22. Green, Pink, Yellow	Green	Green	Pink	Green	Pink	Green
23. Green, Orange, Pink, Yellow	Green	Yellow	Orange	Green	Yellow	Yellow
24. Left, Right (movie)	Left	Left	Left	Left	Left	Left
25. Left, Right (movie)	Right	Left	Right	Right	Left	Left
26. Orange, Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
27. Orange, Yellow	Yellow	Yellow	Yellow	Orange	Yellow	Yellow
28. Pink, Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
29. Green, Pink, Yellow	Pink	Green	Green	Pink	Pink	Pink
30. Green, Orange, Pink	Pink	Pink	Orange	Pink	Pink	Pink
31. Green, Pink, Yellow	Green	Green	Green	Green	Green	Green
32. Green, Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
33. Left, Right	Left	Left	Left	Left	Left	Left

Table 13. Initial Target Selection Response of MOUT KA Drill

As seen in Table 11, out of the 33 drills presented 14 had the same initial response across the SMEs. These slides can be used to determine high-level priorities of factors, given a scenario. As evidenced in Appendix H, and especially important in fast-paced MOUT combat, many of the reasons offered as justifications for these responses boiled down to:

- Was first thing I saw
- Was biggest, most obvious or exposed target

- *Was pointing gun at me*

Thus, especially in close-range, simple scenarios where SME responses were very consistent, target selection priorities appear to be a function of "how fast can the target engage me" relative to "how fast can I engage the target".

Through the structured KA session and AAR, a host of other factors (as well as derivatives or specificities of the baseline factors) were identified as being important. Some of these factors are included in Table 14.

- *Is target escaping to cover OR can target escape building?*
- *Where am I looking (scanning)?*
- *Does something (e.g., muzzle flash, sound, movement) catch my attention?*
- *Is there time for Team Leader to make/change assignments (of targets or sectors)?*
- *Are targets hard to see (lighting or in concealment), use SAW or 203.*
- *Can Team Leader take advantage of Team's geometry when making target assignments?*
- *Can you wait to acquire target when it stops, if target is "on the run"?*
- *Are targets getting into grenade range?*
- *Have targets already fired? Do I know their weapon types?*
- *Can I visually determine what kind of weapon the target has?*
- *There's a difference between prioritizing a target that's in kneeling or prone because it makes it a smaller target versus kneeling or prone because it's preparing stable position to fire.*
- *Running with MG is OK for suppression, but not for effective fire. SAW is useful for suppression.*
- *Am I guarding flank? I may be willing to go out of my primary sector, if I'm responsible for flank and target is trying to out flank us.*
- *In MOUT building clearing, target selection and acquisition is highly correlated to sectors assigned through room clearing drill.*
- *When in doubt, go for the surer (hit) target.*
- *If all things equal, go for closer target.*
- *If target is in building accessible by doors or windows, pop grenade or launcher.*
- *In MOUT by concrete, can't use SAW.*
- *In inside MOUT, very difficult to discern which targets are carrying what kind of weapons. Everything is too close and so fast. This distinction would most likely come visibly, as opposed to audibly in open field combat.*
- *Since target's weapon type are not as influential in MOUT combat, might just consider automatic versus non-automatic.*
- *Key in MOUT is INSTINCT!!!*
- *Am I good at hitting moving targets?*
- *Being able to identify what target is doing is important. Given two targets at equal distances, the more visible (because of lighting or camouflage) is consistently the target picked by SMEs.*
- *Being able to use doorway/windows for cover when prioritizing targets. In other words, can SME shoot at Target1 in a more secure position than he can shoot at Target 2 in?*
- *Are there civilians or non-combatants in the scenario? Prefer rifles shots in precision modes as opposed to automatic bursts OR SAWs or 203s. If civilians are very close, prefer single, well-aimed shots. If civilians are not too close, can use double taps or controlled pairs.*

Table 14. Additional Factors Derived from SME KA Sessions

The initial factors were used to develop a target selection prioritization algorithm (as part of IC-WFA) for Open Field and MOUT combat environments. In some cases and to the extent plausible, some of these other factors mentioned above were also integrated into the algorithm. Typically, this was a function of how common these factors were across SMEs. That is, as we tried to make this target selection scheme as general as possible, we focused development efforts on factors that were prioritized consistently across SMEs.

4 Algorithm

Algorithms developed for Phase I, IC-WFA focused on target selection for riflemen in following combat scenarios:

- **Open Field, Close Distance**
- **Open Field, Medium Distance**
- **Open Field, Far Distance**
- **MOUT, Inside Building (CCB)**
- **MOUT, Outside Close Distance**
- **MOUT, Outside Medium/Far Distance**

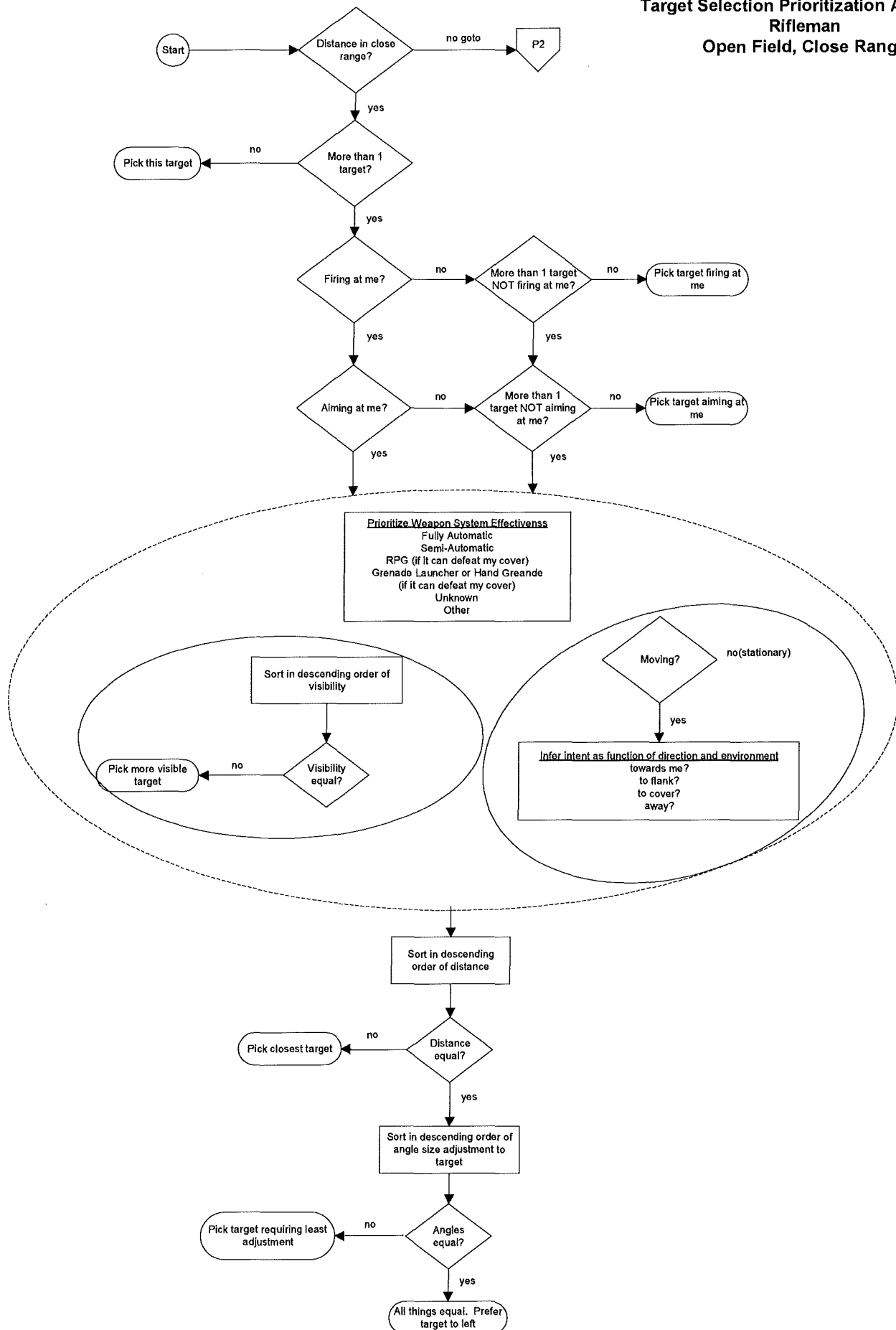
Terms such as "Close", "Medium" and "Far" can be expressed in terms of "fuzzy" definitions generated by sources such as Figure 1. The corresponding algorithms are presented on the following pages, respectively. In all cases, targets that "fall through" "YES" branches of decision blocks take priority over targets that "fall through" "NO" branches for equivalent block.

As we have reported and demonstrated through data, different SMEs have different priorities and individual preferences that affect their target selection and weapons firing mode. While the algorithms presented in following pages are generic in nature, we have attempted to identify groups of decision-related factors that do not have consistent ranking across all SMEs. For example, in the first algorithm presented, Open Field, Close Distance, there is a group of factors clustered towards the middle of the page. Essentially, these factors represent:

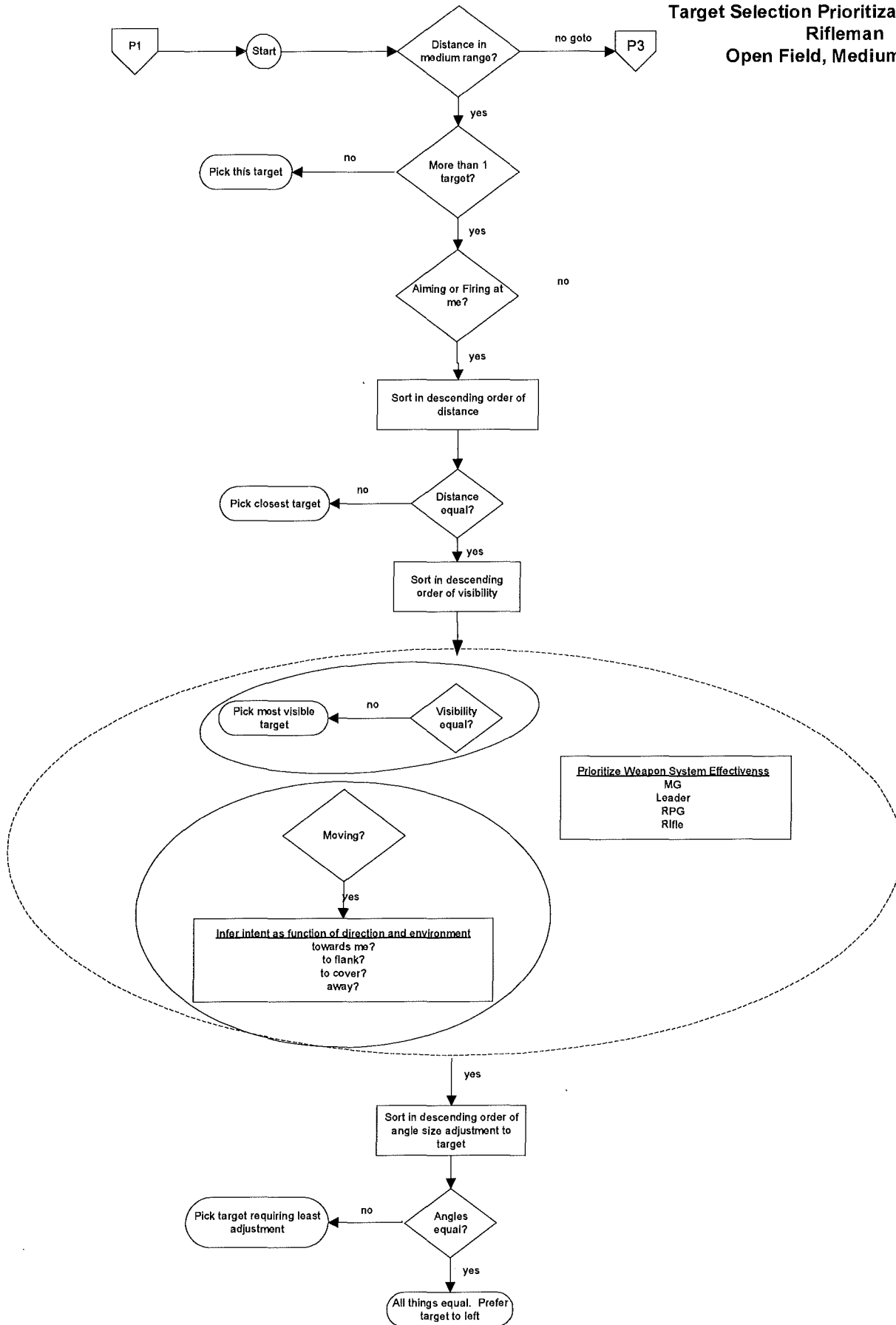
1. Targets' weapons systems/roles
2. Visibility of targets
3. Inferred intent or potential action (to seek cover, make get-away, out flank, prepare to fire, etc.)

These factors are represented in parallel (enclosed in circles) as they were preferred in different orders by different SMEs. For example, as shown in responses to slide shown in Appendix C - Page 25, an example of a Open Field Close Distance Scenario, one SME suggested that he would shoot at "Leader" (because he was the leader). This is an example of prioritizing according to weapon type or role. Two other SMEs suggested they would shoot at "Rifle" first (because we "see more of him" or he "looks closer"). This would be an example of assigning target priority according to visibility. Finally, another SME suggested that he would assign first priority to "Rifle" because he is preparing (intending) to fire. This would be an example of setting priority because of predicted (versus blatant) intent. Thus, the same scenario resulted in different responses in different SMEs for different reasons. It is in instances such as this where we believe empirical distributions will help to more adequately represent IC behavior for an analysis system such as IUSS.

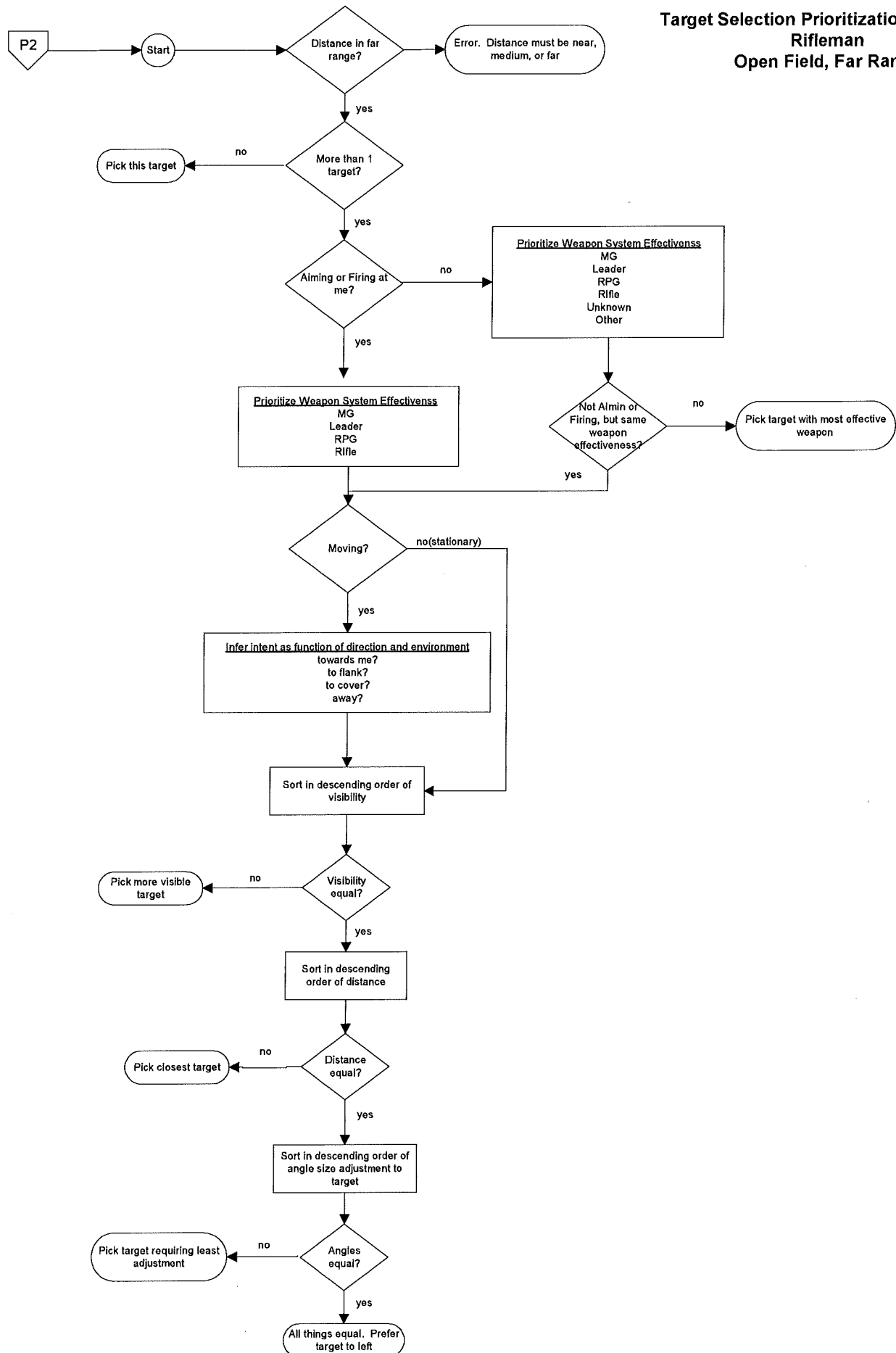
Target Selection Prioritization Algorithm Rifleman Open Field, Close Range



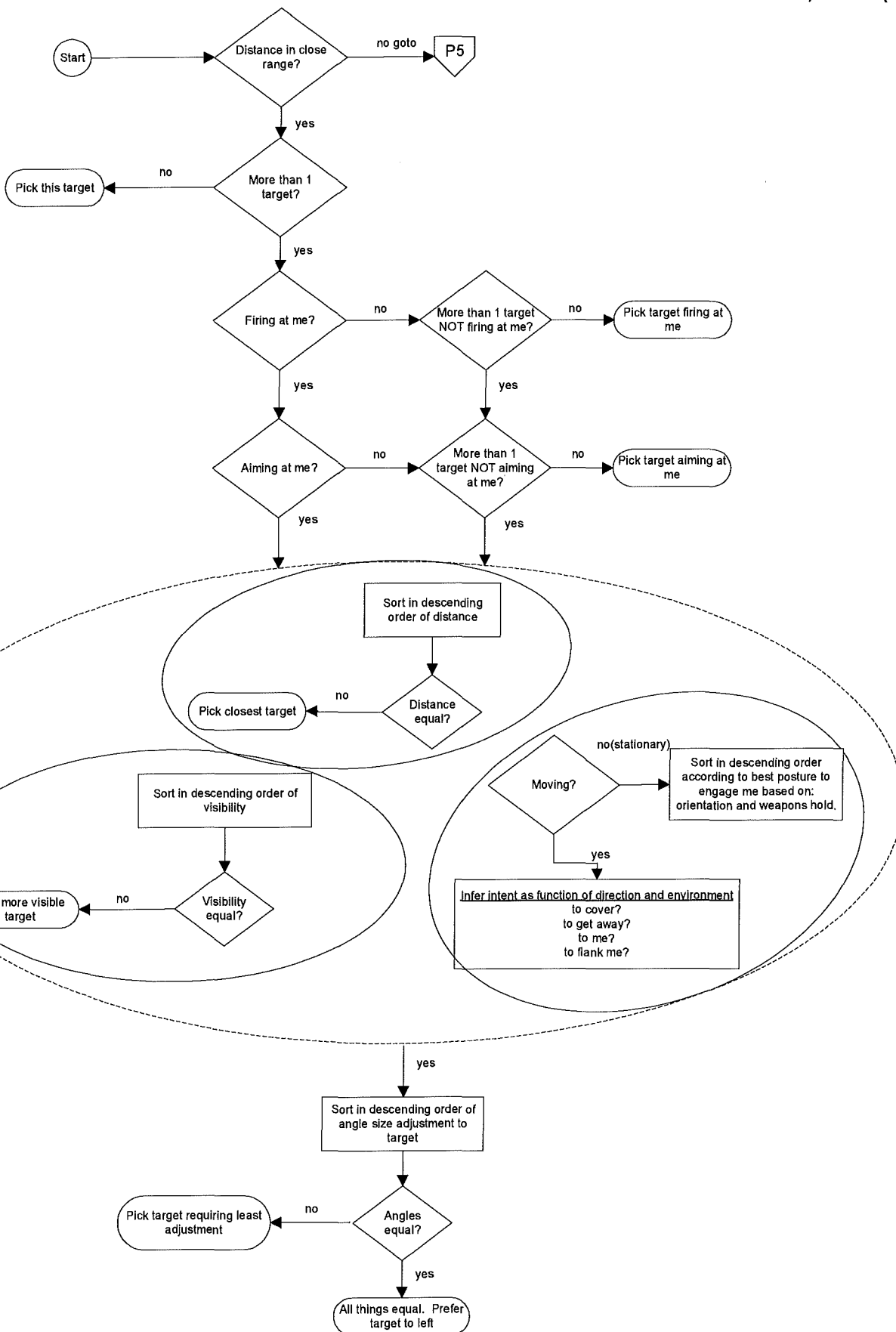
Target Selection Prioritization Algorithm
Rifleman
Open Field, Medium Range



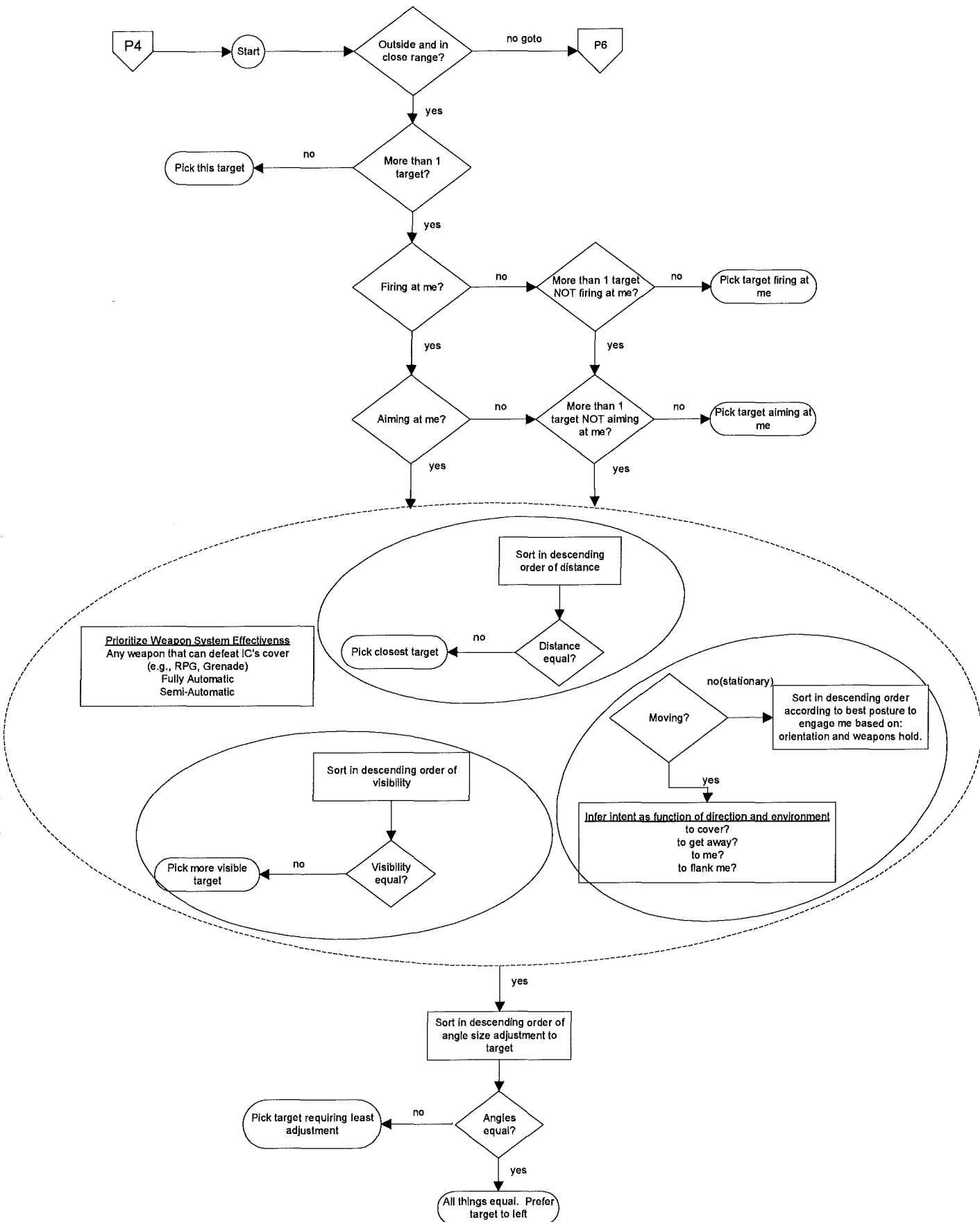
Target Selection Prioritization Algorithm Rifleman Open Field, Far Range



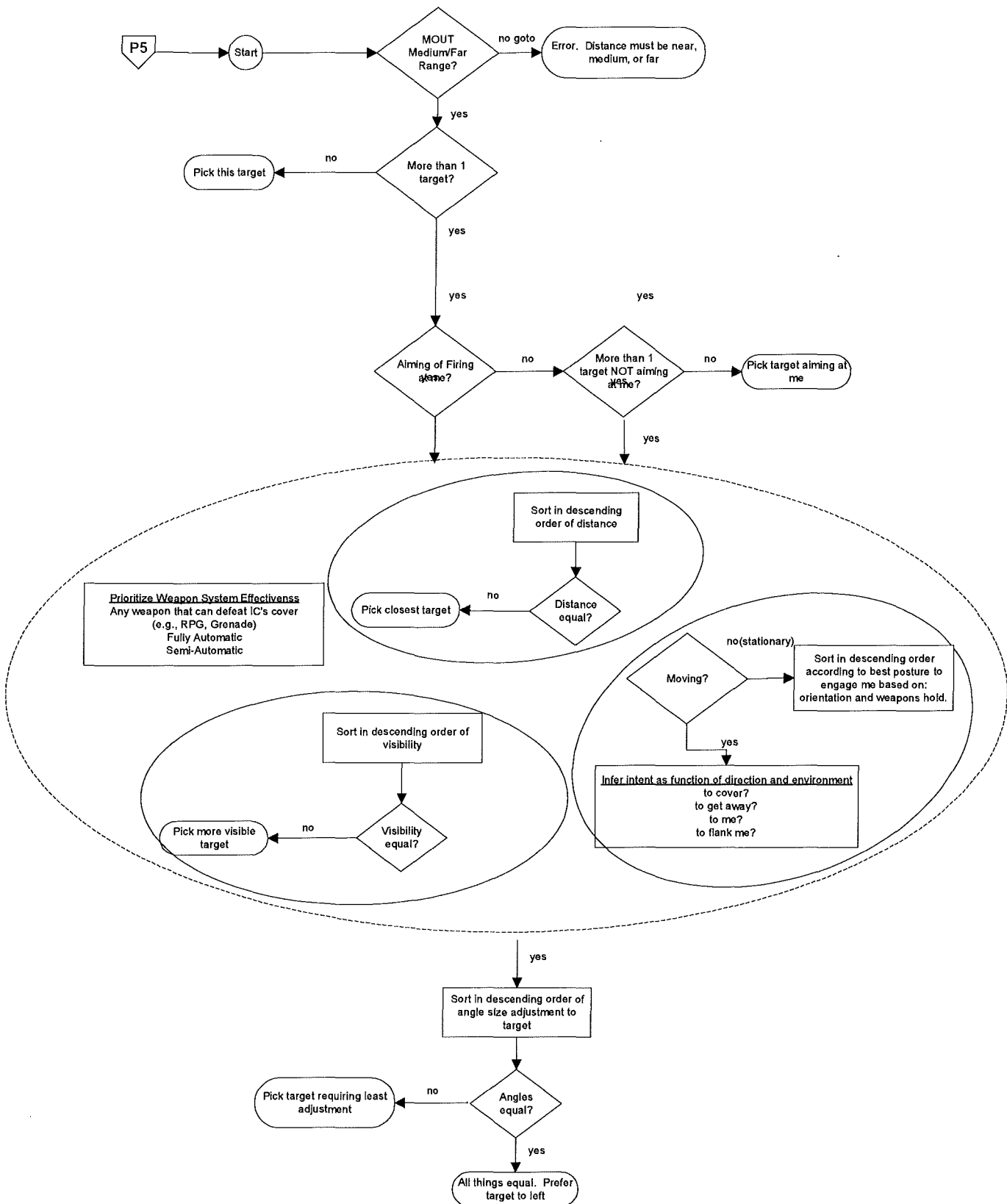
Target Selection Prioritization Algorithm MOUT, Inside (CQB)



Target Selection Prioritization Algorithm MOUT, Outside Close Range



Target Selection Prioritization Algorithm MOUT, Outside Medium/Far Range



5 Conclusions

This section summarizes the methodology and results generated from the investigation, reviews contributions made by the study, and offers recommendations for direction of future work.

5.1 Summary

To summarize, this research examined a number of factors affecting individual combatants' (IC) weapons firing behavior and defined a rudimentary weapons firing algorithm for individual combatants. The objective was to determine which factors were the most influential and how the priorities of these factors can change over a variety of scenarios. To meet this objective, researchers developed a methodology based on structured interview with and scenario drills presented to SMEs. This methodology proved to be time efficient and objective. The most important factors were identified prior to data collection and considered in SME interviews. Each of whom we consider to be our two best SMEs independently recognized and expressed their opinion on the fact that researchers had accurately identified and summarized the key factors that influence IC's selection of a target. As KA sessions over all SMEs progressed, a host of new factors were introduced and many of the original factors were further refined or detailed according to possible scenario variants. Analysis of SME responses across scenarios show that large discrepancies in SME target selection and weapon firing mode exist. Analyses further show largest divergence in prioritization scheme to occur as a function of distance to the enemy. That is, as distance to enemy becomes closer and hence time to respond effectively decreases, target prioritization schemes appear to change significantly.

5.2 Contributions

In completing the requirements of this investigation, a number of contributions to DoD Modeling and Simulation community were made. These include

- Development of methodology to efficiently acquire large amounts of expert data with a limited amount of time and money. This methodology employed the novel use of computer games as KA aids.
- Development and documentation of a large amount of expert knowledge and data on target selection, mode of fire, target assignment, and terrain analysis (Appendices C, D, and F).
- Identification of high-level categories of combat scenarios that share common prioritization schemes for factors influencing target selection. These categories are identified in Section 4, "Algorithm" and include:
 - Open Field, Close Distance
 - Open Field, Medium Distance
 - Open Field, Far Distance
 - MOUT, Inside Building (CCB)
 - MOUT, Outside Close Distance
 - MOUT, Outside Medium/Far Distance

Modular or hierarchical division of behavior algorithms into such categories has proved to be an efficient way to organize and represent knowledge.

- Interview-generated definition of primary factors (Table 1) and interview or empirically generated definitions of how these factors are prioritized over combat categories (see Section 4). Also contributed is additional list of factors that contribute directly to target selection or mode of fire in these combat categories (see Tables 3 and 14).

5.3 Recommendations for Future Work

- **Determine level of resolution WFA should be able to support in the IUSS simulation.** This will depend on uses of the simulation. For example, if simulation models at the level of time required to acquire a target in sight, then it is probably

important to distinguish when IC uses a double tap versus a controlled pair. If, on the other hand, simulation assigns constant acquisition time or completely ignores acquisition time, then simply a "vanilla shoot" will suffice. This is just one example of how to reduce the complexity of this model such that it can be designed more efficiently yet still satisfy requirements of IUSS.

- **Determine best architecture for model representation.** Currently, IUSS behavior engine is being re-designed with a fuzzy-systems/belief network based architecture (Harper et al, 1998). Thus, it would be logical to adopt a similar framework for representation of this model. On the other hand, combat is an extremely dynamic and complex environment. Agents must be flexible to point where they can change goals and interrupt tasks quickly. For example, the Agent must be able to "prematurely" cease work on task A, so that it can take up some (presumably more important) task, task B. But, additionally, the Agent must have the ability to resume work on task A once task B is finished. In a complex combat environment, where a high amount of task switching is required, the ease with which an architecture can accomplish this and the complexity of the task stack the architecture can accommodate is critical to real-time performance in the system. Some systems have the ability to switch frequently between tasks, but incur so much overhead in switching from one task to another that they may not be able to support real-time performance in demanding scenarios. As demonstrated in TacAir-Soar (TAS), a model of fighter pilot tactics (Jones et al, 1999), entity behavior programmed in Soar¹ (Rosenbloom et al 1993), an AI programming language, are highly and continuously interruptible. That is, TAS is frequently interleaving tasks such as communication, flying, weapons employment, sensor use, maintaining SA, etc. This makes Soar a second strong candidate for use in model representation scheme.
- **Design perceptually-based experimental methods that can be used for collecting response data resulting from physical and cognitive influences.** As supported in SME responses listed in Appendices G and H, often times SMEs selected targets based on their scanning patterns, attention, and visualization ability. These cues become even more important in close-up, time-critical situations, like CCB or close-distance combat. One of the most experienced SMEs even mentioned the importance of instinct, auditory, and olfactory cues in his target selection/acquisition scheme. Also, a number of our most experience SMEs emphasized the importance of "knowing your buddy" and having been trained with your team. A number of researchers have explored "instinctive" or naturalistic decision making in stress of combat (e.g., Salas and Klein, 2001; Cannon-Bowers and Salas, 1998), the importance of training and team "mental models" (Stout et al, 1999), and situational awareness from an individual and team perspective (Smith-Jentsch, et al, 1998). Largely, this has been done as part of larger effort to model and understand fighter pilot behavior. We believe that the problem of developing a data-driven model of IC weapons firing behavior would be similar to development of data-driven model of fighter-pilot behavior, and hence, literature in this domain should be reviewed. Further, expertise in this domain should be recruited to consult in the design of experimental methodology to acquire data for empirically-based, data-driven model.
- **Develop objective approach to modeling suppressive fire.** One of the goals of current study was to model use of suppression in weapons firing. This type of information was derived to some extent through KA sessions with SMEs. However, focus of this phase of study was largely on target selection and, to some extent, mode of weapons fire, so discussion of suppressive fire was somewhat limited. Also, references on suppression (Fineberg and McClellan, 1997; Middleton et al, 1997) were consulted but seemed to focus on how suppression affected IC rather than how ICs used suppressive fire to achieve some weapons firing objective. Since assumptions used to scope this study relied on fact that decision to fire had already been made by IC, suppressive fire and fire with intent to kill, for most part, did not seem to significantly change the goal of IC in firing his weapon. That is, it was always IC's goal to kill Target, but IC might fire weapon differently or use different kinds of weapon in cases where the Target was difficult to

¹ The Soar architecture is in the public domain, with source code available at: <http://ai.eecs.umich.edu/soar/>

acquire (e.g., low visibility, area targets, etc). Suppression is obviously a difficult concept to model and define precisely. Even a simple review of definitions provided by a number of FMs (see Appendix B – page 9) demonstrates that no one standardized definition of suppression or suppressive fire exists. Thus, investigators must develop more precise definition and method of measurement for purposes of this study.

- **Incorporate additional factors collected into baseline algorithm.** Baseline algorithms in Section 4 were largely based on initial set of factors defined in Table 1. However, a large set of factors about which heuristic-type information has been collected, has been defined through this KA effort. Mostly, these factors are listed in Table 14, but some are also listed in Table 3. With data currently available, these factors can and should be incorporated into the baseline algorithms defined Section 4. This would provide a more robust baseline algorithm and would prepare researchers with information required to perform next recommended round of experiments to develop empirically-based target selection distributions from data collected over a representative sample of SMEs.

Data collected through this research effort have demonstrated that target selection and mode used for weapons firing are highly variable across SMEs, unique to SMEs, and subject to individual differences in SMEs' training, talents, and preferences. Since models required to support analysis system (e.g., IUSS) must be representative of the population for which the system is used to generate predictions, investigators advise that representation of model most appropriate for use in this application is in form of empirical distributions generated from experimental data collected from a large number of SMEs. Because of the complexity of this task, these experiments must be carefully designed such that data required to ensure model adequacy are captured sufficiently. Results from research presented in this report can help in defining these experiments by providing framework on which factors appear to provide most variability in prioritization scheme over a particular mode of combat.

This document reports research undertaken at the U.S. Army Natick Soldier Research, Development and Engineering Center, Natick, MA, and has been assigned No. NATICK/TR-10/011 in a series of reports approved for publication.

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APPENDIX A
INTERIM PROGRESS REPORT

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LIST OF ACRONYMS and ABBREVIATIONS

BMP	a Threat fighting vehicle
BTR	a Threat vehicle
CGF	Computer Generated Force
FIST	Fire Support Team
FM	Field Manual
FPF	Final Protective Fire
FPL	Final Protective Line
HEDP	High-explosive dual-purpose
IC	Individual Combatant
ICT	Institute for Creative Technologies
ICWFA	Individual Combatant Weapon Firing Algorithm
LOS	Line of Sight
M	meters
MAW	Medium Anti-tank Weapon
MOUT	Military Operations in Urban Terrain
MS	Machine Gun
PDF	Principle Direction of Fire
RHS	Right Hand Side
ROE	Rules of Engagement
SAF	Semi-Automated Forces
SAW	Squad Automatic Weapon
SME	Subject Matter Expert
SOF	Special Operations Forces
SOP	Standard Operating Procedure
SSCOM	Soldiers System Command
STRICOM	Simulation, Training and Instrumentation Command
TOWS	Tube-launched, optically tracked, wire-guided
TRP	Target Reference Point
WFA	Weapon Firing Algorithm

1 Overview of Progress Made Against Milestones

Since initial teleconference (Appendix B1) and 9 April, 2002 meeting at SSCOM, Natick (Appendix B2), Soar Technology, Inc. has been working to define model scope and develop a systematic approach to knowledge acquisition. This report serves to document progress made in this regard.

Initial work early in the project focused on reviewing the background information supplied by Mr. Bob Auer at SSCOM. While a great deal of information was provided and all of it was reviewed at a high level, particular focus was placed on reviewing FM 7-8, weapons lists and Army Green Book descriptions, platoon/squad organizational charts, list of current IUSS deficiencies, and list of factors that sponsors consider important to algorithm definition. In early May, investigators contacted Mr. Victor Middleton and Mr. Chad Hennon of Simulation Technologies, Inc., and Ms. Karen Harper of Charles River Analytics.. They were able to provide us an overview of new IUSS behavior architecture and recommend an open field scenario that could be used in initial data collection efforts. Also in May, Soar Technology, Inc. contacted a number of different organizations in attempts to find other scenarios that could support open field, MOUT urban canyon, and closed quarters scenarios. In early June we acquired services of two local SMEs and started doing interviews. These interviews, coupled with previously reviewed documentation, led to development of factors for open field scenario and a general KA methodology that is expected to promote the orderly acquisition of SME knowledge.

Description of all of these activities and results generated from these activities are reported below.

2 Model Scope

The IC-WFA is being designed to operate in open field, MOUT urban canyon, and closed quarters (CQB) scenarios. According to correspondence from SSCOM, deficiencies in the current IUSS WFA include:

- The soldiers do not use different modes of fire to any great degree (to kill or to suppress)
- The entities exhibit only minimal "self preservation"
- Suppression is overly simplistic
- We do not optimize the use of the weapons mix within the unit against the variety of targets
- We do not account for individual or unit target priority
- We do not account for how easily the desired result could be achieved (no priority to shoot at targets with larger presented areas)
- There is no assessment process on how well actions are achieving the desired result (Battle Damage Assessment)
- There is no modification of actions / behaviors as a result of assessment
- There is no modification of actions / behaviors as a result of enemy actions (except suppression)
- There is a very limited ability to shift fires as a result of mission needs / leader direction
- There is a limited ability to use fires to support other units (coordination between units)
- There is no real ability to use spotter / shooter teams & hand-off targets between units
- There is no ability to coordinate fires within a unit

Thus, approach to developing model is being designed such that we are able to address these kinds of deficiencies. High focus is being placed on: 1. weapons selection based on target, 2. individual/unit target priority, and 3. coordination of fire distribution between ICs, which includes suppression. These are primarily being researched at the IC level. Since some of the deficiencies relate more specifically to situational awareness or tactics, we attempt to make recommendations on how these deficiencies can be addressed (e.g., data structure organization, high-level algorithm, etc), but these other factors, except in capacity that they related to those identified as being priority, are in general a lower priority for this study.

2.1 Initial Data Collection Efforts

Thus far, Soar Technology, Inc. has enjoyed the cooperation of three SMEs to help us in defining the model and developing a knowledge acquisition strategy. These SMEs are: Cpt. Robert Boerjan, LTC. John "Buck" Surdu, and Mr. Rick Matthews (US Army, retired). Brief resumes for Cpt Boerjan and Mr. Matthews may be seen in Appendix A1 and A2, respectively. All of the SMEs have considerable infantry experience and each SMEs infantry experience is from different perspectives/roles (e.g., light infantry, SOF, infantry trainer, etc). One characteristic shared by all three that makes them particularly useful in this task is that they each have a strong background in simulation and training systems. Thus, in addition to fielded infantry expertise, they offer an understanding and appreciation of the issues that constrain the process of formalizing knowledge such that it can be represented computationally.

Initial interviews began with LTC Surdu, an Assistant Professor and Senior Researcher in the Department of Electrical Engineering and Computer Science (EECS) at the United States Military Academy (USMA). Transcripts of this interview may be seen in Appendix B3. LTC Surdu provided a wealth of information and direction to investigators in attempt to define task and factors. Highlights of this interview included his suggestion to use Battle Drills as scenarios to provide context for KA, initial list of factors that would be important to WFA, high-level algorithm on developing sector assignments, and assuming organic definitions supplied by SOPs/doctrine (for unit roles, weapons, etc).

Follow on interviews were conducted with Cpt Boerjan and Mr Matthews. Essentially, these interviews corroborated the initial set of factors developed in earlier research and added more factors. These interviews were also helpful in understanding pros and cons of different weapons systems, SOPs for using/loading/maintaining the weapons, effective ranges for weapons, how infantry are trained with the weapons, how proficiency with the weapons is measured, and how some of the established factors interact to create demanding targeting decisions for the IC. All of these data are presented and discussed in following subsections of this report, and notes from these interviews may be seen in Appendices B4 and B5.

2.2 Important Factors in IC-WFA

A number of factors were considered by SMEs to be important in development of WFA. Also, a number of factors were provided by SSCOM (see Appendix F). From combination of these sources we attempted to develop a matrix of "measurable" factors that could be used as inputs to the model. Table 1 details these factors for the state of IC.

BluFOR State Variables	
Role in Unit	squad leader team leader auto-rifleman grenadier rifleman
Weapon available	rifle (M4 or M16) SAW (M249) grenade launcher (M203) hand grenades
Qty Ammo Available	How much left in weapon? Is it available locally? Near time to reload? Availability relative to remainder of mission
Experience Level	infantry training combat experience etc...detailed in Appendix F1
Number OPFOR in Sector	1 – 4

Table 1. BluFOR State Variable for Experiments

While we do not consider this list comprehensive, we do believe that it represents the most important factors that can be measured to empirically determine relationships. Clearly, other factors (e.g., emotional state, stress, experience, terrain details) are also important. However, this expands the state space beyond comprehensibility. As such, we treat these factors as high level factors that are not embedded in experimental scenarios, but whose affects are described by SMEs through verbal probing or questionnaires. See Appendix F1.

Factors relating to the targets may be seen in Table 2. Some of the factors in Table 2 have been purposefully “discretized” so that they can be considered in design of experiments. Factors such as speed or visibility are clearly not categorical. But, to facilitate the consideration of these factors and SMEs contemplation of how these factors fit in model, we intentionally develop fuzzy categories. While this is not exact, it is a reasonable approximation and should be compatible with the Fuzzy Modeling approach being used by Charles River Analytics in design of new IUSS behavior architecture. Additionally, as we present these factors to SMEs, we coincidentally acquire information on how the SMEs would interpret these labels. This will give us some confidence in appropriate ranges to assign to these categories.

Ideally, data collection would, at a minimum, be able to exercise every one of these cases. But, even for this constrained set of factors and levels, that task cannot be accomplished with present scope of project. For example, considering following OPFOR State factors/levels in isolation of anything else yields 17496 combinations:

Smoke: <smoke, no smoke>
 Cover and Concealment: <cover, concealment, none>
 Posture: <standing, kneeling, prone>
 Distance: <near, medium, far>
 Aim Point: <at You, at Friendly, none>
 Speed: <running, stationary>
 Direction: <toward you, toward friendly, to flank>
 Placing Fire: <well, not well>
 Weapon: <MG, RPG, rifle>
 Role: <officer, sniper, soldier>

Then, assuming only 2 OPFOR Targets present, pairwise comparisons would yield $(17496^2)/2 = 153,055,008$ tests. Thus, even for a very constrained set of factors and comparisons, the number of tests required to perform a full-factorial experiment is unwieldy. This justifies the approach of developing the WFA through heuristics and interview data acquired from SMEs; that is, some of the larger but less complicated sections of the state space may be covered by simple heuristics, whereas other more complicated sections may require more detailed heuristics or even empirical comparisons of experimental data.

OPFOR State Variables	
Posture	standing kneeling prone
Moving speed	fast slow stationary
Moving Direction	at you at crew serve weapon at friendly
Firing Aim Status	IC IC-friendly none
Equipment	MG rifle RPG hand grenade radio
Exposure (combination of cover/concealment and posture)	max med min
Visibility (combination of environment and distance)	clear med poor
Role in Unit	leader sniper soldier
Placing fire well	yes no
Distance/Range relative to weapon (Appendix F1, Question 4)	rifle: near, med, far rifle w/scope: near, med, far Med MG: near, med, far SAW: near, med, far M203: near, med, far hand grenade: near, med, far
Proximity of Targets relative to each other	clustered sparse

*environmental influences incorporated in OPFOR visibility (influenced by grenade smoke, flash/bangs, night/darkness)

Table 2. OPFOR State Variable for Experiments

The IC responses to these inputs are detailed in Table 3. They include weapon selection, target selection, firing position, and mode/duration of fire. These are all responses verbally acquired from SMEs.

(BluFOR) IC Response Variables	
Weapon selection	rifle or hand grenade SAW or hand grenade grenade launcher or rifle or hand grenade
Target	Target1 Target2 Target3 Target4
Firing Position	standing kneeling prone
Mode and duration of fire	single shot double-tap burst (with number rounds) full-automatic (with number seconds)

Table 3. IC Response Variables

These are factors to be considered in an openfield scenario. While most of these will apply to MOUT urban terrain or CQB, other scenarios may require variations of these. For example, in CQB environment, the way the weapon is held when IC shoots may be an important fact that varies according to situational context.

2.3 Units, Roles and Weapons

From review of information supplied by SSCOM, information from FM 7-8 Appendix A, and consultation with SMEs, we have scoped the units, roles, and weapons for this model as specified in Table 4. Clearly, roles and weapons assignments are intricately connected.

Rifle Squad Personnel and Resources (assumed rank)	
Squad Leader	M4 Carbine AN/PVS-14
Team A and B Leaders	M4 Carbine AN/PVS-14
Grenadiers A and B	M203/M4
Auto Rifleman A and B	M249 AN/PVS-14
Rifleman A and B	M4 Carbine AN/PVS-7

Table 4. Rifle Squad Personnel and Resources (in descending order or assumed rank)

Descriptions of these systems are provided by excerpts from Army Green Book follow. This information was supplied by SSCOM.

AN/PVS-14 Monocular Night-Vision Device (MNVD)

The AN/PVS-14 Monocular Night-Vision Device (MNVD) is a system that uses an aviator-grade, passive, third-generation I2 tube for enhanced observation, and command and control. Along with

the enhanced resolution, the lighter monocular design (0.4 kilograms versus 0.7 kilograms for the AN/PVS-7D) provides combat infantry unit leaders with operational flexibility, allowing retention of optimized night vision in one eye or optional monocular mounting to a small arms sighting rail. More than 25,000 AN/PVS-14s have been fielded to date.

AN/PVS-7D Night-Vision Goggles

AN/PVS-7D Night-Vision Goggles are helmet-mounted I2 systems used by soldiers during night operations, including driving, walking, first aid, map reading and maintenance tasks. The passive, third-generation I2 system allows the user to identify a human-size target at a range of 150 meters under starlit conditions. The goggles are designed for use with rifle-mounted aiming lights.

M203 40-mm Grenade Launcher

The M203 40-mm Grenade Launcher is a single-shot grenade launcher designed to be attached directly to the M16A2 rifle and M4 carbine. The M203 replaced the M79 40-mm dedicated grenade launcher in the early 1970s, providing the grenadier with a combined launcher and individual weapon. It has an effective range of approximately 350 meters. The M203 has recently been identified as the delivery means for a growing array of less-than-lethal munitions, ranging from sponge grenades to net-entanglement devices.

M4 Carbine replacing some M16A2 Combat Rifles

The M4 Carbine is a more compact version of the M16A2 rifle with a collapsible buttstock. It permits a soldier operating in close quarters to engage targets at extended range with accurate, lethal fire. The M4 achieves more than 85 percent commonality with the M16A2 rifle and will replace all .45-caliber M3 submachine guns, selected M9 pistols and M16 rifles.



Figure 1. M4 Carbine

M249 Squad Automatic Weapon replacing some M60 Machine Guns

The M249 Squad Automatic Weapon (SAW) is a lightweight, gas-operated, manportable automatic weapon (5.56-mm x 45-mm NATO) capable of delivering a large volume of effective fire (up to 750 rounds per minute) at ranges up to 800 meters. The basis of issue is two per infantry squad. It replaces the M60 7.62-mm medium machine gun in certain units. Recent M249 program modifications adopted by the Army include the M5 collapsible buttstock, which can be installed as a retrofit to existing systems.



Figure 2. M249 Squad Automatic Weapon

Regarding these weapons systems, we have made a number of simplifying assumptions for the IC-WFA. These include:

- We have assumed that M4s or M16s do not have scopes.
- We have assumed that WFA for M4 is same as for M16
- We have assumed that WFA for AN/PVS-14 and AN/PVS-7 are same.
- We have assumed that all squad members are equipped with pouch of 4 hand grenades
- We have assumed that all rifles have 5-to-1 mix of bullets-to-tracers
- We have assumed rifles have 30 rounds in magazines and combat standard load of 7 magazines
- We have assumed Auto-rifle has 200 rounds, and carries 600 rounds in drum

According to FM7-8 Appendix B, Infantry Platoon Reference Guide, effective ranges for these weapons are:

	Area (m)	Point	Moving (m)
M16A2	800	580	200
M249 MG	800	600	N/A
M203	350	160	N/A

Table 5. Organic Weapons Effective Ranges

Initial interviews with SMEs suggest that, for a point target, practical (reasonable) effective ranges for firing these weapons systems are approximately:

	Point
M-16	200 – 250 m
M-249	300 – 400 m
M203	200 – 300 m
M240	800 m
Hand grenades	5 – 10 m

Table 6. Organic Weapons Effective Ranges Estimates by SMEs

These ranges, however, are being acquired through questionnaires distributed to all SMEs. It is our intent to assign fuzzy ranges to these systems based on trends identified in this data. These fuzzy ranges, then, can be used in perception modules of IUSS behavior architecture as inputs to weapon firing/target selection models.

For context, information on roles and responsibilities of various team members was derived from FM 7-8 and interviews with SMEs. Portions of FM 7-8 that are particularly appropriate to development of WFA are excerpted below.

(FM 7-8, Appendix A-3, 2001)

Rifle Squad Leader. This soldier is responsible for all that the rifle squad does or fails to do. He is a tactical leader and, as such, leads by example. The rifle squad leader-

- Controls the maneuver of his squad and its rate and distribution of fire
- Trains his squad on the individual and collective tasks required to sustain combat effectiveness
- Manages the logistical and administrative needs of his squad. He requests and issues ammunition, water, rations, and special equipment.
- Maintains accountability of his soldiers and equipment.
- Complete casualty feeder reports and reviews the casualty reports completed by squad members
- Submits requests for awards and decorations
- Directs the maintenance of the squad's weapons and equipment.
- Inspects the condition of the soldiers' weapons, clothing, and equipment
- Ensures that material and supplies are distributed to the soldiers in the squad
- Keeps the platoon sergeant/leader informed on squad supply status and squad requirements
- Ensures supplies and equipment are internally cross-leveled within the squad.

Team Leader. This soldier is a fighting leader who leads by personal example and helps the squad leader as required. He controls the movement of his fire team and the rate and placement of fire by leading from the front and using the proper commands and signals. He maintains accountability of his soldiers and equipment. He ensures his soldiers maintain the unit standards in all areas.

(FM7-8, Section 2-18 Weapons Emplacement, 2001)

The success of the defense depends on the positioning of soldiers and weapons. To position their weapons effectively, all leaders must know the characteristics, capabilities, and limitations of their weapons, the effects of terrain, and the tactics used by the enemy. Leaders should position weapons where they have protection; avoid detection; and surprise the enemy with accurate, lethal fires. In order to position the weapon, the leader must know where he wants to destroy the enemy and what effect he wants the weapons to achieve. Additionally, the platoon

leader must consider whether his primary threat will be armored vehicles or dismounted infantry. When the platoon must fight armored vehicles, the platoon leader positions antiarmor weapons along the most likely armored avenue of approach first. When the primary threat is from dismounted infantry, the platoon leader should position his machine guns on the most likely dismounted avenue of approach first. The platoon leader must consider both mounted and dismounted avenues of approach. His plan should address both; one as a contingency of the other. Squad leaders position all other weapons to support these key weapons, cover dead space, and provide security.

- a. Machine Guns. M60 (7.62-mm) and M249 (5.56-mm) machine guns are the platoon's primary weapons against a dismounted enemy. They provide a high volume of lethal, accurate fires to break up enemy assaults. They also provide limited effects against lightly armored vehicles and cause vehicle crews to button-up and operate with reduced effectiveness. Leaders position machine guns to –
- b. Concentrate fire where they want to kill the enemy
- c. Fire across the platoon front
- d. Cover obstacles by fire
- e. Tie-in with adjacent units

(1) The following definitions apply to the employment of machine guns.

(a) Grazing Fire. Grazing fire occurs when the center of the cone of fire dots do not rise more than 1 meter (about waist high) above the ground. When firing over level or uniformly sloping terrain, a maximum of 600 meters of grazing fire can be obtained.

(b) Dead space. Dead space is an area within the maximum effective range of a weapon, surveillance device, or observer that cannot be covered by fire and observation from a given position because of intervening obstacles, the nature of the ground, the characteristics of the trajectory, or the limitations of the pointing capabilities of the systems. The platoon covers dead space with another direct fire weapon, M203 fire, indirect fires, or mines (communal-detonated Claymores). Additionally, the platoon leader should attempt to tie-in obstacles (wire and mines) and fires to cover dead space. He may also position Ops to observe dead space for another position.

(c) Final protective line. A final protective line (FPL) is a predetermined line along which grazing fire is placed to stop an enemy assault. Where terrain allows, the platoon leader assigns a machine gun an FPL. Once in position, one soldier from the machine gun team walks the FPL to identify both dead space and grazing fire along its length. (Figure 2-38, p 2-74)

(d) Principle direction of fire. A principle direction of fire (PDF) is a priority direction of fire assigned to cover an area which provides good fields of fire or has a likely avenue of approach. It is also used to provide mutual support to an adjacent unit. Guns are laid on the PDF if an FPL cannot be assigned due to terrain. If a PDF is assigned and other targets are not being engaged, guns are laid on the PDF.

(2) Each gun is given a primary and secondary sector of fire. Their sectors of fire should overlap each other and those of adjacent platoons. A gunner fires in his secondary sector only if there are no targets in his primary sector, or when ordered to do so. Each gun's primary sector includes an FPL or a PDF. The gun is laid on the FPL or PDF unless engaging other targets. When FPFs are called for, the gunner shifts to and engages on the FPL or PDF.

- b. AntiArmor Weapons. The MAW is normally the antiarmor weapon that supports a rifle squad or platoon. In some units these weapons are organic to the platoon. At times, the platoon may be supported by TOWS. During planning, the leader

considers the enemy vehicle threat, then positions antiarmor weapons accordingly to cover armor avenues of approach (Figure 2-39). He also considers the fields of fire, the tracking time, and the minimum arming ranges of each weapon. The platoon leader selects a primary position and a sector of fire for each antiarmor weapons. He also picks supplementary positions for them. The antiarmor leader selects alternate positions. Each position should allow flank fire and have cover and concealment. The leader can integrate the MAW thermal sight into his limited visibility security and observation plan.

- c. Grenade Launchers. The M203 is the squad leader's indirect fire weapon. He positions it to cover dead space in the squad's sector, especially the dead space for the machine guns. The M203 gunner is also assigned a sector to cover with rifle fire. The high-explosive, dual-purpose (HEDP) round is very effective against lightly armored vehicles such as the BMP-1 and the BTR.
- d. Rifles. The leader assigns positions and sectors of fire to each rifleman in the squad. Normally, he positions the riflemen to support the machine guns and antiarmor weapons. They are also positioned to cover obstacles, provide security, cover gaps between units, or provide observation.

FM7-8, Section 2-15 Conducting a Defense, 2001)

(b) Leaders control fires using standard commands, pyrotechnics, and other prearranged signals. The platoon increases the intensity of fire as the enemy closes within range of additional weapons. Squad leaders work to achieve a sustained rate of fire from their positions by having buddy teams fire their weapons so that both are not reloading them at the same time.

(c) In controlling and distributing fires, platoon and squad leaders consider –

- The range to the enemy
- Priority targets (what to fire at, when to fire, and why)
- Nearest or most dangerous targets
- Shifting to concentrate fires on their own or as directed by higher headquarters
- Ability of the platoon to engage dismounted enemy with enfilading, grazing fires.
- Ability of the platoon's antiarmor weapon to achieve flank shots against enemy vehicles

(d) As the enemy closes on the platoon's protective wire, the platoon leader initiates final protective fires (FPF) (the following actions occur simultaneously):

- Machine guns and automatic weapons fire along interlocking principle direction of fire (PDF), or final protective lines (FPL) designated principle direction of fires. M203 grenade launchers engage enemy in dead space or against enemy attempts to breach protective wire.
- The platoon continues to fight with Claymores and hand grenades

If applicable, the platoon leader requests indirect final protective fires (FPF) if they have been assigned in support of his positions

(FM7-8, Annex G: Fire Control and Distribution, 2001)

1 FIRE CONTROL

1.a Fire control measures.

1.a.1 Graphic measures

1.a.1.a Boundaries or sectors. Divide areas of tactical responsibility between units

1.a.1.b Battle positions. Defensive position oriented along likely enemy avenues of approach

1.a.1.c Engagement areas. The area in which the leader intends to destroy the enemy

- 1.a.1.d TRPs. TRPs are used to reference enemy locations. They can be man made or natural. TRPs must be easily identifiable.
- 1.a.1.e Maximum engagement lines. Imaginary line which identifies the point where a particular weapon system is engaging at its maximum effective range.
- 1.a.1.f Trigger lines. An imaginary line where, once the enemy crosses, friendly units can engage. Trigger Lines can be oriented to terrain, obstacles, TRPs, or maximum engagement lines.
- 1.a.1.g Phase lines. Imaginary line placed along identifiable terrain which is used to control movement or coordinate fires.
- 1.a.1.h Final protective fire. A preplanned barrier of both direct and indirect fire designed to prevent or disrupt the enemy assault.
- 1.a.2 Rules of engagement. Rules of engagement are directives issued by military or political authorities that specify circumstances under which the platoon will initiate or continue combat operations. Rules of engagement will generally be issued with the company operations order. Ensure everyone understands ROE.
- 1.a.3 Engagement priorities. Targets appear in random order at different times and locations throughout the battlefield. Engagement priorities allow the leader to designate which target he wants destroyed first. Engagement priorities are usually done by weapons systems.
- 1.a.3.a **Antiarmor weapons systems.** The platoon antiarmor weapons engage targets in the following priority:
- Most threatening armor
 - Armor in primary sector
 - Armor in secondary sector
 - Unarmored command and control vehicles
- 1.a.3.b **Platoon machine guns.** Machine gunners should always attempt to engage at their maximum effective range and should strive for grazing fire. Machine guns have the following target priority:
- The FPF, if directed
 - The most dangerous or threatening target
 - Groups of dismounted infantry in primary sector
 - Enemy crew-served weapons
 - Groups of dismounted infantry in secondary sector
 - Unarmored command and control vehicles
- 1.a.3.c The target priority for **M203s** is -
- The most dangerous or threatening target
 - Light-armored vehicles
 - Groups of three or more in primary sector
 - Groups of three or more in secondary sector
- 1.b Fire Commands. Leaders use fire commands to direct the fires of the unit. A subsequent fire command adjusts or changes information given in the initial fire command. Only the elements that change are given. Fire is terminated by the command or signal for CEASE FIRE, END OF MISSION. A fire command has the following six parts.
- 1.b.1 Alert. The leader can alert the soldiers by name or unit designation, by some type of visual or sound signal, by personal contact, or by any other practical way.
- 1.b.2 Direction. The leaders tells the soldiers the general direction or pinpoint location of the target.
- 1.b.3 Description. The leader describes the target briefly but accurately. The formation of enemy soldiers is always given.
- 1.b.4 Range. The leader tells the soldiers the range to the target in meters.
- 1.b.5 Method of fire. The leader tells the soldiers which weapons to fire. He can also tell the type and amount of ammunition to fire, and the rate of fire.

- 1.b.6 Command to fire. The leader tells soldiers when to fire. He can use an oral command, a sound or a visual signal. When he wants to control the exact moment of fire, he says AT MY COMMAND (then pauses until ready to commence firing). When he wants to start firing upon completion of the fire command, he just says FIRE.
- 1.c Fire Control During Limited Visibility. During limited visibility, leaders ensure that the platoon's fires are controlled. To do this, they can use aiming stakes, T&Es for all machine guns, illumination, TRPs, and night vision devices.
- 2 FIRE DISTRIBUTION. The two methods of fire distribution are point fire and area fire.
- 2.a Point Fire. The platoon's fires are directed at one target. The platoon leader accomplishes this by marking the desired target with tracer fire or by M203 fire.
- 2.b Area Fire. The platoon's fires cover an area from left to right and in depth. The platoon leader accomplishes this four ways,
- 2.b.1 Frontal fire. Frontal fire is used when the enemy is moving perpendicular to the platoons direction of fire. Each squad engages the targets to their immediate front. As targets are destroyed, fires are shifted toward the center of the enemy
- 2.b.2 Cross Fire. Cross fire is used when the enemy is moving perpendicular to the platoon's direction of fire and terrain does not allow frontal fire. It is also used when the enemy is moving oblique to the platoon's direction of fire. When using cross fire, squads engage targets from left to right or from right to left depending on their location.
- 2.b.3 Depth fire. Depth fire is used when the enemy is moving parallel to the platoon's direction of fire. Squads engage targets from front to rear or from rear to front. As targets are destroyed, fires are shifted toward the center of the enemy.
- 2.b.4 Combination. Depending on the METT-T, the platoon may use any combination of the above techniques.

2.4 Scenarios

To facilitate knowledge acquisition process, we have attempted to find a number of SME-generated scenarios in the open field, MOUT urban canyon, and closed quarters domains. Inquiries of the availability of these scenarios were made to:

- CPT Scott Crino, MOUT FACT Coordinator, TRADOC
- LTC Charles Robinson, Modeling and Simulation Action Officer, USJFCOM
- Karen Harper, Charles River Analytics
- Chad Hennon, Simulation Technologies, Inc.
- Mike Van Lent, Research Scientist, ICT
- Alyscha Pascal, Electronics Engineer, STRICOM
- Bill Pike, Electronics Engineer, STRICOM
- Ronnie Soles, Engineer and VIRTE Technical Lead, NAWCTSD
- Jan Chervenak, Chief Simulation Lab, DBBL
- LTC. Buck Surdu, Ph.D., Asst. Prof. and Sr. Researcher, USMA, Dept. of EE&CS

To our surprise, very few "official" or "approved" scenarios exists for this kind of use. Even simulation oriented organizations such as ICT and STRICOM do not have SME-approved scenarios available for use, though they are in the process of creating such scenarios. STRICOM/ICT expects to have company-level MOUT attack scenario defined within a month. This, however, was outside of scope of the ICWFA model. Future plans include scoping this scenario to the platoon and ultimately, the squad level. However, according to Ms. Pascal, STRICOM representative for ICT, this won't be completed for approximately 6 months.

The next best source of scenarios seemed to be M. Chervenak of DBBL. However, according to Mr. Chervenak, there wasn't anything immediately available off-the-shelf.

We were able to secure one open field (squad patrol) scenario from Akroyd, P., Harper, K., Middleton, V., and Hennon, C. (2002). This scenario is attached in Appendix C.1.1. While graphics supporting this scenario suggest that it encompasses of "Hasty Squad Defense", our SMEs have suggested that "Hasty (Far) Ambush" is a better descriptor, as the BluFOR squad has the clear tactical advantage. Thus, we have approached this scenario from perspective of "offensive" as opposed to "defensive".

We were also able to secure one closed quarters scenario from Mr. Ronnie Soles, an engineer supporting the USMC Virtual Technologies Environment Program. This scenario is typical building clearing scenario that was designed by USMC SME. It may be seen in Appendix C.2.1.

A number of MOUT urban canyon scenarios were downloaded from the WWW, the most detailed residing at: <http://call.army.mil/products/mout/street/strfight.htm>.

Lastly, recommendations from SME1 prompted us to use FM 7-8 Battle Drills. According to SME1, these Battle Drills are essential part of infantry training, and thus, principled scenarios that are familiar to all warfighters who have completed infantry training.

Thus, based on scenarios we have been able to collect and scenario available through Battle Drills, the following scenarios are being recreated in computerized scenarios with these assistance of a SME, as a means of providing context and visualization to SMEs supporting knowledge acquisition.

Open Field

Squad Patrol – Squad Hasty Ambush
Battle Drill 1A – Squad Attack
Battle Drill 2 – React to Enemy Contact

MOUT Urban Canyon

tbd

Closed Quarters

Battle Drill 6 – Enter Building/Clear Room

2.5 Major Assumptions

To scope the model, we have made a number of assumptions. Major assumptions are listed below, while other more minor assumptions have been presented in sections where the best fit within the organization of this document.

Acknowledging counsel of Mr. Victor Middleton of STI (see Appendix A2), the most important assumption we make in defining this model is that the decision to engage has already been made. Thus, the ROEs support the engagement of enemy contact and the analysis to determine to engage has already been made and yielded decision to engage.

From that conversation (Appendix A2), we also determined need to recommend a number of data structures that must exist to support the algorithm. Essentially, these data structures include information on targets for selection and battle damage assessment. Final report will include an organized list of data required to support ICWFA.

Lastly, to scope the study, we have assumed that threat targets are dismounted infantry and have not considered light armor.

3 Knowledge Acquisition Methodology

3.1 Objective

In earlier sections we described our approach as being dependent on complexity of the response space. For example, in situations where large areas of the response space can be covered by a single heuristics, we are able to verbally acquire this knowledge from SMEs. In other sections of the response space, where the relationships are more complex, we are employing more scientifically appropriate methods to empirically collect the data necessary to develop these relationships. Since the focus of this study is to define weapons/target priorities for the unit and IC, and we have learned that a number of factors influence this relationship in complex, highly situational ways, our approach is to study this section of the WFA empirically. Specifically, we are designing a methodology that promotes the orderly acquisition of knowledge focused on defining the relationship between the factors expressed in Tables 1, 2, and 3. So, for example, a situation such as "According to mission orders, target X is priority" could be covered heuristically, whereas a more complicated situation such as "Target A - 100 yards away with rifle and a Target B 300 yards away with a M/G, fire on the most dangerous target or highest threat" will be determined empirically.

3.2 Design

We have developed KA tools with computer games (see Appendix E), specifically Operation Flash Point, for a prototype KA system. This system is prototyped in an Open Field Scenario. Specifically, we have developed a mission and series of static screen shots for a Squad Patrol, like Ms. Harper provided in her paper. Additionally, we have developed like tools for a Squad Attack (Battle Drill 1A) scenario and a React to Enemy Contact (Battle Drill 2) scenario. These scenarios were developed with the assistance of our SMEs.

Using this method, we are able to use computer game to set up the scenario and provide a context, and then present SME with a series of static screen shots with scenario variants that will help us prioritize targets. So, for example, two factors that have tradeoff value (e.g., target proximity and target's weapons capability) can be examined in one "scene" by presenting a target, Target A - 100 yards away with rifle and a Target B 300 yards away with a M/G. Experimenting with different combinations of these factors helps us to develop rule for the distance at which IC would prioritize OPFOR weapons capability over OPFOR position. This is just one example of tradeoff for two important factors. As indicated in Tables 1 and 2, there are many more factors. Because this study can not consider pairwise comparisons of all combinations of factors (as demonstrated in Section 2.2), we opt to develop scenarios with SME guidance and input that will help us focus on those factors that can be the most confounding.

3.3 Open Field Scenarios - Design

As explained in previous section, 3 scenarios have been selected for KA efforts to support Open Field scenarios: Squad Attack (Battle Drill 1-A), React to Enemy Contact (Battle Drill 2), and Hasty (Far) Ambush. While all three have been developed in computer scenarios and have static scenarios captured for data acquisition, the scenario that has served as our prototype thus far is the Squad Hasty (Far) Ambush. Thus, other scenarios are presented from a high-level perspective and the Hasty Ambush KA effort is presented in great detail.

3.3.1 Patrol - Squad Hasty Ambush

The objective of developing a scenario for Presence Patrol is similar to that of a Squad Attack. The methodology for designing the scenario was a three step process:

- A Identifying specified and unspecified tasks of tasks outlined in FM 7-8 manual

- B Link tasks to responsible personnel
- C Develop a scenario that created opportunities for individual to prioritize targets based on context of situation

The first step began with decomposing the Squad Hasty Ambush through SME interviews and tasks outlines in FM 7-8 manual to identify which personnel were responsible for completing the tasks.

The second step began with the knowledge that a standard US Army Infantry Squad had 9 personnel: the Squad Leader (SQD LDR), Alpha Team Leader (TM A LDR), Bravo Team Leader (TM B LDR), and three team members in each team. With this information, a mission task worksheet was developed. Each task was assigned to a matrix shown in Table 7 and linked to the personnel responsible for the tasks. This decomposition identified individual tasks that may have only one responsible person or all squad members. For example, the task Movement has the subtask of directing or controlling team members. The individual's with primary responsibility for executing this task are the Alpha and Bravo Team Leaders.

Lastly, we developed a scenario using this task breakdown sheet as a guide. In this scenario (based on Appendix C.1.1. supplied by STI and Charles Rivers Analytics) a US Army Squad is assigned mission to patrol a road and gather intelligence. Then, they receive radio report of enemy presence and set up a hasty ambush in tree line approximately 250m. In this scenario, the squad is operating in isolation, and they have a clear tactical advantage.

Task ID	LDR/Team Tasks/Actions	SQD LDR	TM LDR A	TM LDR B	Individual Soldier
1	SQD Movement				
1.1.	Traveling Overwatch				
1.1.1.	Attached weapons move near the squad leader and under his control so he can employ them quickly	X			X
1.1.2	Direct Teams	X			
1.1.3.	Navigation	X	X	X	
1.1.4.	Direct TM Members		X	X	
1.1.4.1.	Weapops face proper directions		X	X	X
1.1.4.2	Spacing between members		X	X	X
2.	Actions on Enemy Contact				
2.1.	React to Contact				
2.1.1.	Seek Cover and Concealment	X	X	X	X
2.1.2.	TM in contact returns suppressive fire towards enemy		X		X
2.1.2.1.	Reposition (bound/crawl) to ensure they have observation, fields of fire, cover/concealment		X		X
2.1.2.2.	Report known or suspected enemy positions to TM LDR				X
2.1.2.3.	TM LDR directs fires using tracers and fire commands		X		
2.1.3.	TM not in contact observes flanks and rear of SQD			X	X
2.1.4.	SQD LDR reports to PLT LDR and moves to TM in contact	X			
3.	Locate the enemy				
3.1.	Use sight and sound acquire known or suspect enemy locations			X	X
3.2.	Place well-aimed fire on enemy positions			X	X

3.3.	SQD LDR moves to where he can observe enemy and assess situation	X			
3.4.	SQD LDR requests immediate suppression indirect fires	X			
3.5.	SQD LDR reports situation to PLT LDR	X			
4.	Suppress Enemy				
4.1.	SQD LDR determines if TM in contact can gain suppressive fire based on volume/accuracy of enemy	X			
4.1.1.	If Yes then:				
4.1.1.1.	TM destroys or suppresses enemy crew-served weapons first		X		X
4.1.1.2.	TM places smoke on enemy to obscure enemy observation		X		X
4.1.1.3.	TM LDR directs well aimed sustained fire on enemy – no lulls		X		
4.1.1.4.	Buddy TMs fire weapons so both are not reloading at same time				X
4.1.2.	If No then:				
4.1.2.1.	SQD LDR deploys TM not in contact to a support by fire position	X		X	
4.1.2.1.1.	TM repositions to ensure they have observation, fields of fire, cover/concealment			X	X
4.1.2.1.2.	TM LDR directs well aimed sustained fire on enemy			X	
4.1.2.2.	SQD LDR reports situation to PLT LDR	X			
4.1.2.3.	SQD continues to suppress enemy and responds to further orders from the PLT LDR	X	X	X	X
5.	Attack				
5.1.	SQD LDR determines if TM not in contact can maneuver by assessing enemy: positions and obstacles; size; equipment; vulnerable flank; covered/concealed flanking route	X			
5.1.1.	If Yes then:				
5.1.1.1.	SQD LDR directs TM in contact to maintain suppressive fires on enemy	X	X		X
5.1.1.2.	SQD LDR leads or directs assaulting TM along route that puts them in position to assault the enemy	X		X	
5.1.1.3.	Once in position, SQD LDR gives prearranged signal for support TM to cease fires or shift to opposite flank	X		X	X
5.1.1.4.	Assaulting TM fights through enemy positions using fire and movement			X	X
5.1.1.4.1.	TM LDR selects route to reach objective that provides best cover/concealment			X	
5.1.1.4.2.	TM LDR leads TM in shallow wedge			X	
5.1.1.4.3.	TM members move using individual movement techniques as individuals or buddy teams the other covers movement			X	X
5.1.1.4.3.1.	3 –5 second rush; high crawl; low crawl				X
5.1.1.4.3.2.	Buddy TMs one moves the other covers movement				X
5.1.2.	If no then:				
5.1.2.1.	SQD LDR deploys assaulting team to add its	X			

	fires against enemy, reports situation to PLT LDR, requests instructions				
6.	Consolidate and Reorganize				
6.1.	Once assaulting TM seized enemy position, SQD LDR establishes security	X		X	X
6.2.	SQD LDR signals supporting TM to move forward into designated positions	X	X		
6.3.	SQD LDR assigns sectors of fire to both teams	X		X	
6.4.	SQD LDR positions key weapons	X			
6.5.	Soldiers take up hasty positions				X
6.6.	SQD LDR develops initial fire support plan against an enemy counterattack	X			
6.7.	SQD LDR posts an OP to warn of enemy activity	X			
6.8.	Reestablish Chain of Command	X	X	X	X
6.9.	Redistribute and resupply ammunition	X	X	X	X
6.10.	Man crew-served weapons first	X	X	X	X
6.11.	Redistribute critical equipment (radios, NBC, NVDs, etc...)	X	X	X	X
6.12.	Treat casualties and evacuated wounded	X	X	X	X
6.13.	Fill vacancies in key positions	X	X	X	
6.14.	Search, silence, segregate, safeguard, and speed EPWs to collections points	X	X	X	X
6.15.	Collect and report enemy information and materiel	X	X	X	X
6.16.	TM LDRs provide ammunition, casualty, and equipment (ACE) reports to SQD LDR		X	X	
6.17.	SQD LDR consolidates ACE report and passes to PLT LDR	X			
6.18.	SQD continues mission after receiving instructions from PLT LDR.	X			

Table 7. Squad Attack Mission List

3.3.2 Battle Drills: Battle Drill 1-A and 2

"Infantry battle drills describe how platoons and squads apply fire and maneuver to commonly encountered situations. They require leaders to make decisions rapidly and to issue brief oral orders quickly." (FM 7-8, p. 8). The following are key aspects of all battle drills:

- very few orders given by the leader
- actions should be instinctive
- actions take place sequentially
- limited to situations requiring immediate responses
- require much practice to proceduralize and internalize the steps

The objective of the the Squad Attack Battle Drill scenario was to present test subjects with the opportunity to present weapons firing knowledge in context of well-rehearsed, "drilled", offensive operation. The methodology for designing the scenario was the same as explained in previous section.

The first step began with decomposing the Squad Attack tasks outlines in FM 7-8 manual to identify which personnel were responsible for completing the tasks. There are two types of tasks

in the Squad Attack Battle Drill: specified, those tasks identified in the Battle Drill steps; and unspecified, those tasks not identified, but inferred. In Table 7, an example of an identified task would be the Action on Enemy Contact task (FM 7-8, pp. 4-8). However, the first implied step is the "Squad Movement" task to an area, which provides opportunity and context to then execute Action on Enemy Contact.

The second step, already completed from previous section, was to develop a mission task worksheet was developed. Each task was assigned to a matrix shown in Table 7 and linked to the personnel responsible for the tasks. We were able to reuse this decomposition, as "React to Contact" was detailed in Task 2, and "Attack" was already detailed in Task 5.

Lastly, we developed scenarios using this task breakdown sheet as a guide. In the Attack scenario a US Army platoon is assigned the mission to destroy small isolated groups of enemy forces that are attacking friendly supply lines. One squad was moving from the right flank and a second squad was following the main squad, which was used specifically for data collection scenario. The scenario begins with the main squad in the Assembly Area (AA). This squad moves along a designated route and eventually makes contact with small enemy force (within 200 meters of dense forested area). At this point, a Squad Attack Battle Drill is executed. In the "React to Contact" drill, a US Army squad is conducting a patrol and is ambushed by the enemy.

3.4 Hasty Far Ambush – Sample KA Scenes

At this time, for the Hasty Far Ambush prototype, we have developed a computerized version of the "road to war". This scenario exists in an electronic game environment and cannot be attached/embedded in this report or executed without the appropriate game software. The game used for the study (see Appendix G) was Operation Flashpoint (OPF). OPF is a member of the First Person 3D Shooter Genre of computer games. By taking screenshots from OPF while the scenario is executing, we are able to generate a number of scenes where factors affecting target prioritization are interacting. Then, to make the process more clear, we are able to annotate those scenes with information to help SME make his decision. A few representative screenshots are included below. In all, we have 62 slides that present variants of those shown below.

First screenshot that provides top-down view of battlefield is shown in Figure 3. The game actually starts at this point. We use this scene to familiarize the SME with the scenario, so he understands game playing out, when it is presented to him.

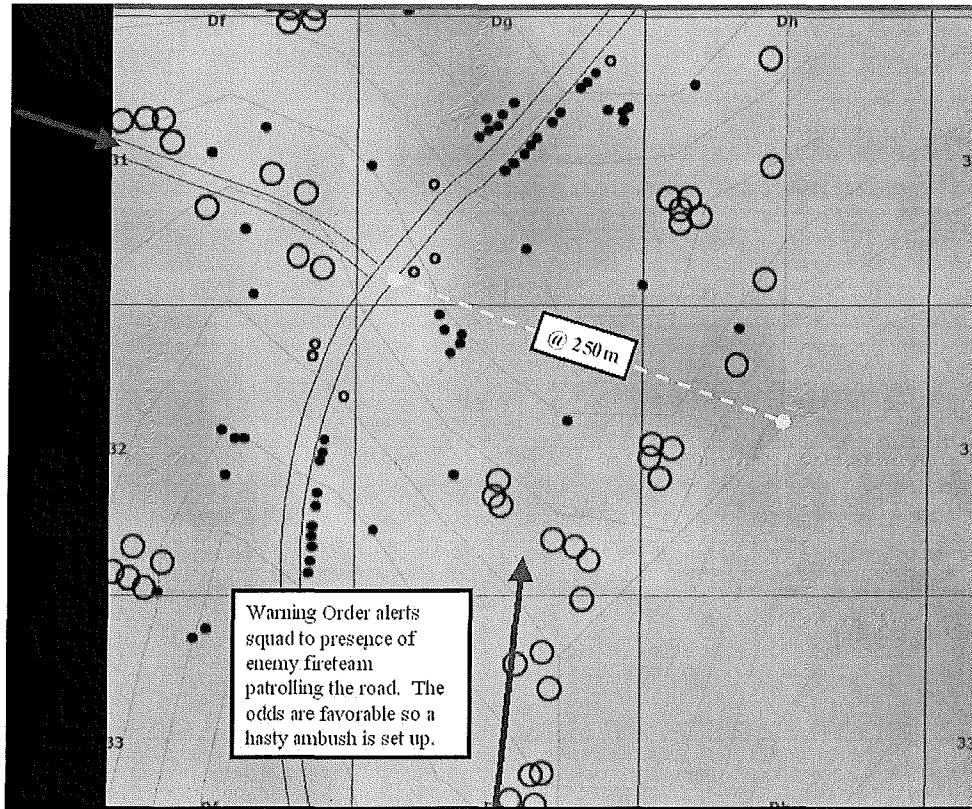


Figure 3. Initial Set up of Hasty Far Ambush

After we show him the entity movement and terrain in the game environment, we ask the SME to:

Slide 1: Pretend you're the Squad LDR. Show us (draw for us) how you set up the ambush.

Pretend your TMA LDR and TMB LDR and just received orders from SQD LDR, draw you will set up your fireteam and define the sectors of fire.

Both of these operations are performed interactively with the SME drawing stickmen and lines on hard copy of map. We believe that doing this over a number of scenarios will give us a good sample of how people will set up fire sectors and lay out their squads/teams. This does not directly support the scope of our task, but we consider it good background knowledge and since it complements the remainder of the KA session, we are opting to collect the data while it is easily available to us.

Then we start presenting scenario snapshots in the area designated as the kill zone. Figure 4, for example shows the enemy fireteam approaching the intersection. From this slide we can ask the SME to identify which target he assigns highest priority and why. We can also ask SME if his targeting priorities change according to what kind of weapon he has. For example, a grenadier might choose to fire his rifle or fire a grenade. Or, perhaps, as we've seen in initial run through of these experiments with SME, in role of SQD LDR, the SME may have actually identified that intersection as priority for firing grenades. Thus, in this situation, the grenadier isn't even making the decision; firing grenades at targets in the intersection is simply part of his orders.



Figure 4. Sample 1 of Target Situation Early in Scenario

A screenshot such as that shown in Figure 5 can be used to determine tradeoffs between assigned sectors of fire (represented by blue lines), threat of target (e.g., rifle, MG, RPG), and target's stance/exposure. In this Figure, for example, our SMEs initial reaction was to target the RPG, even though RPG is out of his sector of fire, because of the high threat of the weapon and because it looks like the RPG is shooting back. Then after some contemplation, the SME decided that he best depend on his "buddy" and trust that his team partner will target RPG. Then SME elaborated further by suggesting that if he (SME) was placed on far RHS of team and he noticed the RPG running to right flank, he would target RPG (even though RPG is not in subject's fire sector). Generating questions for this single screenshot resulted in the acquisition of a fair amount of target prioritization knowledge. Also, however, this scenario demonstrated to us that our methodology is somewhat flawed, as SMEs have "too long" to contemplate the situation. We believe, and our SMEs agree, that the selection of target must be performed more reactively or instinctively. Nonetheless, as a knowledge acquisition tool, the slide was useful in suggesting new rules to us that we hadn't previously considered (e.g., If IC is on far side of team and detects target trying to outflank his team, IC might fire at that target even though target is not in ICs sector). Of course, an alternative to this, acknowledged by the SME would be to verbally confirm that your "Buddy" has also detected that target.

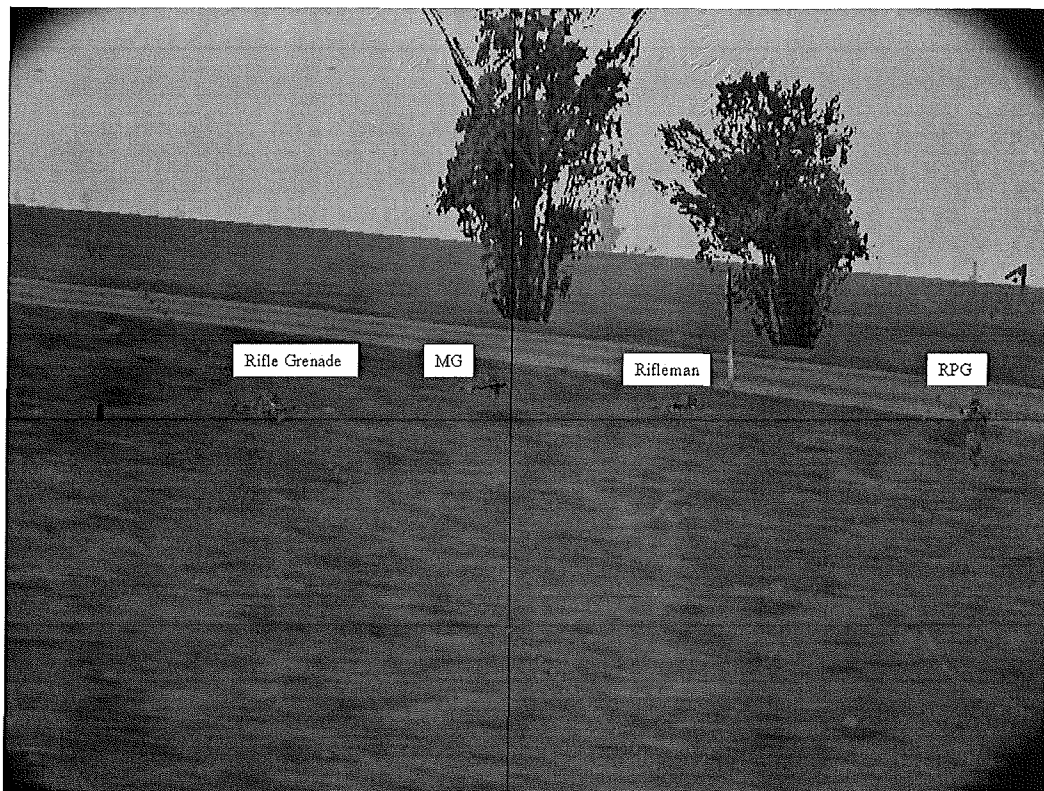


Figure 5. Sample 2 of Target Situation Early in Scenario

A screenshot such as that seen in Figure 6 could be used to determine tradeoffs between threat of targets' weapons systems and proximity/position/visibility of target. In this scene, for example, even though the RPG is the more threatening weapon system, the fact that the Rifleman was closer, more visible, and seemed to be running towards SME, resulted in SME selecting Rifleman as higher priority target.

Using this methodology and computer game to develop KA scenarios, we are even able to consider visibility and concealment factors, as demonstrated in Figure 7. In this screenshot, because of visibility and proximity, even though Rifle to right of fire sector is outside of SMEs fire sector, he chose that Rifleman as his first target. Another interesting heuristic determined from this slide was that the SMEs second target would be the Rifleman on far RHS of fire sector. So, for example, even though other targets had more threatening weapons systems or represented leadership role (i.e., RPG, Officer), the SME indicated that since his weapon was already positioned to right side of sector (result of selecting far right Rifleman as initial target), he would probably sweep the targets one at a time in a right to left manner to save on time spent in repositioning his weapon.



Figure 6. Sample 3 of Target Situation Early in Scenario



Figure 7. Sample 4 of Target Situation Early in Scenario

Figures 3 – 7 are just a representative subset of the types of scenarios we are able to present to the SME. For this scenario alone, we have 62 slides that can be used to acquire firing heuristics. While we haven't completed formal analysis of these data, it appeared that the SME was quite consistent in his target selection. That is, we never really noticed him contradicting heuristics that he had applied to earlier scenarios.

4 Financial Summary

A financial summary as of 11 July, 2002 is attached in Appendix G. As of 11 July, we have expended approximately \$26,856.61 of the total contract billing amount of \$69,976.41. Thus, remaining funds total \$43,119.80.

5 Salient Technical Issues

The most pressing technical issue facing us at the moment is securing SMEs for formal data collection. We have streamlined the KA process through the development of visual scenarios that require quick responses on part of SME. Thus, we are able to collect a large amount of data fairly quickly. Also, as many of these factors are intricately connected, some consulting SMEs thus far have suggested that in many of the more complicated instances the selection of a target might simply "boil down to" personal preference. Through collection of large amounts of data, we would like to identify patterns in these preferences. Any support SSCOM can provide in gaining access to SMEs would be helpful. This is especially important if we want to study teamwork/handoff aspects of WFA. To do this effectively, we need access to fireteam that has trained together, and preferably served together. One of our SMEs suggested that it might be possible to work with fireteam at Ft. Drum, as they have recently returned from Anaconda operations.

Lastly, as discovered in going through this prototype KA system with consulting SME, this method could be improved upon by adding a time constraint to SME response. The general belief was that data would be more representative if the SME doesn't have "too much time" to think about his response. Ideally, we would work with touch-screen system and present scenarios to SMEs rapidly such that they are responding reactively and instinctively as opposed to largely rationally. While we support the implementation of such system, we feel that budget and time constraints on the study do not facilitate the development/procurement of such a system. If SSCOM would like us to pursue this form of data collection, we would be receptive to suggestions on how to best accommodate. In meantime, in absence of such a system, we will attempt to keep KA process as reactive as we can, to extent we are able with the tools presently being used.

Appendices

- A RESUMES
 - A.1 RICK MATTHEW'S RESUME
 - A.2 ROBERT BOERJAN'S RESUME
- B TRANSCRIPTS AND MEETING NOTES
 - B.1 TRANSCRIPT OF INTERVIEW WITH BUCK SURDU
 - B.2 MEETING NOTES FROM KICKOFF TELECONF WITH SSCOM
 - B.3 MEETING NOTES FROM MEETING AT NATICK, WITH V. MIDDLETON TELECONF
- C SCENARIO DESCRIPTIONS
 - C.1 OPEN FIELD SCENARIOS
 - C.1.1 SQUAD PATROL FROM STI
 - C.1.2 SQUAD ATTACK
 - C.1.3 REACT TO ENEMY CONTACT
 - C.2 CLOSED QUARTERS
 - C.2.1 BUILDING CLEARING - VIRTE SCENARIO FOR DEMO 2
 - C.3 URBAN CANYON SCENARIOS
- D FACTORS AFFECTING TARGET SELECTION (SUPPLIED BY SSCOM)
- E COMPARISON OF GAMES TO USE FOR KA
- F SME EXPERIENCE QUESTIONNAIRE

A.1 Resume – Richard W. Matthews

RICHARD W. MATTHEWS
2546 Ekana Dr, Oviedo, FL 32765
407.492.7587 rickmatthews@cfl.rr.com

OBJECTIVE To obtain an experienced professional position drawing upon my extensive SOF leadership, training and management experience. **Availability Date: 1 July 2002**

SUMMARY OF QUALIFICATIONS

- 24 months experience as Project leader in software simulations supporting STRICOM, using SEI level 5 industry standards and processes on three diverse, multi-million dollar projects.
- Director of Special Forces Program Integration Office for two years: planning, coordinating emerging technology, change management, process improvement and virtual archives integration.
- 20 years of experience as a Special Forces Training Manager in formal and informal classroom instruction
- Special Forces Project Manager in the design, development, and implementation of Computer Based Training and curriculum/courseware development for the United States Army Special Operations Command.
- Possess active Top Secret Security Clearance valid thru 2003.
- Respected and held in high regard by senior leadership at Special Warfare Schoolhouse and USSOCOM.

6/00 to Present: Project Leader, General Dynamics (Motorola), Advanced Distributed Simulation Systems, Research Parkway, Suite 390, Orlando FL 32826.

- Project Leader for a \$32M program to design, develop and field a system that provides realistic battle command training through simulation, stimulation and presentation of Joint and Army intelligence capabilities. Project Leader for a \$1.2M cooperative Concept Exploration effort to provide engineering and operations analysis, developing an Operation Software Model for the system training device. Project Leader providing collective training to Military Intelligence Brigade Commander and his staff for Intelligence, Surveillance and Reconnaissance capabilities.

8/98 to present: **Director, Program Integration Office, USAJFKSWCS, Fort Bragg, NC.**

- Supervised senior level professional development Distance Learning Programs worth \$2M
- Oversaw strategic development through 2010 for Special Operations Forces. Implemented decisions that affected domains of doctrine, training, leader development, organization, materiel, and soldier systems.
- Interpreted and integrated training requirements for Computer Based Training curriculum/courseware development, to include design, storyboards, media selection, and quality assurance.

Systems integrator: Produced and managed detailed Distance Learning Hardware and Software requirements for computer based courseware implementation within the 15,000 man Special Operations Command.

7/96 to 7/98: **Director, Army SOF Modeling and Simulation Activity, USAJFKSWCS, Fort Bragg N.C.**

- Integrated Army Special Operations Forces (ARSOF) into US Army Advanced Warfighting Experiments / simulations that developed an integrated (revolutionary) cohesive strategy through 2005. Supervised the research and development of emerging technology for military applications in simulations and modeling,
- Coordinated necessary interface between Subject Matter Experts (SME), consultants, and training facilities to ensure consistency and continuity of enterprise hardware/software purchases.
- Supervised execution of simulations using BBS, JANUS, operating on UNIX, WIN NT, Win95/98 platforms.
- Researched, developed a funding plan, and executed a mission planning simulation, involving integration of Air Force, Navy and Army Special Operations Forces, using DISA Common Operating Environment (COE).

EDUCATION AND SKILLS

- **Masters Degree**, Information Management and Computer Resources, Webster University 1995
- **BS Engineering**, US Military Academy 1980.

4/84 to 6/96: Additional SOF Assignments:

SGS/G1, USAJFKSWCS	Battalion Executive Officer, 1/10 th SFGA
Company Commander, 1/10 th SFGA	SF Officer Recruiter
SF Training Company Commander	SF Detachment Halo Commander
SF Scout Swim Detachment Commander	

A.2 Resume – Robert Boerjan

4538 Bond LN
Oviedo, FL 32765

(407) 971-4152
rboerjan@cfl.rr.com

Robert Boerjan
Captain (Promotable), United States Army

Experience

1999 – 2001 Training and Doctrine Command Fort Monroe, VA

Simulation Officer for the Office of the Deputy Chief of Staff for Combat Developments

- CPT; Acquisition Officer.
- Project Officer for the Advanced Concept Research Tool (ACRT) Program: re-configurable man-in-the-loop virtual simulators for vehicles, dismounted soldiers, and rotary aircraft.
- Developed key capabilities in the Dismounted Soldier ACRT. A suite of the simulators provide key insights of squad/platoon concepts for the Dismounted Battle Space Battle Lab at Fort Benning, GA.

1998–1999 III Corps Fort Hood, TX

Company Commander of the Corps Military Intelligence Element

- CPT; Intelligence Officer.
- Provided daily intelligence briefings to the Commander, III Corps.
- Provided intelligence support to the Hunter Unmanned Air Vehicle unit deployed during U.S. actions in Kosovo.

1996–1998 III Corps Fort Hood, TX

Intelligence Planner on III Corps Staff

- CPT; Intelligence Officer.
- Developed scenario for 1st Cavalry Division Pre-Warfighter exercise.
- Conducted planning for III Corps Wartime Mission.

1995–1996 III Corps Fort Hood, TX

Counter Intelligence Officer

- CPT; Intelligence Officer.
- Responsible for threat analysis of the III Corps Rear Operational Area.
- Involved in threat analysis for Fort Hood, TX.

1995 3-15 Infantry Battalion (Mechanized) Fort Stewart, GA

Battalion Supply Officer

- 1LT; Infantry Officer.
- Managed Battalion funding.
- Executed the deployment of a Mechanized Company to Haiti.

1994 - 1995 3-15 Infantry Battalion (Mechanized) Fort Stewart, GA

Company Executive Officer

- 1LT; Infantry Officer.
- Deployed to the National Training Center.
- Led Company in several Company level training exercises.

1992 - 1994 3-15 Infantry Battalion (Mechanized) Fort Stewart, GA

Company Platoon Leader

- 2nd LT; Infantry Officer.
- Trained platoon in mechanized infantry operations.
- Platoon selected for several tactical demonstrations for VIPs.

1988 - 1989 4-87 Infantry (Light) Schofield Barracks, HI

Team Leader

- Sergeant.
- Led fire team on numerous exercises and external evaluations.

1986 - 1988 4-87 Infantry (Light) Schofield Barracks, HI

Fire Team Member

- Served as a rifleman.
- Served as a M203 gunner.
- Served as the Platoon Leader's RTO (communications).
- Participated in deployments to Korea, Japan, Panama, Hunter Ligget, CA.

Military Education

1999	M&S Staff Officer Course	Fort Lee, VA
1999	Materiel Acquisition Management Course	Fort Lee, VA
1995	Military Intelligence Tactical Signals Course	Fort Huachuca, AZ
1995	Military Intelligence Advanced Course	Fort Huachuca, AZ
1992	Bradley Fighting Vehicle Commander's Course	Fort Benning, GA
1992	Airborne School	Fort Benning, GA
1991	Infantry Officer Basic Course	Fort Benning, GA
1988	Air Assault School	Schofield Barracks, HI
1988	Primary Leadership Development Course	Schofield Barracks, HI
1987	Jungle Warfare Training	Panama
1986	Infantry Basic Training and Advanced Infantry Training	Fort Benning, GA

**Awards &
Decorations**

- Expert Infantry Badge
- Airborne Badge
- Air Assault Badge
- 2 Meritorious Service Ribbons
- 3 Army Commendation Ribbons
- 4 Army Achievement Ribbons

Civilian Education

2001 - Present University of Central Florida Orlando, FL

- Army Fully Funded Masters Program
- Enrolled in the Masters of Science Modeling and Simulation Interdisciplinary Studies Program.

1989–1991 University of Texas at Arlington Arlington, TX

- B.A., History.
- Commandant's List, ROTC

B.1 ICWFA Kickoff Meeting Notes

CGFWFA Kickoff Meeting Notes (Phonecon)

14 March 2002

Glenn Taylor

Attendees

Amy Henninger, SoarTech

Glenn Taylor, SoarTech

Bob Auer, Natick

Paul Short, Natick

Background

Natick Labs sponsored the SBIR. Their goal is R&D to find the value of equipment for acquisition purposes.

Natick uses a simulator called the Integrated Unit Simulation System (IUSS), developed by Simulation Technologies, Inc. (STI – www.stiusa.com). IUSS is a force-on-force simulator focusing on the individual and small unit level. It uses high-resolution terrain DBs for urban, rural, and MOUT simulations. IUSS is primarily used by a small group of analysts and the Marine Corp.

Historically, IUSS has used a very simple task network approach for generating behavior, which is by its nature very sequential and very burdensome on the analyst. They are currently in an 18-month rewrite of the system, part of which includes a replacement of the behavior system with a goal-oriented “beliefs desires network” developed by Charles River Analytics. Weapons firing algorithms are still quite simple – entities fire at the closest target always, and to the death – which is why this SBIR came to be.

Aiming Deficiencies

A (partial) list of deficiencies in the current algorithm:

- entity gets perfect information about target and identification
- entity aims at closest target (usually)
- entity fires even if at risk
- there are some suppression effects, but rudimentary

With new system, information will be imperfect, there will be stages of discrimination, and there will be non-combatants

The next version will be demonstrated in October '02, not fully mature, but enough to show progress.

The Task

Our task is to study how targets are chosen based on target type, proximity, goals, mission type, mission details, etc., and develop an algorithm that accurately represents this decision-making process. One important aspect is the idea that knowledge is not perfect, and can degrade based on multiple factors – the algorithm must take this into account, and (perhaps) ask for more info, or wait until that info becomes available.

In general, we need to study what factors go into the decision-making process for weapon aiming (targeting) in close combat (under 25m). There may be some data available that we can leverage (some concern over whether it's certified by AMSA), or we may collect our own. SMEs should have combat experience. (Natick may set us up with people.)

Will need to look into individual differences in factors that affect target selection.

They want an "open architecture" on decision-making in IUSS.

Part of the task involves factoring in the decision-maker's equipment (weapons, sensors) when making the decisions. Weapons would include those common to Rifle Infantry Platoons: M16/M4, M203, OICW (new bursting munition coming on line), anti-tank, smoke grenades, etc.

Will be multiple levels of decision-making: platoon level, squad level, individual.

References

- FM 90-10-1
- FM 7-8 Rifle Platoon
- Compendium of algorithms
- IUSS briefings
- IUSS user manual
- Weapons systems listing
- Decision factors
- Technical reports

Action Items

- Possibly a trip to Natick Mar25 or early April to learn IUSS.
- Natick will get updated timeline information to us (when things are due, etc)
- Phase 2 proposal due in May(?)
- Look into SMEs -- those who have been in combat; Natick may supply

B.2 ICWFA Trip to Natick Notes

Weapons Firing Algorithm Trip to Natick

Glenn Taylor

09Apr2002

Glenn Taylor, SoarTech
Amy Henninger, SoarTech

This trip (we thought) was going to be for us to learn the IUSS simulation Natick uses, for which our aiming algorithm will be used. Instead (and thankfully), it turned more into a requirements gathering and programmatic meeting.

Given that they have decided to go ahead with a behavior system (described as a "beliefs desires network" and "fuzzy" hybrid, developed by Charles River Analytics), the focus is less on narrowing a list of potential HBR candidates, and more on data gathering, analysis, and synthesis of an algorithm. Our findings will be integrated into their HBR system.

We were given a few briefings about IUSS, both about the system as it was, and how it's being improved. IUSS is focused on equipment, and less on tactics. It is DIS compliant (and will be HLA), so can (and has been used to) feed other simulators when needed. Analysts typically set up detailed scenarios (going down to the properties of the fabric of the entity's clothing), then run lots of times to get stochastic answers to questions like "what effect does more weight on this entity have?" or "what if these entities had this kind of information given to them by this new type of radio?"

Met (via a phonecon) Victor Middleton of STI in Dayton, who is the technical lead on the IUSS rewrite. He helped guide the discussion on scoping the problem.

We're trying to answer two questions: what weapon? what target?

We need to find the level of domain knowledge necessary to answer these questions, and the ranges on the "goodness" of the information available.

Need to find what factors (variables) go into these decisions.

Desirables

Improve the system in the following ways:

- Make the entities not get killed as often (Auer)
- Improve the Battle Damage Assessment (BDA) of the entities (Middleton)
- Appreciation of value of the target (Auer?)
- Modes of fire: suppression/kill/deception (Auer)
- How much to fire? when to stop? (Auer)

Initial Conditions

- We don't necessarily want to focus on the target acquisition process (how something is sensed to how it becomes ID'ed as enemy) – assume we know this.
- Assume rules of engagement have been decided
- Assume that "I've run into a force I think I can handle, so what targeting decisions to I have to make?"
- Assume three important arenas: MOUT urban canyon vs MOUT indoor vs Open Field (find important differences between MOUT and Open Field)
- Try not to worry about non-combatants

References

- Morris (?) paper
- Suppression Algorithms Paper (CGF 94 or 95?)
- Feinberg & McClelland Paper (PSR)

Resources

Human Sciences Data Collection Effort, Mike Statkis (sp?): might have data of interest, including engagements and room clearing tasks.

Action Items

- Define scenarios (use cases) for data collection (Natick)
- Send out more documentation/background (Natick)
- Formalize a requirements document for review (SoarTech)
 - o Formalize scope/breadth/depth requirements
- Formalize "givens" (SoarTech)
- Define sensor and weapon systems (Natick)
- Define unit size and levels of decision-making (Natick)
- Start mailing list – include Natick folks in any emails to Vic
- Work toward sessions with SMEs on-site at something like Fort Benning, GA, to use Individual Soldier Stations (ISS) – some concern about getting IUSS scenarios into their simulator (DI-SAF?)

B.3 LTC Buck Surdu KA Notes

LTC Buck Surdu Interview Soar Technology June 12, 2002

OPERATOR: The host's name is Amy Henninger and the conference ID is Z as in zebra, J as in Janet, R as in Red, 5, 2, 1, 2. Thank you.

AMY HENNINGER, SOAR TECHNOLOGY: This is Glen (ph)?.

GLEN TAYLOR (ph): Yes.

HENNINGER: Did I send out the right number?

TAYLOR (ph): Nope.

HENNINGER: How did you find it out?

TAYLOR (ph): I called the number you gave me and...

HENNINGER: ...and complained...

TAYLOR (ph): ...a different number...

HENNINGER: ...oh, good for you. OK. Well that's all right. I just sent out the new number to Bach (ph) right now.

TAYLOR (ph): Oh, so did I.

HENNINGER: Oh, awesome. Thank you.

TAYLOR (ph): And we are already being recorded, right? Did someone already tell you that?

HENNINGER: Yes, they did say that.

TAYLOR (ph): OK.

I'm reluctant to say anything now, knowing that I'm being recorded.

HENNINGER: I'm sure we'll forget soon.

TAYLOR (ph): Yes. And I wonder how they are going to send you a big audio file.

HENNINGER: I asked her about that, and they actually put it on a tape and they mail it...

TAYLOR (ph): ...oh...

HENNINGER: ...and the transcripts could be either electronic or hard copy. So I asked for an electronic copy and she said they would e-mail those to me.

TAYLOR (ph): OK...

HENNINGER: So she said it would take a day or two.

TAYLOR (ph): Oh. Is the audio recording now digital, or do they just transfer it to a tape?

HENNINGER: That's a good question. I didn't ask her. But I could find out.

TAYLOR (ph): That would be interesting...

HENNINGER: ...to have a digital version?

TAYLOR (ph): Yes.

HENNINGER: It'd be awfully huge wouldn't it?

TAYLOR (ph): Yes.

HENNINGER: Would it...

TAYLOR (ph): It would probably fit on a CD...

HENNINGER: It would do you think? I was just going to ask that. OK.

TAYLOR (ph): A music CD is about an hour long.

HENNINGER: Yes, that's a good point.

TAYLOR (ph): And if you compress it with (ph) mp3...

BACH (ph): Hello?

HENNINGER: Hi, Bach (ph).

BACH (ph): Hi.

HENNINGER: How are you?

BACH (ph): Good, how about ya'll?

HENNINGER: I'm great. Thanks. I want to introduce you to Glen Taylor (ph) who is on the other line.

TAYLOR (ph): Hi Bach (ph).

BACH (ph): Hi, how are you?

TAYLOR (ph): All right.

HENNINGER: Glen (ph) works for the same company I do in Ann Arbor, Michigan.

BACH (ph): Oh, OK. OK.

HENNINGER: Yes.

TAYLOR (ph): Did you get the warning, Bach (ph), that we are being recorded?

BACH (ph): Yes, that's fine.

TAYLOR (ph): That's OK?

HENNINGER: I thought it was OK, OK.

BACH (ph): Great.

HENNINGER: Thank you. I appreciate it. It will make their job a little bit easier at the end.

So, I guess, were you able to look at the scenarios at all or...

BACH (ph): ...I did...

HENNINGER: OK, awesome.

So Glen (ph) and I are doing this work for Soldier Systems Community (ph), and it's - the author of them is going to be incorporated into the IUSS (ph) system. I don't know if you are familiar with that, it's an analysis based (ph) system.

BACH (ph): No. No.

HENNINGER: OK. So it's our analytical system.

BACH (ph): Yes, I was wondering if this was going to work this way into One Staff (ph)? Because they need the individual combatant behaviors as well, so.

HENNINGER: I don't know. We are good friends with the SCIC (ph) people and there is - there's a chance that maybe this information would be served (ph) with them. I know that...

BACH (ph): Well I'm going to be - I'm going to be the next PM One Staff (ph).

HENNINGER: Oh you are! So you're going to moving to Orlando.

BACH (ph): Yes, in June.

HENNINGER: Oh well that's great news. Are you - are you sorry to be leaving Westpoint (ph), though or...

BACH (ph): No, not really.

HENNINGER: No, you are looking forward to your next assignment.

BACH (ph): Yes.

HENNINGER: Oh, that's awesome. Well that's great to know. Well, then maybe we should. Introduce you...

BACH (ph): I was just curious...

HENNINGER: ...One Staff (ph). So yes, this is for, like I said, it's a whole different community, but you know, if people at One Staff (ph) can use it, then that would be even more you know, even better.

So basically though at the very bottom line of this, a decision or what we have to develop an algorithm for is what weapon we should be hiring and at what target. So that's the very lowest level. And of course since Glen (ph) and I are going through these scenarios where we were under the impression that that's going to depend on a lot of things, probably higher up than - than just what's at the very lowest IC level.

So like in this scenario for example, we're seeing that there're assuming some rules of engagement and there orders that are passed on to the squad leaders that are - or that are disseminated through the fire teams to the team leaders and to the individual combatants. So I guess in this scenario our first objective was to try again (ph) to come up with a hierarchy of - well like what the individual goals are, depending on if you are the squad leader or the fire team leader, or an individual combatant.

BACH (ph): It seems like to me that there's another input to this system, and that is unit standard operating procedures.

HENNINGER: OK. That's a new term to me.

BACH (ph): OK, yes. SOP has been developed at all different echelons, but like I know, you know we had these procedures that if you take direct fire, you immediately, you seek cover and immediately return fire. And that was in an effort to sort of suppress the enemy. Now in your scenario in your first case, you make contact visually before you actually start shooting at the bad guys.

HENNINGER: Well...

BACH (ph): You would detect that first.

HENNINGER: ... I have that note myself actually. I - I have that - from the scenario I read that we know they are there, but I didn't know if we were actually seeing them before they - like assign the sectors of fire for example...

BACH (ph): .Right.

HENNINGER: It doesn't really say explicitly whether or not that's true.

BACH (ph): Yes, and that, you know it could be different, you know. If we have like an Intel (ph) report that there is a fire team coming, like some UAV reported it, we might behave a little bit different than if we actually them.

HENNINGER: OK.

BACH (ph): OK, because if you see them, it's too late probably, to establish much in the way of an ambush.

HENNINGER: OK.

BACH (ph): You know you are going to - you are going to lay down somewhere, and that's what's known as a hasty ambush, right? And you are going to wait for them to get close enough in - within affective range and then start blazing away. But you know if - if we have some kind of Intel (ph) report that they are coming, we can do more detailed prep. We can lay out claymore (ph) mines and some of the other stuff...

HENNINGER: Oh, OK...

BACH (ph): It's more effective. So it really depends on how much time you have to prepare this quote hasty ambush unquote. But again you know, if contact is made and the enemy as initiated it, OK, the battle drill book - do you have a copy of seven eight dash (ph)...

HENNINGER: I do, I have it right here with me...

BACH (ph): OK, and the battle drill book has a drill for - in the back where they have the little drill pictures, they have a drill for if you know, we're initiating contact or the enemy is initiating contact. And most unit - small unit SOP are pretty much based on that - that drill book. So...

HENNINGER: OK...

BACH (ph): ...so that SOP (ph) is another input into the system in addition to you know, the current situation, that kind of thing. Because like I said, I mean if you start taking direct fire from the enemy, the first thing you are going to do is find a tree or a rock or something.

HENNINGER: Right.

BACH (ph): And return fire in an effort to suppress them. And that - the idea behind that is to allow the squad leader time to assess the enemy strength so that he can decide if he can take them out himself or if he needs to call for help. That was the other thing that wasn't clear from reading the scenario - this is a squad all by itself wandering around like on a patrol, or is there a platoon in support somewhere?

HENNINGER: They - yes. I - I don't know the answer to that.

BACH (ph): The way the scenario reads, that platoon is all by themselves somewhere, because you know, if there was - because the scenario and they run into a - that - that enemy unit, chances are they would lay down a basic fire, observe the enemy or whatever while the platoon maneuvered to take them on the flank or whatever and that's not the way the scenario reads. So I'm assuming this patrol is out well away from the platoon.

HENNINGER: Independently, OK.

BACH (ph): So OK, so anyway, that was the first thing that came to me, was this idea of SOPs .

HENNINGER: OK.

BACH (ph): Hang on - hang on just one second.

HENNINGER: Sure, no problem.

BACH (ph): OK, I'm back.

HENNINGER: OK. So the...

BACH (ph): So did that just complicate things or make it easier?

HENNINGER: Well no, I will definitely research the SOPs and see what we can get out of those.

BACH (ph): Yes, I mean I think you could start with the battle drill books you know, and there is eight or nine or ten drills in the back of that book, right?

HENNINGER: So the battle drill book - I guess I'm going to get the terminology straight here.

The field manual...

BACH (ph): Right, right...

HENNINGER: ...is not the same as the battle drill book.

BACH (ph): Oh, yes, that - that - that's SM seven dash eight dash something, right? Seven dash eight dash one...

HENNINGER: I have seven dash eight, yes.

BACH (ph): OK. Do you have little, or is it?

HENNINGER: It's quite big and it just has seven dash eight.

BACH (ph): OK, no. There is another one...

HENNINGER: Oh, OK.

BACH (ph): There is a smaller unit one, because that's the infantry platoon book, right?

HENNINGER: Right.

BACH (ph): OK, or company platoon or what - what's the title of that thing? Infantry Company?

HENNINGER: It's actually a copy. Moved around. Infantry Rifle Platoon and Squad.

BACH (ph): Yes, OK. There's another little one...

HENNINGER: OK...

BACH (ph): ...that's got the battle drills in it. It's - it's like half an eight and a half by eleven size...

HENNINGER: Oh, OK...

BACH (ph): ...and - and I think manual is still in production, but I'll look for it. But anyway, that - that's got these - there's appendixes in the back that have the battle drills listed.

HENNINGER: And that book is a another field manual, but it's a seven eight one, we think.

BACH (ph): I think, yes. Yes. And so anyway, in the back there it lays out these drills, and there is a drill for you know, if you are caught in a - in a near ambush, or you are caught in a far ambush, or you know, react to contact you see them first, react to contact they fire on you first you know. There is all these different drills. That's a good place to start to come up with what the average infantry squad is going to do and it pretty much lays out here's what the team leader is doing and here is what the individual riflemen should be doing.

HENNINGER: Oh really? OK.

BACH (ph): And I think that would make a good starting point.

HENNINGER: Like a baseline for us to work from.

BACH (ph): Yes and then - and then as units develop different SOPs, those would essentially be modifications to the drill manual, right? And the idea behind the battle drills is to react in not an inflexible way, but to act in a very automatic way so that your reaction to contact is very quick. So that the idea is to get inside the enemy's decision loop, you know. Initially you may contact if they fire first. You are reacting to them right? So the idea is to start to do things so that they have to react to what you are doing. Then - then you have the initiative at that point.

HENNINGER: OK.

TAYLOR (ph): You said the develop - the units will develop their own SOPs based on those battle drills?

BACH (ph): Right, right. You know, it could be because at the squad leader level, you know and some of it depends on the actual people in the unit, but - but you know, at the squad leader level you know he might say all right look, you know if there is a cursor of weapon out there, then I want you three guys to make sure that you are engaging that reserve weapon, right? So if there is a machine gun, the enemy's got a machine gun, you know if I want the two automatic riflemen and one of the grenadiers to engage that cursor of weapon without any guidance, that's what they do. And then - and then - then it's up to the team leader or the squad leader as the battle progresses to modify that guidance.

HENNINGER: Based on the assignment.

BACH (ph): .Yes, based on the current situation. And - and the idea of it you know, when the fighting first starts, things are chaotic. And so you want - and the squad leader and the team leaders are trying to figure out what's going on, where the enemy is. You know they are not usually very cooperative at always engaging this from the front, right? Particularly on a patrol like this. So you have to figure out how many bad guys there are, which is actually hard even though they are shooting at you. It's actually hard sometimes to determine how many there are, where they are, and - and so the idea is that the members of the squad immediately begin to engage the enemy to provide you time to assess the situation. And you know there will be things like - I know

we tried for awhile that the squad leader would always carry a grenade launcher so that he could mark places where he wanted people to shoot with smoke.

HENNINGER: OK.

BACH (ph): And OK, here's your left limit, here's your right limit, and - and that, or team leaders could do that, or whatever. So these are all modifications to the drill. These are nuances.

HENNINGER: Right.

BACH (ph): But I think if you started at the squad with using the battle drills to program in these behaviors, that would be a really good beginning.

HENNINGER: That is a excellent lead, thank you. I'm surprised I didn't hear it from out customer actually.

BACH (ph): I don't know.

HENNINGER: I don't know either. I'll ask them about it though. It could be they don't know about, I don't know. So assuming we, OK. Assuming we could get that from these battle drills, and we could get down to this lowest level, we want to start looking at target selection and weapon selection. Which I - it sounds to me like from what you are saying it's going to be sort of more of a individual call once you get down to that part of it.

BACH (ph): Right, you know when we talk about - people talk about you know, we are going to develop autonomous vehicles, right?

HENNINGER: Right...

BACH (ph): And my argument is always that you know, nobody is autonomous. I'm not autonomous, right? Everyone is semi-autonomous (ph). So whatever the squad leader does is going to be based on external guidance.

HENNINGER: Right.

BACH (ph): In your case external guidance is coming from the rules of engagement right? And what was the other thing? Rules of engagement and their orders, whatever their mission is, right? So like if their mission is reconnaissance they may not even engage the enemy even if they seem them first. Right? Or if the rules of engagement call for you know, positive identification beyond any shadow of a doubt before engaging the enemy for whatever reason, which that may well be true in a peace keeping kind of a situation, you know. Then - then that's going to modify the drill, right? You know, because you're not going to lay down and start shooting at the enemy.

HENNINGER: Right.

BACH (ph): Because the rules of engagement now act as a constraint.

HENNINGER: OK.

BACH (ph): In almost all cases you can - I think you can think of rules of engagement as a constraint.

HENNINGER: OK.

BACH (ph): On freedom of action, right?

HENNINGER: OK.

TAYLOR (ph): Are there a limited set of rules of engagement?

BACH (ph): No, it's really, I wish there was you know, OK, we are going to apply rules of engagement six, twelve and 42 today. It's really so situation dependant and it's decided on you know - at Kosovo there's a different set of rules of engagement than Bosnia, which has a different set of rules of engagement, or from Afghanistan which has you know, and - and it's really set by the commander, depending on whatever the strategic mission is.

HENNINGER: And the rules of engagement, are they usually - like in the scenario it says, allows engagement with enemy forces. I mean are rules of engagement like pages and pages of - of...

BACH (ph): No, they - they try to keep them down to something you can fit on you know, three or four bullets that you can fit on a three by five card.

HENNINGER: OK.

BACH (ph): Because you know if it's pages and pages of stuff.

HENNINGER: Right

BACH (ph): Nobody is going to remember when they are being shot at.

HENNINGER: OK.

BACH (ph): So I mean, you try to keep it simple and unambiguous.

HENNINGER: OK.

BACH (ph): And you know a really good place for you guys to go and see rules of engagement would be the Joint Readiness Training Center at Fort Polk (ph).

HENNINGER: OK.

BACH (ph): Because they practice a lot of low intensity conflict operations other than war stuff and when they exercise units. And so they probably have some good realistic examples of what rules of engagement might look like.

HENNINGER: OK.

BACH (ph): And unfortunately I don't have a point of contact I can point you at. But...

HENNINGER: We can work on that anyway.

BACH (ph): yes, they would have - that would have a pretty good idea I think, of what realistic rules of engagement look like.

HENNINGER: OK.

BACH (ph): And I think when you - when you see a set sitting in front of you, you will see that it really is a constraint, not a - a constraint on freedom of actions.

HENNINGER: OK. So it sounds like maybe according to your recommendation, we want to start with these battle drills and get as much as we can out of those, obviously. Instead of reinventing the wheel, having you know, to interview someone until we get this information. And then, so when we get something like signing - assigning fire sectors for example. Would that be the kind of thing we would see in this battle drill, like an algorithm to do that? Or is that the...

BACH (ph): No.

HENNINGER: Oh, OK.

BACH (ph): No - now you get in to judgment, and that's...

HENNINGER: OK

BACH (ph): ...that would be - that's the job of the team leader. Well, the squad leader - initially the team leader, eventually the squad leader may modify that, OK?

HENNINGER: OK.

BACH (ph): So, the team leader is going to say, hey you know, a fire team and instrument fire team is four guys, including the team leader, all right? So usually he's going to get there and he's going to be crawling behind his guys and he's going to say, all right you know, you've got from here to here, all right? Now initially you know, from that tree to this rock, or from that house over to this car or whatever the - some kind of easily identifiable left and right limits for each soldier. Now ideally that begins at you know, the platoon leader assigns sectors for the squads and the squad leaders assign sectors for the fire teams, and then he divides that up among the number of folks that he's got. And you would do that in a defense. But in a situation like this where you have just made contact with the enemy.

HENNINGER: Right

BACH (ph): What's going to happen is that fire team leader is going to go and he's going to start taking you know, likely or suspected enemy positions and assign those to people and then as the squad leader modifies the team leader's sector of fire, then he may have to do that process again.

HENNINGER: OK.

BACH (ph): Yes, but see that - that assigning sectors of fire to the individual riflemen or to individual soldiers, that's really the fire team leader's job.

HENNINGER: OK.

BACH (ph): OK. And algorithmically, I mean the first cut at it would be divide the sector by N where N is the number of guys and you know - and try to find identifiable terrain features that are close to where those intersections should be, those theoretical intersections of sectors. And you want those to be interlocking.

HENNINGER: OK.

TAYLOR (ph): So they cross over each other.

BACH (ph): You want them to cross over each other so that - in where they cross over, you know do they cross over each other 100 meters away, do they cross over each other at 50 meters away, that's very situation dependant, too, but if you need a rule of thumb I would say they should cross each other at about 150 meters.

HENNINGER: OK.

BACH (ph): OK, which doesn't make sense if the enemy is only 40 meters away right? In the woods or whatever. But you know ideally, something like that, so that now that our whole sector is

covered by fire. So that even if you know Soldier C is killed, the sectors from soldiers A and B or whatever still kind of cover his sector to some extent.

HENNINGER: OK. And these assignments are always going to be made to the individual soldier...

BACH (ph): Right

HENNINGER: ...not to like a pair for example...

BACH (ph): Correct.

HENNINGER: OK. And...

BACH (ph): Now they may be in a hole together...

HENNINGER: OK...

BACH (ph): ...where - but they would each have their own sector of fire...

HENNINGER: ...responsible for. And so once we got to that point and let's say there are, I don't know - for some reason in one guy's sector there are three enemy for example, and so it's completely his decision as to which target to select and what weapon he's going to use to do that.

BACH (ph): Right, of course in most cases he's only got one weapon.

HENNINGER: OK.

BACH (ph): There's only one guy in the squad who's got two weapons and that's the - the grenadier.

HENNINGER: OK, and he has a rifle and...

BACH (ph): He has a rifle and a grenade launcher...

HENNINGER: ...and a grenade launcher.

BACH (ph): It's actually one weapon but he has two different kinds of ammunition he can shoot out of them.

HENNINGER: OK.

BACH (ph): Actually at this point with current technology, the only guy who has a choice of weapon is the grenadier.

HENNINGER: OK.

BACH (ph): All right. Yes, I suspect which weapon you decide to shoot is as much a personal preference issue and a training issue as anything.

HENNINGER: Really? OK.

BACH (ph): You know if I had a grenade launcher, I'd want to be shooting the grenades until I ran out of them, right? But maybe not, you know. Maybe you look for the right kind of...

HENNINGER: Circumstance.

BACH (ph): ...targets for grenades. There are those two guys together or there is a crew surf weapon or whatever. And that - that would again be a kind of an SOP sort of an issue.

HENNINGER: OK.

BACH (ph): And also a logistics issue. You know if you've only got three or four grenades left, they may want to preserve those.

HENNINGER: OK...

BACH (ph): For high valued targets. So there is another input into your system. What kind of ammunition do I have?

HENNINGER: All right. OK.

TAYLOR (ph): So are you not counting hand thrown grenades?

BACH (ph): Right. Right. Yes, most folks might have a grenade or two. There is space on the equipment to carry four and again that's as much a logistics issue as anything else. You know in the 82nd jump into Grenada they had everything. But you -- after weeks of sustained campaigning you might not have all those - and really a grenade you know, that's a close end desperation kind of a thing or the enemy is in an enclosed space, you know like a trench or a bunker or whatever where the grenade will really have a lot of effect. Despite Hollywood, grenades are not hand thrown thermonuclear devices, you know. A grenade is not a good open battlefield kind of a weapon. It's the kind of thing you want the enemy to be close together or whatever. It's most effective in - in bunkers or buildings or those kinds of things.

HENNINGER: OK. So if we really want to narrow in on the target selection part and - and this is going to be by individual and let's say he has a number for some reason, and I don't know why that would be, but he had a number of targets in his sector...

BACH (ph): That could well be.

HENNINGER: ...OK, so that could very well be. So if we want to really start looking at target selection, probably it sounds to me like we need to start presenting scenarios that say you have these targets, this is where they are, this is what their weapons capability is, who are we going to go for first?

BACH (ph): Right.

HENNINGER: That's - that's the kind of...

BACH (ph): Yes.

HENNINGER: ...scenario that would help us elicit that information

BACH (ph): Right.

HENNINGER: OK.

BACH (ph): Yes, yes, I think I would have - have those three targets out there, and...

HENNINGER: These are their.

BACH (ph): ...even if they are all three the same, but one is closer, or maybe two - two are moving and one is stationary...

HENNINGER: OK.

BACH (ph): You know and chances are you want to shoot the stationary guys because...

HENNINGER: I never would have thought of that as a factor, that's excellent point..

BACH (ph): ...yes, because he's going to want to - he's going to be better prepared to shoot you if he's stationary.

HENNINGER: OK. So moving, stationary, the kind of weapons they are carrying.

BACH (ph): .And also if somebody is carrying a radio...

HENNINGER: Oh, OK.

BACH (ph): ...you want to shoot the guy next to him.

HENNINGER: Glen (ph) seemed to catch that, but I don't think I did. Why is that?

BACH (ph): Well because the platoon leader or the squad leader is usually not the guy carrying the radio.

HENNINGER: Oh I - I understand...

BACH (ph): ...he usually has a radio operator. So you want to shoot the guy next to the radio.

HENNINGER: Oh, OK. All right.

BACH (ph): And then shoot the radio next. But the radio - the guy next to the radio operator first. That's why we lieutenants have a low life expectancy in - in battle, so.

TAYLOR (ph): If you want to survive, carry a radio.

BACH (ph): Yes.

HENNINGER: OK.

BACH (ph): You know, really anybody different is going to catch your eye. You know so you'll see snipers, they'll cover up their rifles so they don't look like sniper rifles. You know, those kinds of things. So you know somebody with a cruise surf weapon, you're going to want to shoot them first. And I think most guys have a feel for that in a - if they were in a completely dispassionate, thinking about it ahead of time, here's this photograph to look at. I think though, when bullets are flying that probably the closest guy loses. You know, you are going to shoot at the closest target first. I don't know for sure.

HENNINGER: OK. That's really the kind of thing we wanted to do the live data collection for, but I think that this isn't such a big project for as far as funding goes, if they want us to be working on that part right now, so.

BACH (ph): Well you might be able to do that though with - with smaller simulators. You know where you could present people in - you could do it with these video games that they've got at the - at the mall with the pistols.

HENNINGER: Oh, that's an idea. We were trying - we were thinking about maybe trying to use some video game like Ghost Recon (ph) or something to come up with just visuals.

BACH (ph): Yes, you know the Delta Force Two (ph) game...

HENNINGER: Or Delta Force (ph)...

BACH (ph): ...that allows to present different targets potentially in a semi-automated way and that might be - and I know that the army has access to scenario generator and things. We've got some folks in our department of military instruction that have some skill in building Delta Force Two (ph) scenarios.

HENNINGER: OK.

BACH (ph): So they might be able to help with some of that.

HENNINGER: Oh great. Does that - is that Two-D (ph) or Three-D (ph) view, do you know? Delta Force (ph)?

BACH (ph): It is a first person shooter.

HENNINGER: First person shooter. I was wondering if you can like see an overhead too.

BACH (ph): Well with the Delta Force Two Land Warrior(ph) variant that they have, that they use upstairs, they've got a different gooey placed over it that - that allows you to get that Two-D map view as well. And you - I can't speak for DMI, but they're always looking for things to do it seems like. And - and you might be able to get them to organize an experiment with cadets and things to do.

HENNINGER: Oh OK that would be great. I'll keep that in mind.

BACH (ph): Yes, or you maybe you know - on the other hand, I don't know if they'd be willing to talk to you, but on the other hand you know, some folks at the ranger regiment, some of these other places may already have at least what the official approved solution is to the target selection problem. Whether or not people would follow that in the heat of battle is yet to be determined, but you know. So they may have some stuff. It's already been collected.

HENNINGER: OK. As far as one of the other things of interest to our sponsor is when do you shoot to kill versus suppression, versus using it to defeat your enemy. Do you have any?

BACH (ph): Yes, well the definition of suppressive fire is, aim to fire at known or suspected enemy positions. So you never fire to scare the enemy.

HENNINGER: OK.

BACH (ph): All right. You are always trying to kill somebody. The best way to suppress an enemy unit is to have two or three guys screaming for a medic. All right. So you would never in a combat situation, you would never be shooting over people's heads just to scare them.

HENNINGER: OK.

BACH (ph): You would be trying to shoot some guys to scare them. In fact there is some reason to believe that firing over people's head in a battle only makes them less suppressed.

HENNINGER: Oh, OK. Interesting.

BACH (ph): And I read something just the other day about that in fact, written by somebody. It might take me awhile to find what I read. But anyway, yes, so there is some reason to believe that you know, if you are doing - if you are shooting badly, that that only emboldens the enemy.

HENNINGER: OK.

BACH (ph): So now in training, a lot of times when you are practicing these drills, there are times when you want to shoot everyone once in awhile, just to keep their heads down, right? Even though you can't see them anymore maybe.

HENNINGER: OK.

BACH (ph): OK. So there would be occasionally times when - what I use is this is not procedure or technique. You know I would have OK, Person A shoots, Person B waits five or six seconds and shoots toward the last known position of the enemy, right? And again you are just not like shooting in the air, you are saying, well like if I was the bad guy, I might hide behind that rock or behind that little bush, or whatever. Some of that's helpful like if that's the base of fire element, you know we're supposed to be keeping the enemy inbound. Some of that's helpful to stop the enemy from maneuvering, right? And it also helps the maneuver force. You'd be surprised how hard it is sometimes when that second fire team or whatever starts maneuvering off to the left to get behind the enemy, how hard it is for them sometimes to figure out where that other fire team they've left in contact is. So sometimes the sounds of the shots from the friendly forces would actually help them...

HENNINGER: Oh, OK...

BACH (ph): ...do their job a little bit. So anyway, but in general you're always trying to locate a real target and kill them when you're shooting. Now you talk about you know, rubber bullets and operations other than war and non-lethal things and I can't really speak for that, I'm not - I'm not - a lot of those kinds of things have developed in the last couple of years and you know I haven't been in a troop unit the last couple of years.

HENNINGER: Right, OK. Yes, fortunately that's - that's sort of a TBD for us, so - so this is going to work out great. What about if - what about if you change the environments, and let's say you

were going to - you were in an urban canyon environment or inside a building? I've read things before where maybe you don't hear anything, somebody will just you know, shoot a machine gun for a little bit. Just like spray the walls or - or I don't know, does that ring a bell with you or?

BACH (ph): Well I've heard people talk about reconnaissance by fire.

HENNINGER: OK.

BACH (ph): Right you know which is bad idea, right? We think there might be some enemies in the wood line, so let's shoot at them and hopefully they will shoot back.

HENNINGER: OK.

BACH (ph): You don't usually use your key weapons to do that.

HENNINGER: OK.

BACH (ph): Right? Because often you try to hide the locations of your machine guns and your key weapons as long as possible. Yes, that would be the technique. I guess I - that would be very situation dependant.

HENNINGER: Yes.

BACH (ph): You'd have to kind of look at the scenario.

HENNINGER: And the train, or the building, or whatever. OK. Let me think.

BACH (ph): Now are you going to take into account the training level of the unit in this? You see, because some of this like target selection and that kind of stuff I think would be very training dependant.

HENNINGER: Oh, OK.

TAYLOR (ph): I think we would like to deal with the model people who are fresh versus people who have been out in the field for a couple of years.

BACH (ph): OK. So you're talking about trained versus trained and experienced.

TAYLOR (ph): Right.

BACH (ph): We have lots of trained folks in the army but up until recently, not all of them actually had combat experience. And there is no substitute for - if we'd come very close and we try really hard. There is no substitute for actually being out there.

HENNINGER: Out in the field OK.

TAYLOR (ph): So the difference is just from an armchair psychologist might be that if you are fresh you rely more on instinct than on training. Or?

BACH (ph): Yes, initially. Right, initially that training, those drills are all you know. And that's what you are going to fall back on and you read after action reports all the time. Even on an Afghanistan unit guys would you know, it was our training. You know we did these drills, we were acting immediately to the enemy and that's what saved us or whatever you know, like in Anaconda (ph), those kinds of things. So - so yes I mean initially until you have actual experience by which you will then modify your own SOPs (ph), whether you do that explicitly or implicitly. I mean I think - but the other thing that - that comes with that experience is the ability of the leaders to identify where the enemy is, what the enemy is doing, to predict what the enemy is doing based on experience.

HENNINGER: Yes, it would be interesting to make one of our scenarios like them; base it on one of those drills and use that asset to distinguish (ph) and see is there a difference between people fresh and people who have actually been out in the field and have experience. So those drills, what does that mean? Like what kind of drill would that be, or how could we find out - if we wanted to model something after that drill, a drill that would be used in training, where would we get that information?

BACH (ph): That same manual.

HENNINGER: Oh, in that battle drill manual?

BACH (ph): Yes.

HENNINGER: Oh, OK. So those are the drills they would actually use in training. OK.

BACH (ph): Yes, and literally, we have a -- you know, we'd spend two days working on one drill, you know. And to do it first, you know kind of the base case and everything looks like the pictures in the book you know. And then we would, OK, well now the enemy is not to the front, they're coming from the side, and they're coming from the back or whatever and you start modifying, or we would immediately kill off the squad leader.

HENNINGER: OK, so those pictures in the books actually have like numbers of enemies and placements and the whole spill?

BACH (ph): Numbers, yes. I mean or at least approximate, yes.

HENNINGER: OK.

BACH (ph): And location and...

HENNINGER: And location and stuff like that. Oh, OK.

BACH (ph): And there will be arrows showing where people are moving and those kinds of things.

HENNINGER: So we would theoretically be able to recreate those in some other environments...

BACH (ph): Oh sure...

HENNINGER: In some digital environment...

BACH (ph): Yes, I think there is enough there to like to put in to Motshaff (ph) or something...

HENNINGER: Oh really? Oh OK. Awesome. All right. Glen (ph), do you have...

BACH (ph): And now the other - you know I do a lot of simulation work as a hobby as well, and one of the things that the hobby of war gaming is kind of see people talk about a little bit is that when you are raiding a unit, there is like two different axis. One is training, but the other one is morale. Don't know if that matters in this case, right. I mean I can be a very well trained unit, but if morale is bad and I'm tired or whatever, right - and I guess I see fatigue at this point as an input to morale that you know, my reactions may not be exactly right even though my training is right. You know so there is really two vital axis are when you are trying to rate the performance of a unit, I think.

HENNINGER: OK.

BACH (ph): Don't know that it matters.

HENNINGER: Well you know we really haven't given too much thought to the issues of moderators, internal moderators and external performance moderators, but of course we are going to have a factor. So, I - I think...

BACH (ph): Sure, when guys get tired...

HENNINGER: Yes.

BACH (ph): ...they may not do the right thing, just because they are tired.

HENNINGER: So we'll have to adjust that down the line somewhere.

TAYLOR (ph): Are there any other things you look for when you are picking targets? I think you've given us maybe five of them.

BACH (ph): What weapon they are carrying. How far away they are.

TAYLOR (ph): Right.

BACH (ph): What they are doing. And maybe any other equipment that they've got, if there're radios, or sniper rifles, or those kind of things. I think those are really...

TAYLOR (ph): OK.

BACH (ph): ...the key.

HENNINGER: What they're doing means stable versus moving.

BACH (ph): Right, yes. Are they aiming at you?

HENNINGER: Aiming at you.

BACH (ph): That's - that's a key indicator that you need to be shooting.

HENNINGER: OK. Well I'm pretty good with this. I think we have a lot to work with here. Do you have any other questions you want to ask?

BACH (ph): No. Not at this time. Based on all of this, does it still look like nine or eleven July is useful?

HENNINGER: Well...

BACH (ph): I don't need an answer now.

HENNINGER: OK.

BACH (ph): If you could let me know though.

HENNINGER: I'll look at the battle drills as soon as I can and maybe that will help me be able to tell you.

TAYLOR (ph): Amy do you know where you can get that manual?

HENNINGER: No, I was going to start with SAIC (ph).

TAYLOR (ph): Oh, OK.

BACH (ph): They may be able to get. Do you have access to the Rimer (ph) digital library?

HENNINGER: Doesn't ring a bell with me.

BACH (ph): OK. There may be an electronic version. Let me look.
HENNINGER: Oh, OK.
BACH (ph): In fact, here wait a minute. Let me pull it up real quick.
HENNINGER: OK.
BACH (ph): Roll up Netscape. There may be a copy of the manual on line in PDF and let's see.
Oh wait a minute. What was that link? OK, drills, infantry, now you are just doing dismounted individual combatants at this point, right?
HENNINGER: That's right. At the platoon level and below, right.
TAYLOR (ph): Right.
BACH (ph): OK. Let's see, seven dash.
Seven dash eight. That's the one you have. I just wanted to look to see if drills were in the back of this one.
HENNINGER: Yes, I'm seeing something in the end of these chapters. It looks like it's drills orient.
BACH (ph): Yes here they are. OK. So you have seven dash eight, right?
HENNINGER: Right.
BACH (ph): OK, chapter four is battle drills.
HENNINGER: I'm topping it right now, OK.
BACH (ph): OK, and look at battle drill number two, Reactive Contact.
HENNINGER: Yes.
BACH (ph): OK, you see there's a picture there?
HENNINGER: Yes, OK. Yes sure, OK.
BACH (ph): The situation description, there's a picture, there's kind of a flowchart to walk you through the drill. It shows where the folks, you know, where the people in the team are on it.
HENNINGER: And these are the drills that you would use in actual OK?
BACH (ph): Yes, we would train to these.
HENNINGER: You would train to these, OK.
BACH (ph): And you see what are there, ten or eleven of them right?
HENNINGER: Yes.
BACH (ph): So that would give you - or there are eight. All right, so those are eight different scenarios and then you can really start to modify those, right. I mean if you look at React to Contact, right, there are decision points in the drill. Let's see, step four in the React to Contract drill. It says, can the squad maneuver? That's the decision point. So you can set up a scenario so that there is a yes decision and a no decision. Or it's set up as a yes, and the no decisions are correct.
HENNINGER: Oh, OK. I guess I'm seeing step four as - it says something different in mine. So this is React to Contact.
BACH (ph): OK, looking at figure four dash three.
HENNINGER: Oh, where there's problem, OK. Oh there we go, oh I understand. Yes, I see, OK.
BACH (ph): OK. So you could actually set up a scenario - every place is a decision point, right? Step three says, can the fire team end contact, suppress the enemy? OK, so yes or no, right? I mean the squad on a patrol may have a machine gun with it. So it could suppress a larger unit than maybe it would normally be able to suppress.
HENNINGER: And then that would be another good step for us then in acquiring knowledge is to go to those decision points and stick to them specifically, if there is an expect - what are the factors that are going effect this decision?
BACH (ph): Right.
HENNINGER: OK.
BACH (ph): Can the squad in contact, you know, can the fire team in contact suppress the enemy. What goes in to that. You know are you taking effective fire, do you have wounded folks, are you at full strength? Do you have a cruise surf weapons attached? Do you have access to mortars? All right so there is all those.
HENNINGER: OK. OK. Yes, this is very helpful, thank you.
BACH (ph): OK.
HENNINGER: I'll go through these in detail and.

BACH (ph): Yes this should give you what you want. There was a smaller manual at one point. This may have superceded it, because I don't see the smaller manual listed.

HENNINGER: OK.

BACH (ph): They may have...

HENNINGER: Put it in and right.

BACH (ph): ...clumped the drills from the smaller manual in to this one.

HENNINGER: OK.

BACH (ph): Yes, because I don't see the other one listed. But you've got lots of drills here. You know, Knock Out Bunker, React to Ambush, Break Contact , you know you've got - your scenario has a break contact in it, right?

HENNINGER: Right.

BACH (ph): The scenario you provided? Well here's a break contract drill. So it talks about how you do that.

HENNINGER: OK.

BACH (ph): And sometimes, like in the React to Contact drill, there will be a pointer to the Break Contact drill.

HENNINGER: OK.

BACH (ph): So.

HENNINGER: OK. And so associate SOP (ph) with the battle drill for me again.

BACH (ph): OK, the SOP (ph) would be a modification./.

HENNINGER: OK.

BACH (ph): A local modification to the battle drill.

HENNINGER: OK, thank you. OK.

BACH (ph): Sometimes people you know, talk about tactics, techniques and procedures. Those are things that you'll know to do that are not in manuals. It's the same thing really.

HENNINGER: All right. OK. Thank you so much for your help on this. I'll go through those battle drills and I'll let you know...

BACH (ph): Sure.

HENNINGER: ...if we have more questions or maybe if we could arrange another conference call down the road if - if that's going to work with your schedule.

BACH (ph): Yes, that's no problem. I should be here around - with rare exception you know, a day here a day there, I should be around until August.

HENNINGER: OK.OK, awesome. And when - when do you come to Orlando for your new job?

BACH (ph): Well, not until next June.

HENNINGER: Oh, it's next June.

BACH (ph): Yes, I've got all kinds of project managers schooling that I have to go to between now and then, so you know six week and ten week course, and that kind of stuff, so/

HENNINGER: So how long - how long will you be at West Point (ph), still?

BACH (ph): Until June. On and off.

HENNINGER: So you would be - I understand. When you are attending these courses, OK.

BACH (ph): Yes. So I'm supposed to report in June, down there in Orlando.

HENNINGER: Well congratulations on your new position. Yes, that's awesome.

BACH (ph): Well good, Well I'm - you know, call me whenever you want.

HENNINGER: We will.

BACH (ph): And you know -- I think if you get ready to maybe do some experiments that are - DMI folks might be interested in participating in that kind of hook you up with who the right people are.

HENNINGER: OK, that would be great.

TAYLOR (ph): What's DMI?

BACH (ph): The Department of Military Instruction. They are the one's that have the Delta Force Two model and access to cadets that they could use as your guinea pigs. And we've done that before. I was - I'm doing some work for Land Warrior and we tried to set up some experiments to gather some data network traffic. And it turned out the game uses game network traffic instead of Land Warrior network traffic, so the experiments didn't get us anything, but you know DMI was very cooperative on setting up the scenarios that we wanted and lining up cadets to work on it and that kind of thing, so...

HENNINGER: And this Delta Force Two is off the shelf? They haven't made any enhancements specific to.

BACH (ph): To the game itself, no. They have added the track Monterey (ph) folks have added this other interface to it, which looks more like Land Warrior . But as far as I know, the game is not different. Now the other thing is, have you gone to - you should go to www.americasarmy.com and order a copy of this game that the army wrote.

HENNINGER: Yes, I'm - I read about that, OK.

BACH (ph): Yes, it's free. You can write, they will send you the CD in July I think, when the CD is available. The advantage of that over Delta Force Two is going to be that the physics are correct.

HENNINGER: Oh, OK.

BACH (ph): Which may impact on the I don't know the fidelity of your results, all right, yes. Because once people figure out that it doesn't matter if I hide behind the wall, he can shoot through them anyway, you know, that's going to change what people do in the game.

HENNINGER: Right, OK.

BACH (ph): But one of the things they were real sticklers on when they developed that game was that the physics was correct.

HENNINGER: OK. All right.

BACH (ph): And the game's free. So you can't beat that.

HENNINGER: Yes, yes, OK. Awesome. All right, well thanks again so much for your help.

BACH (ph): Sure.

HENNINGER: And we'll be talking to you next week or so.

BACH (ph): OK.

HENNINGER: Thanks, take care.

BACH (ph): All right. Bye.

C.1 Squad Patrol – Hasty Ambush Scenario

Squad Patrol Scenario*

*excerpted from: Akroyd, P., Harper, K., Middleton, V., and Hennon, C. (2002). Cognitive Modeling of Individual Combatant and Small Unit Decision-Making within the Integrated Unit Simulation System. In Proceedings of the 11th Annual Computer Generated Forces and Behavior Representation Conference, p. 597-604.

The example tactical scenario focuses on an infantry squad given the mission of patrolling the road south of McKenna, which is known to have an enemy presence. The squad's goal is to establish a presence in the region and gather intelligence on the enemy. See Figure 2-1 for a graphic representation of the scenario. The rules of engagement (ROEs) allow engagement with enemy forces. The squad begins in the patrol phase moving along the road in formation.

A warning order received via radio initiates the contact phase and the squad immediately spreads out but continues along the road, alert for the enemy presence. This transition to the contact phase may also be spurred by coming into visual range of the enemy or coming under fire. In either case, the squad leader makes an immediate decision to:

- Engage the enemy;
- Engage the enemy with fire support; or
- Break contact

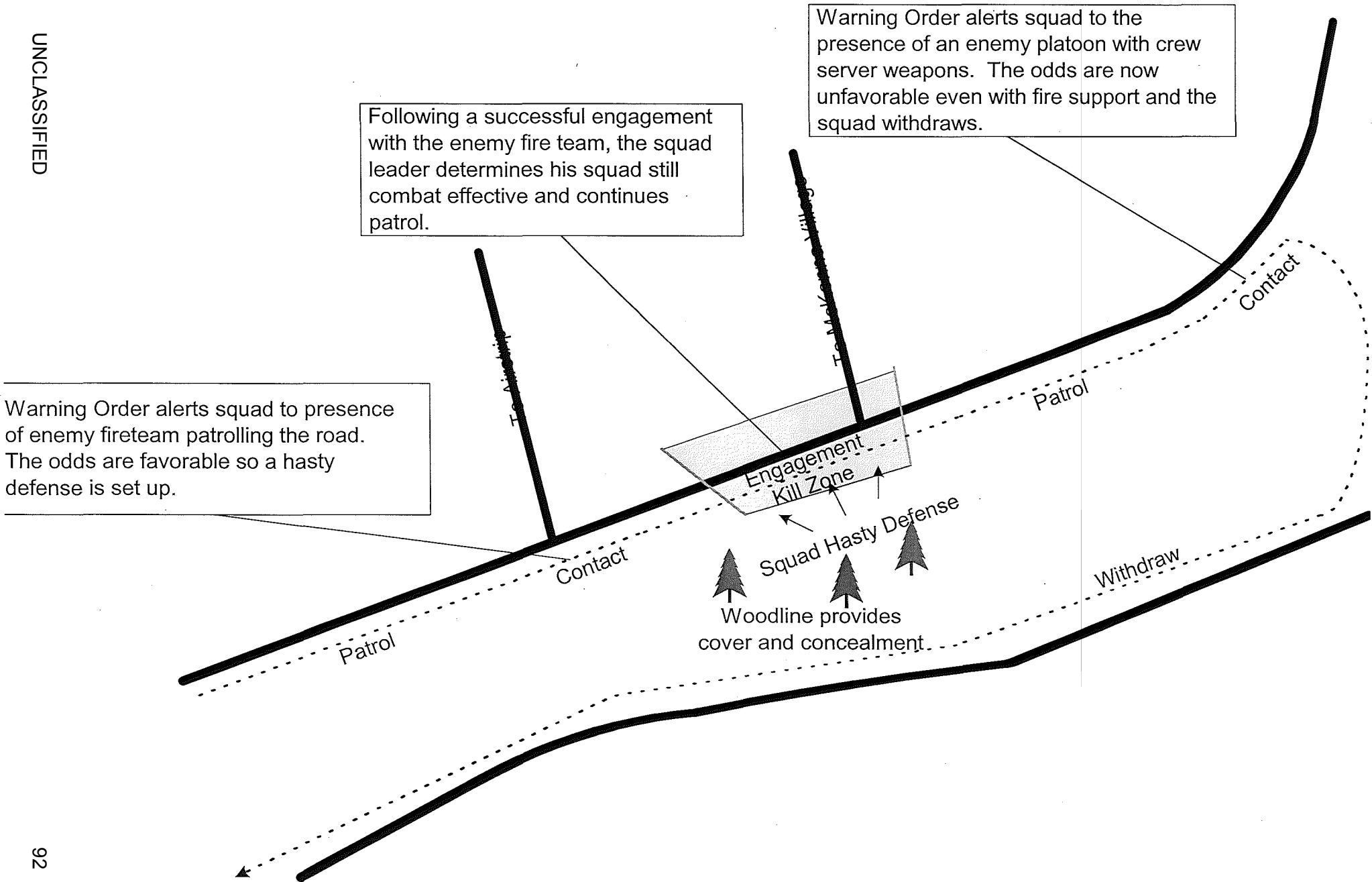
The squad leader bases this decision on an assessment of favorability of the odds, the availability of cover and concealment to support a hasty defense or ambush on the enemy, and whether his squad has enough ammunition to support an engagement. If the squad leader chooses not to engage, he will maneuver the squad back to friendly territory, thereby ending the scenario.

However, in this scenario, the squad leader is notified that the enemy force consists of a fire team. The odds are favorable and he chooses to engage the enemy, deciding where to set up his squad's hasty defense or ambush line. He chooses the south side of the road because, should a withdrawal be necessary, his men will be moving away from the enemy-controlled village. At this time, he will also set up fire support if required and assign sectors of fire across the squad. Once set up, the squad enters the engagement phase, and the squad leader continuously assesses the ability of the squad to continue the engagement, whether the odds are still favorable, and whether the engagement is taking so long as to incur the risk of enemy indirect fire. Based on this determination, he will decide whether to continue the engagement, call for fire support, or perform a break-contact maneuver. Following a movement from contact, the squad would return to friendly-controlled territory, thereby ending the scenario. However, in this engagement, all goes well during the engagement and no withdrawal is necessary.

The individual combatants must also make decisions throughout the engagement. Targets must be selected, albeit within the sector of fire assigned by the squad leader. The nature of the fire must also be selected based on whether the objective is to suppress or to kill the enemy. This goal may be provided by the squad leader. Once the engagement is successfully concluded, the squad continues to patrol along its assigned route, once again in the patrol phase of the mission.

Farther up the road, the squad once again receives a warning order reporting the presence of an enemy platoon with crew serve weapons. In this contact phase, the squad leader easily determines that the odds are not favorable for an engagement with an enemy force of this strength, and quickly selects a withdrawal route moving away from the enemy and the enemy controlled urban area. The squad moves in a spread out traveling overwatch formation and heads back to friendly territory completing the scenario.

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C.2 Building Clearing Scenario – Battle Drill 6

CQB Battle Drill 6 Scenario – VIRTE Demo II

Training System and Scenario Context

- High intensity urban combat; no civilians.
- Two-story building defense. See figure below.
- Supports Squad and FireTeam. No initial entry points assigned yet.
- Old battlefield; there will be no personal articles, furniture, etc.
- Also no large rubble or other large obstacles that would provide cover.
- Lighting—ambient light from outside only (windows).
- Rubbled environment with holes to provide outside light.
- Assume trainee force controls the outside so that trainees don't have to worry about exposing themselves in windows.
- Spraying weapons without aiming can be effective in CQB; let CGF do this sometimes
- Allow CGF to throw rocks as well as grenades; forces trainees to react as if grenade.
- CGF should use communications—speak (be heard), gestures too. Allows trainees to learn (but don't be the same all the time).
- CGF don't make last stands in dead ends except in exceptional cases.

Offensive Support Actions for CGFs

- CGF should pause and look at weapon before clearing. Several clear attempts may be necessary.
- Push open doors. Important to have open and closed doors; opposing and alternating doors going down hallway.
- Defensively fire and maneuver with another CGF. "Australian peel" = retrograde fire and maneuver in hallway.
- React to light, movement and noise naturally. CGF should be able to hear trainees, or see shadows move. (No silenced weapons).
- These actions can have an impact on trainee—trainee may go too close with wounded CGF and mistakenly ignore danger zones from side doors, etc.
- Recognize overwhelming incoming fire. Also nearby casualties.
- Difficult to operate against an opponent without a discernable SOP. May be difficult to achieve objectives of capturing terrain, while enemy is trying primarily to cause casualties.
- Dynamic shadows give OPFOR movement cues.
- Rounds go through walls, ricochet off walls in different ways. Rounds tend to follow walls after hitting them.
- Could cheat on movement and behavior if CGF is outside arc of vision. Inclination is not to cheat.

Stairway Defense

Stairway defense, going up (see second figure below):

- Defender goes up to landing; second CGF defender goes higher
- First defender can fight, then withdraw to top landing
- Both CGF can fight from top, then withdraw down hall
- Defenders throw hand grenades down stairway

CGFs 1 and 2: Hold entry point

- Fire prone/kneeling/offhand; barricaded into defilade firing position
- Communicate to 1st floor CGF verbally ("they're coming!")
- Be suppressed—duck down from firing position
- Withdraw Decision criteria—number of hits nearby (e.g. 70). Proximity to entity important. Rate of fire. Can't stay in position because it becomes too dangerous/fear.
 - To hallway OR up stairs (difficult for trainees)
- OR Charge while firing to entry—to limits of building. Possibly throw out grenades if trainees don't maintain momentum.
- Given too much time use area weapons
- Warn off, i.e. yell at trainees
- Wounded—crawl/limp back along hallway behind other CGF. One healthy could cover other limping or crawling; or drag incapacitated CGF.

CGF 3:

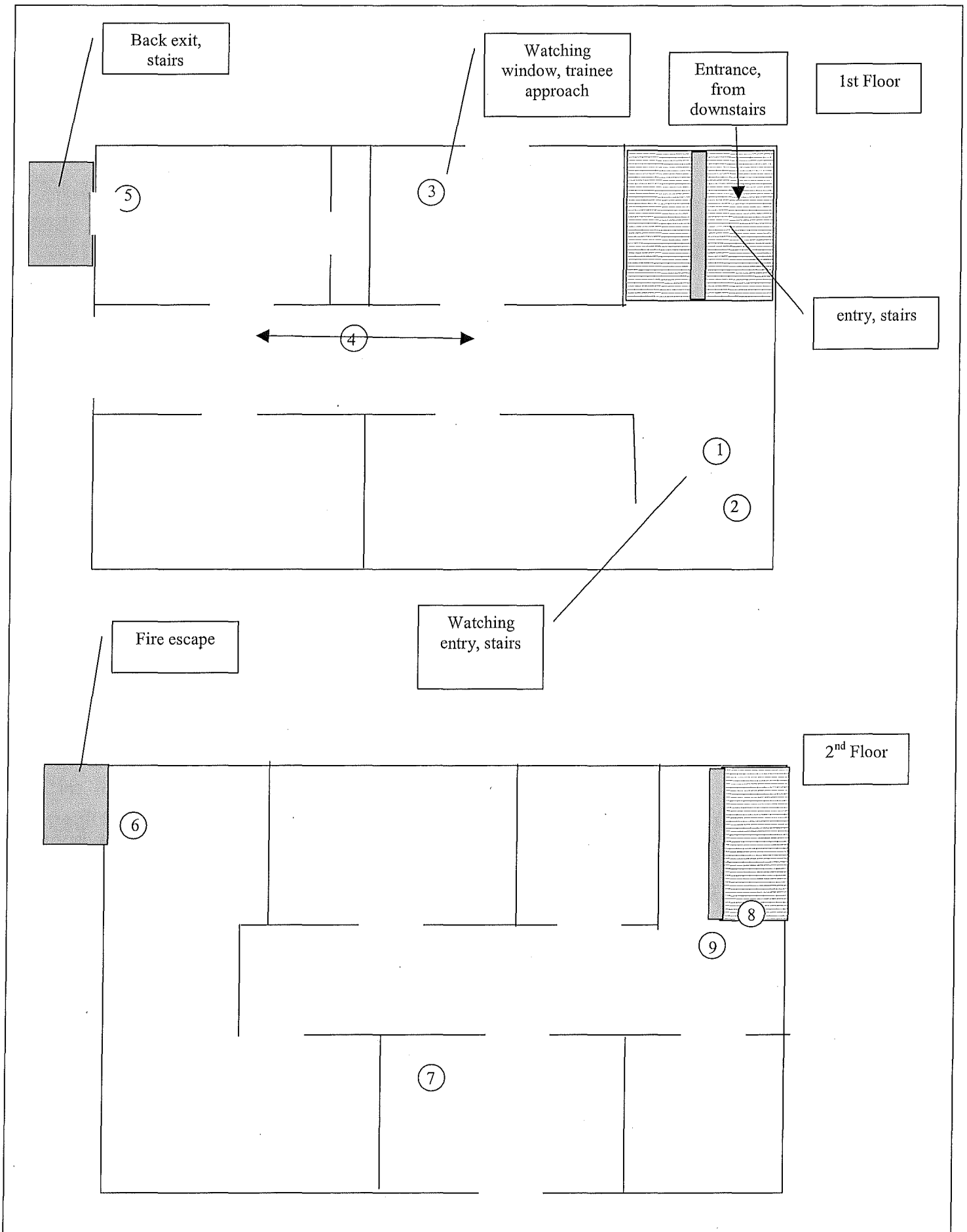
- Covers outside area through window
 - Can be suppressed—possibly part of scenario as trainees approach building
- Updates 1st floor CGF on what he sees
- May support hallway defense
 - Step out into hallway; full frontal stance
 - Barricade in doorway (using doorframe for cover)
 - Fire while retreating down hallway. (E.g. cover retreat of wounded 1, 2)
- OR cower (weapon down), refuse to fight, run away. Random; depends on noise, received fire, etc.
- Possibly—hide in corner waiting for trainees to come; mistaken situation assessment, mistaken bravery, fanaticism

CGF 4:

- Hallway defense
- Same rules as 3
- Maybe secretes in closet (upper left room) or in other rooms

CGF 5: Escape out back stairs

Others: Similar; defend by barricading in doorways, withdraw down hallways, secrete in rooms, be suppressed, etc.



D. Factors Affecting WF Decision

Partial Listing of Factors Affecting Weapons Firing Decision

The following is a partial listing of factors and decisions that could impact upon the varied elements that make up the engagement process for a small infantry unit. Attempts were made to outline many of the factors known to be important at one time or another.

There are various goals that could be achieved through firing. They could include, but not limited to; firing to hit and destroy the target, firing to keep the target from firing at me (suppress it), firing just to make noise or using smoke to obscure the target. As a result, there are different modes of firing at targets. A few are; well aimed fire at point targets, area fire at unit sized targets or when there is significant uncertainty regarding the location and number of the enemy.

Reasons for not firing could include; attempts to reduce the fog of war and to gain a clearer picture of the tactical situation, waiting for a more advantageous opportunity to engage the target, engaging the target in a different manner (e.g. call in artillery on the OPFOR), not wanting to give away position or to avoid detection, fear, need to accomplish a higher priority task (move, communicate, command, etc.); perception that the desired affect would not be achieved (or achieved at too great of a cost), determining that this is not a fight that we should not get into (or could not get out of if it was not going well).

Factors Affecting Target Selection

- Presentation of the target
- Ability to clearly identify the target as a hostile; have gone through the stages of target discrimination (detection, classification, recognition and identification).
- Perceived ability to hit a target (dependent upon many factors)
- Range
- Perceived threat of target (e.g. I perceive the OPFOR Machine Gunner to be a greater threat than that of an OPFOR rifleman)
- Shooters Skill
- Suitability of weapon

Selection of the best mode of fire with a given weapon. An M-4 rifle for example can be set to single shot, burst or full automatic.

The trade-off between time and accuracy of one's fires.

The trade-off between exposure and accuracy of one's fires.

Level of cover and concealment available.

Quantity of ammunition available.

Level that the shooter would have to expose himself in order to engage the threat.

Ability of the selected weapon to have the desired affect

Availability of other weapons (organic to myself or to the unit) and ability to use them or to call for their use.

Orders from superiors to engage the enemy (where, when and who)

- Sector of fire (area of responsibility) and field of regard
- Selection of specific targets
- Mission of the unit; attach, observe, locate, etc.
- Coordination / synchronization with other units

Role within the small unit; e.g. anti-tank, squad leader, forward observer, rifleman, etc.

Personal characteristics also play an important role. A few factors are; motivation, skill level, psycho-physiological state and willingness to take risks

Also important is one's perception of the environment and of the situation.

Throughout the small arms engagement process there is a continuous process of battle damage assessment. This assessment is important to an individual or leader to help evaluate the effectiveness of past actions and the present course of action, i.e. did I or am having the desired or expected effect.

E. FPS Game Comparison

Comparison of games to use for military training and as SME evaluation.

The objective of this paper is to evaluate games suitable for use as a tool to evaluate and gain insight into SME's performing a MOUT operation. There are many games out there that can serve as a good environment for MOUT operations. These games are:

- Ghost Recon
- Delta Force 3 Land Warrior
- Operation Flashpoint
- Counterstrike

Game	Cost	Publisher	Main Website
Ghost Recon	\$49.99	Red Storm Entertainment Inc.	http://www.ghostrecon.com/
Delta Force 3 Land Warrior	\$39.99	Novalogic	http://www.novalogic.com/games/DF3/body_index.html
Operation Flashpoint	\$34.99	Code masters	http://www.codemasters.com/flashpoint/front.htm
Half-Life Counterstrike	\$29.99, need to buy half-life, then get the mods	Valve	http://www.counter-strike.net/

The criteria on which the games were evaluated.

Criteria / Game	Description	Ghost Recon	Delta Force	Operation Flashpoint	CounterStrike
Engine Type	What kind of engine is it	3D	Voxel	3D	Quake 2
Indoor	Does the game support indoor environments	Yes, detailed buildings	Yes, but low detail on buildings and bad textures	Yes	Yes
Outdoor	Does the game support outdoor environments	Yes, High – detail outdoors	Yes, Low detail outdoors, smooth terrain, larger area supported then the other games	Yes, Med-High detail, large outdoors	Small outdoors, Med detail
Play Mode	How do you play the game	Squad based, play as any team member, first person	Single player, first person, third person, but bad perspective, from behind	Single player, first or third player	Single player, first person
AI	Does the game support AI, how does the AI play	Enemy and Friendly AI, Intelligent behavior	Enemy and Friendly AI, Stupid behavior	Enemy and Friendly AI, Med-Intelligent behavior	No AI, Multiplayer only, Single game supports AI, there are some AI bots out
Team mode	Can you control a team	Yes, up to 6 players on a squad. You can switch between players	There are teams, small 2 people, with AI as other team member, you cannot control them, they usually get killed.	Yes, many people on your team, can control them as your rank goes up.	Yes, but they are all humans, as it is multiplayer only
Multiplayer	Does the game support Multiplayer	Yes, One person can control a team with AI or have other people play as a team member, 4 teams max. 4 to 36 players	Multiplayer support, up to 24 players, can have 4 per team, but they must all be human. 4 teams.	Yes, all human teams, up to 24 players. 2 teams.	2 teams, up to 24 players, must all be human.
Record/Playback	Can you record games and play them back later	Yes, can switch views to other team member during playback.	No	No	No
Observer Mode	Can you join a game as an observer	Yes	No	Yes	Yes

Realism	Is the game realistic	Yes	Slightly, bad AI and terrain detract from it. Models are not very detailed	Yes, but it's 80 era weapons.	Yes
Weapons	Does the game contain a good set of weapons	Yes, can configure new weapon sets	Yes	80 era weapons	Yes, but limited
UI interface	Is there a good interface	Yes, easy to tell where shots are coming from	Standard	Standard	Standard
Night vision	Does the game support night vision	Yes, full screen	Yes, but limited to circle, and when scope is on limited to small circle	Yes, standard	Yes, standard
Vehicles	Does the game support vehicles and can you ride/use them	Yes, but you can't drive them	Yes, but you can't drive them	Yes, and you can drive jeeps, trucks, tanks and fly helios.	Drivable trucks, depends on the Mod.
Terrain	How big is are the maps	Med size, 400x400 meters	Very large	Very Large	Small
Mods	Is there a mod community and can you download mods and maps	Yes	No	Maybe	Yes, Counter strike is a mod on Half-life.
Future games	Will there be future games for this series	Yes, Desert Seige add on missions	Yes, This is part of a series	One, can play as a Russian	Always new mods and additions coming out for counterstrike.
Scenario design	Can you design your own scenarios	Yes, can place objects and people, additional tools needed	No	Yes, whole scenario editor	Yes, design own maps only, additional tools needed
Training	Is the game useful for training	Yes	Yes, limited	Yes	Maybe
SME	Can the game be used for SME input	Yes, playback included	If you are watching them, no playback	If you are watching them, no playback	If you are watching them, no playback
VON	Does the game support voice over net	With additional software	Yes	Yes	With additional software

Overall it depends on what the requirements are and what you need to get out of it. If you need to build scenarios and watch the action Operation flashpoint has the best editor. Ghost recon has the best replay and is more realistic. They all have the proper weapons and equipment. Delta force has large outdoor environments. Counterstrike is suited well for multiplayer, and training, but not the good for SME evaluation.

I am biased towards Ghost recon, as it provides a general overall better experience than the other games.

F.1 KA Questionnaire for SMEs**Subject Questionnaire – Please check only one response per question**

Name: _____

Highest Rank Achieved: _____

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☐ Platoon Leader
☐ Squad Leader
☐ Grenadier
☐ SAW Gunner
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ Fireteam Leader
☐ Platoon Sargeant
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon.

Weapon	Easy	Reasonable	Difficult
M4/M16			
M4/M16 with scope			
M249 (SAW)			
M203			
Hand grenade			
MG (M240)			

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?
 - ☐ Never
 - ☐ Less than 2 years ago
 - ☐ 2 – 5 years ago
 - ☐ More than 6 years ago

6. When is the last time you participated in real-world execution of Infantry Battle Drills?
 - ☐ Never
 - ☐ Less than 2 years ago
 - ☐ 2 – 5 years ago
 - ☐ More than 6 years ago

7. How many real fire fights have you been in?
 - ☐ None
 - ☐ Less than 3
 - ☐ 3 – 9
 - ☐ 10 or more

8. Of those fights, what percentage were successful?

9. What would you consider the most important aspect of executing infantry Battle Drills?
 - ☐ Quick Response
 - ☐ Team Work
 - ☐ Situational Awareness
 - ☐ Other _____

10. How many years of combat training have you received?
 - ☐ None
 - ☐ Less than 2 years
 - ☐ 2 – 5 years
 - ☐ 6 or more

11. Can you list any differences between open field combat and urban canyon combat that significantly change the way you would select/prioritize targets in one versus the other?

12. In an **Open Field** scenario, when selecting targets within a sector of fire, what factors into your decision? (Please prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance)

☐	Your role in unit
☐	Your weapon
☐	Amount of ammo available
☐	Amount and/or duration of your exposure
☐	Range/distance to target
☐	Visibility of target (impeded by smoke, dark, concealment)
☐	Target's exposure
☐	Target's role in unit (e.g., Leader, Sniper)
☐	Target's weapon (Rifle, RPG, MG, hand grenades)
☐	How well enemy is placing fire
☐	Speed/direction enemy is moving
☐	Firing aim status of Target (at you, at buddy, at LDR)
☐	Number and proximity of Targets relative to one another
☐	Other: _____

13. In a **MOUT Urban Canyon** scenario, when selecting targets within a sector of fire, what factors into your decision? (Please prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance)

☐	Your role in unit
☐	Your weapon
☐	Amount of ammo available
☐	Amount and/or duration of your exposure
☐	Range/distance to target
☐	Visibility of target (impeded by smoke, dark, concealment)
☐	Target's exposure
☐	Target's role in unit (e.g., Leader, Sniper)
☐	Target's weapon (Rifle, RPG, MG, hand grenades)
☐	How well enemy is placing fire
☐	Speed/direction enemy is moving
☐	Firing aim status of Target (at you, at buddy, at LDR)
☐	Number and proximity of Targets relative to one another
☐	Other: _____

14. In a **CQB** scenario, when selecting targets within a sector of fire, what factors into your decision? (Please prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance)

☐	Your role in unit
☐	Your weapon
☐	Amount of ammo available
☐	Amount and/or duration of your exposure
☐	Range/distance to target
☐	Visibility of target (impeded by smoke, dark, concealment)
☐	Target's exposure
☐	Target's role in unit (e.g., Leader, Sniper)
☐	Target's weapon (Rifle, RPG, MG, hand grenades)
☐	How well enemy is placing fire
☐	Speed/direction enemy is moving
☐	Firing aim status of Target (at you, at buddy, at LDR)
☐	Number and proximity of Targets relative to one another
☐	Other: _____

F.2 Notes from KA Session with SME (11 July)

Weapons Firing Algorithm KA Session with Buck Surdu – 2nd session 11 July 2002

Attendees:

Buck Surdu (Orlando)
Amy Henninger (Orlando)
Glenn Taylor (Ann Arbor – Phone)

Random Notes

- Grazing fire is the preferred method of fire, vice plunging fire
- “Cooking off” a grenade for a few seconds is probably not doctrine.
- Buck thinks SOF drills and team composition is probably much different, and a whole different KA session. (From other KA experience, this may not be true.)
- May be an “ambush control policy” rather than just sectors of fire: “start on left, move to center” or “start on right, move to center”. There are alternatives to sectors of fire.
- May be primary and secondary sectors of fire to consider.
- Crew serve weapon: anything requiring more than a single person to fire, such as mortars or heavy machine guns. Example: heavy machine gun requires one person to shoot, one person to feed ammo, and another to carry ammo & work security with light machine gun.
- See James Michner “The Bridge at Andau” (ch 6 or ch 10) on clever ways to defeat tanks.
- Heavy machine gun typically fired as bursts – do not all get placed the same – small cone of spread.
- Light machine gun bursts effective only in close quarters – typically single shot mode is use.
- Sector assignment:
 - May typically want heavy MG near either side of squad (one in each fire team). Sometimes want a someone (squad leader?) outside MG to protect MG.
- Engage target until dead, then shift to another

Slide Session

Can tell MG from rate of fire, tracers (only heavy MG has tracers), movement of vegetation in front of gun (muzzle flash usually only visible at night).

“Assuming you trust your buddy in the next sector to make kills...”

“...Unless I’m the right (or left)-most sector”

Important factors mentioned:

- If target is pointed toward or away
- If target is actively firing or not

- Is target landing well-placed fire at me?
- What kind of weapon the target has (Crew serve vice light guns)
- Is the target concealed or exposed? (Shoot easy target first, all else being equal)
- Is target moving toward (vice across)? (But might favor targeting those "about to get away" out of sector?)
- Is target close or far? (close target less likely to be in someone else's sector; also, may prefer targets in center of sector)
- Is target moving into concealment?
- Is target an officer?
- Is target near the last target in my sector? (bias to move to target nearest last target)
- Is target outside sector but a reasonable threat (too close, big gun, etc.)
- Moving target may catch eye, so might get picked over stationary.

Context will be important – if the target just moved into sector?

If I've been shooting at one target of lower priority, and another of higher shows up, favor continuation over switching. Switch when original target is dead.

G. Financial Report, 11 July

DCAA Approved Provisional Overhead Rate for 2002

\$ 486.54 Period covered 3/1/02-5/31/02

Jul-02 Scientist		\$	-		
Scientist 1	50.00	\$	7,046.44		
Scientist 2		\$	-		
Scientist 3		\$	-		
Scientist 4		\$	-		
Scientist 5		\$	-		
Sr. Systems Engineer		\$	-		
Sr. Systems Engineer 1		\$	-		
Research Engineer		\$	-		
Research Engineer 1	4.50	\$	549.40		
Software Test Eng.		\$	-		
Software Engineer		\$	-		
Software Engineer 1		\$	-		
Software Engineer 2		\$	-		
Software Engineer 3		\$	-		
Software Engineer 4		\$	-		
Software Engineer 5		\$	-		
Software Engineer 5		\$	-		
Software Engineer 6		\$	-		
Software Engineer 7		\$	-		
Systems Admin		\$	-		
Project Administrator		\$	-		
Interns		\$	-		
President		\$	-		
Admin		\$	-		
Travel		\$	-		
Material		\$	-		
ODC/Consultants	1200.00	\$	1,284.00	Boerjan	
Total for July 2002	54.50			\$8,879.83	\$ 7,595.83

Total Hours

168.50

Total Cost to date	168.50	\$26,856.61
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Contract Remaining	-168.50	\$43,119.80
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APPENDIX B
EXCERPTS FROM PERTINENT FIELD MANUALS

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(FM 7-8, Appendix A-3, 2001)

Rifle Squad Leader. This soldier is responsible for all that the rifle squad does or fails to do. He is a tactical leader and, as such, leads by example. The rifle squad leader-

- Controls the maneuver of his squad and its rate and distribution of fire
- Trains his squad on the individual and collective tasks required to sustain combat effectiveness
- Manages the logistical and administrative needs of his squad. He requests and issues ammunition, water, rations, and special equipment.
- Maintains accountability of his soldiers and equipment.
- Complete casualty feeder reports and reviews the casualty reports completed by squad members
- Submits requests for awards and decorations
- Directs the maintenance of the squad's weapons and equipment.
- Inspects the condition of the soldiers' weapons, clothing, and equipment
- Ensures that material and supplies are distributed to the soldiers in the squad
- Keeps the platoon sergeant/leader informed on squad supply status and squad requirements
- Ensures supplies and equipment are internally cross-leveled within the squad.

Team Leader. This soldier is a fighting leader who leads by personal example and helps the squad leader as required. He controls the movement of his fire team and the rate and placement of fire by leading from the front and using the proper commands and signals. He maintains accountability of his soldiers and equipment. He ensures his soldiers maintain the unit standards in all areas.

(FM7-8, Section 2-18 Weapons Emplacement, 2001)

The success of the defense depends on the positioning of soldiers and weapons. To position their weapons effectively, all leaders must know the characteristics, capabilities, and limitations of their weapons, the effects of terrain, and the tactics used by the enemy. Leaders should position weapons where they have protection; avoid detection; and surprise the enemy with accurate, lethal fires. In order to position the weapon, the leader must know where he wants to destroy the enemy and what effect he wants the weapons to achieve. Additionally, the platoon leader must consider whether his primary threat will be armored vehicles or dismounted infantry. When the platoon must fight armored vehicles, the platoon leader positions antiarmor weapons along the most likely armored avenue of approach first. When the primary threat is from dismounted infantry, the platoon leader should position his machine guns on the most likely dismounted avenue of approach first. The platoon leader must consider both mounted and dismounted avenues of approach. His plan should address both; one as a contingency of the other. Squad leaders position all other weapons to support these key weapons, cover dead space, and provide security.

- a. Machine Guns. M60 (7.62-mm) and M249 (5.56-mm) machine guns are the platoon's primary weapons against a dismounted enemy. They provide a high volume of lethal, accurate fires to break up enemy assaults. They also provide limited effects against lightly armored vehicles and cause vehicle crews to button-up and operate with reduced effectiveness. Leaders position machine guns to –
 - b. Concentrate fire where they want to kill the enemy
 - c. Fire across the platoon front
 - d. Cover obstacles by fire
 - e. Tie-in with adjacent units

(1) The following definitions apply to the employment of machine guns.

(a) Grazing Fire. Grazing fire occurs when the center of the cone of fire dots do not rise more than 1 meter (about waist high) above the ground. When firing over level or uniformly sloping terrain, a maximum of 600 meters of grazing fire can be obtained.

(b) Dead space. Dead space is an area within the maximum effective range of a weapon, surveillance device, or observer that cannot be covered by fire and observation from a given position because of intervening obstacles, the nature of the ground, the characteristics of the trajectory, or the limitations of the pointing capabilities of the systems. The platoon covers dead space with another direct fire weapon, M203 fire, indirect fires, or mines (comm-detonated Claymores). Additionally, the platoon leader should attempt to tie-in obstacles (wire and mines) and fires to cover dead space. He may also position Ops to observe dead space for another position.

(c) Final protective line. A final protective line (FPL) is a predetermined line along which grazing fire is placed to stop an enemy assault. Where terrain allows, the platoon leader assigns a machine gun an FPL. Once in position, one soldier from the machine gun team walks the FPL to identify both dead space and grazing fire along its length. (Figure 2-38, p 2-74)

(d) Principle direction of fire. A principle direction of fire (PDF) is a priority direction of fire assigned to cover an area which provides good fields of fire or has a likely avenue of approach. It is also used to provide mutual support to an adjacent unit. Guns are laid on the PDF if an FPL cannot be assigned due to terrain. If a PDF is assigned and other targets are not being engaged, guns are laid on the PDF.

(2) Each gun is given a primary and secondary sector of fire. Their sectors of fire should overlap each other and those of adjacent platoons. A gunner fires in his secondary sector only if there are no targets in his primary sector, or when ordered to do so. Each gun's primary sector includes an FPL or a PDF. The gun is laid on the FPL or PDF unless engaging other targets. When FPFs are called for, the gunner shifts to and engages on the FLP or PDF.

- b. AntiArmor Weapons. The MAW is normally the antiarmor weapon that supports a rifle squad or platoon. In some units these weapons are organic to the platoon. At times, the platoon may be supported by TOWS. During planning, the leader considers the enemy vehicle threat, then positions antiarmor weapons accordingly to cover armor avenues of approach (Figure 2-39). He also considers the fields of fire, the tracking time, and the minimum arming ranges of each weapon. The platoon leader selects a primary position and a sector of fire for each antiarmor weapons. He also picks supplementary positions for them. The antiarmor leader selects alternate positions. Each position should allow flank fire and have cover and concealment. The leader can integrate the MAW thermal sight into his limited visibility security and observation plan.
- c. Grenade Launchers. The M203 is the squad leader's indirect fire weapon. He positions it to cover dead space in the squad's sector, especially the dead space for the machine guns. The M203 gunner is also assigned a sector to cover with rifle fire. The high-explosive, dual-purpose (HEDP) round is very effective against lightly armored vehicles such as the BMP-1 and the BTR.
- d. Rifles. The leader assigns positions and sectors of fire to each rifleman in the squad. Normally, he positions the riflemen to support the machine guns and antiarmor weapons. They are also positioned to cover obstacles, provide security, cover gaps between units, or provide observation.

FM7-8, Section 2-15 Conducting a Defense, 2001)

(b) Leaders control fires using standard commands, pyrotechnics, and other prearranged signals. The platoon increases the intensity of fire as the enemy closes within range of additional weapons. Squad leaders work to achieve a sustained rate of fire from their positions by having buddy teams fire their weapons so that both are not reloading them at the same time.

(c) In controlling and distributing fires, platoon and squad leaders consider –

- The range to the enemy
- Priority targets (what to fire at, when to fire, and why)
- Nearest or most dangerous targets
- Shifting to concentrate fires on their own or as directed by higher headquarters
- Ability of the platoon to engage dismounted enemy with enfilading, grazing fires.
- Ability of the platoon's antiarmor weapon to achieve flank shots against enemy vehicles

(d) As the enemy closes on the platoon's protective wire, the platoon leader initiates final protective fires (FPF) (the following actions occur simultaneously):

- Machine guns and automatic weapons fire along interlocking principle direction of fire (PDF), or final protective lines (FPL) designated principle direction of fires. M203 grenade launchers engage enemy in dead space or against enemy attempts to breach protective wire.
- The platoon continues to fight with Claymores and hand grenades

If applicable, the platoon leader requests indirect final protective fires (FPF) if they have been assigned in support of his positions

(FM7-8, Annex G: Fire Control and Distribution, 2001)**1 FIRE CONTROL****1.a Fire control measures.****1.a.1 Graphic measures**

1.a.1.a Boundaries or sectors. Divide areas of tactical responsibility between units

1.a.1.b Battle positions. Defensive position oriented along likely enemy avenues of approach

1.a.1.c Engagement areas. The area in which the leader intends to destroy the enemy

1.a.1.d TRPs. TRPs are used to reference enemy locations. They can be man made or natural. TRPs must be easily identifiable.

1.a.1.e Maximum engagement lines. Imaginary line which identifies the point where a particular weapon system is engaging at its maximum effective range.

1.a.1.f Trigger lines. An imaginary line where, once the enemy crosses, friendly units can engage. Trigger Lines can be oriented to terrain, obstacles, TRPs, or maximum engagement lines.

1.a.1.g Phase lines. Imaginary line placed along identifiable terrain which is used to control movement or coordinate fires.

1.a.1.h Final protective fire. A preplanned barrier of both direct and indirect fire designed to prevent or disrupt the enemy assault.

1.a.2 Rules of engagement. Rules of engagement are directives issued by military or political authorities that specify circumstances under which the platoon will initiate or continue combat operations. Rules of engagement will generally be issued with the company operations order. Ensure everyone understands ROE.

1.a.3 Engagement priorities. Targets appear in random order at different times and locations throughout the battlefield. Engagement priorities allow the leader to designate which target he wants destroyed first. Engagement priorities are usually done by weapons systems.

1.a.3.a **Antiarmor weapons systems.** The platoon antiarmor weapons engage targets in the

following priority:

- Most threatening armor
 - Armor in primary sector
 - Armor in secondary sector
- Unarmored command and control vehicles

1.a.3.b **Platoon machine guns.** Machine gunners should always attempt to engage at their maximum effective range and should strive for grazing fire. Machine guns have the following target priority:

- The FPF, if directed
- The most dangerous or threatening target
- Groups of dismounted infantry in primary sector
- Enemy crew-served weapons
- Groups of dismounted infantry in secondary sector
- Unarmored command and control vehicles

1.a.3.c The target priority for **M203s** is -

- The most dangerous or threatening target
- Light-armored vehicles
- Groups of three or more in primary sector
- Groups of three or more in secondary sector

1.b Fire Commands. Leaders use fire commands to direct the fires of the unit. A subsequent fire command adjusts or changes information given in the initial fire command. Only the elements that change are given. Fire is terminated by the command or signal for CEASE FIRE, END OF MISSION. A fire command has the following six parts.

1.b.1Alert. The leader can alert the soldiers by name or unit designation, by some type of visual or sound signal, by personal contact, or by any other practical way.

1.b.2Direction. The leaders tells the soldiers the general direction or pinpoint location of the target.

1.b.3Description. The leader describes the target briefly but accurately. The formation of enemy soldiers is always given.

1.b.4Range. The leader tells the soldiers the range to the target in meters.

1.b.5Method of fire. The leader tells the soldiers which weapons to fire. He can also tell the type and amount of ammunition to fire, and the rate of fire.

1.b.6Command to fire. The leader tells soldiers when to fire. He can use an oral command, a sound or a visual signal. When he wants to control the exact moment of fire, he says AT MY COMMAND (then pauses until ready to commence firing). When he wants to start firing upon completion of the fire command, he just says FIRE.

1.c Fire Control During Limited Visibility. During limited visibility, leaders ensure that the platoon's fires are controlled. To do this, they can use aiming stakes, T&Es for all machine guns, illumination, TRPs, and night vision devices.

2 FIRE DISTRIBUTION. The two methods of fire distribution are point fire and area fire.

2.a Point Fire. The platoon's fires are directed at one target. The platoon leader accomplishes this by marking the desired target with tracer fire or by M203 fire.

2.b Area Fire. The platoon's fires cover an area from left to right and in depth. The platoon leader accomplishes this four ways,

2.b.1Frontal fire. Frontal fire is used when the enemy is moving perpendicular to the platoons direction of fire. Each squad engages the targets to their immediate front. As targets are destroyed, fires are shifted toward the center of the enemy

2.b.2Cross Fire. Cross fire is used when the enemy is moving perpendicular to the platoon's direction of fire and terrain does not allow frontal fire. It is also used when the enemy is moving oblique to the platoon's direction of fire. When using cross fire, squads engage targets from left to right or from right to left depending on their location.

2.b.3Depth fire. Depth fire is used when the enemy is moving parallel to the platoon's direction of

fire. Squads engage targets from front to rear or from rear to front. As targets are destroyed, fires are shifted toward the center of the enemy.

2.b.4 Combination. Depending on the METT-T, the platoon may use any combination of the above techniques.

MCWP 3-35.3 p1-18

i. **Rules of Engagement (ROE).** The nature of military operation may restrict our use of weapons. The majority of urban battles since 1967 (such as Beirut II, Hue, Jerusalem) have had one or more of the following restriction imposed on the attacking force:

- (1) Minimizing civilian casualties and/or collateral destruction in order to:
 - Avoiding alienation of the local population.
 - Reducing the risk of adverse world or domestic opinion
 - Preserving facilities for future use
 - Preserving cultural facilities and grounds
- (2) Limiting the use of specific ground or air weapons

MCWP 3-35.3 p 4-1

4101. Indirect and Direct Fire Support

a. General. MOUT operations present unique fire support considerations. On urbanized terrain, buildings provide excellent cover and concealment to the enemy while limiting friendly observation and targeting efforts. Targets are generally exposed for brief periods of time and are often in close proximity to friendly forces. Observers will experience difficulty in finding targets with adequate fields of observation. Terrain masking by tall buildings may restrict the delivery of indirect fires. Collateral damage and rubble effects must be considered during ammunition selection. The importance of effective communications, ROE, control measures, and procedures to prevent fratricide is magnified.

MCWP 3-35.3 p 4-10

4108. Employment of Snipers

a. General. Snipers are highly trained in field skills and marksmanship and can deliver long-range precision fire at selected targets from concealed positions. The method by which snipers are employed in urban warfare will be governed by the nature of the terrain/weather, number of snipers available, and whether the enemy employs snipers. A sniper can play an important role in MOUT. Employment of snipers influences the actions by:

- Creating adverse psychological affects on the enemy by negating feelings of security
- Inflicting casualties on enemy leadership
- Enabling the infantry to seem to cover a large area, regardless of whether the terrain is physically occupied or not
- Detailing enemy positions and activity through the use of advanced optical equipment and observation techniques
- Controlling fire support
- Conducting reconnaissance in conjunction with their sniper role
- Disrupting enemy movement, observation, and infiltration, and negating the possibility of surprise

b. Offensive Employment. Snipers should be used to gain and maintain contact with the

enemy. This enhances security and prevents surprise by keeping constant and unrelenting pressure on the enemy. Some of the considerations for sniper employment include:

- (1) As the “eyes” of a commander, a sniper increases the commander’s flexibility by gathering and transmitting information on fire support targets.
 - (2) Snipers attack those targets that affect the enemy’s ability to wage battle and those that will cause the maximum amount of confusion on the battlefield.
- Potential targets for a sniper are:

- Officers and noncommissioned officers
- Enemy snipers and marksmen
- Engineer personnel
- Personnel manning crew-served weapons
- Communications personnel and equipment
- Fire support observers and/or equipment
- Commanders of armored vehicles.

c. Combat on Urbanized Terrain

- (1) Snipers can be employed to operate for extended periods of time from hidden positions to dominate and establish a “no-man’s land”, screen flanks, protect the rear, and deny the enemy access to certain areas or avenues of approach. Snipers can operate with the covering element to deliver accurate fires in support of search elements. Optical devices enhance their ability to detect movement and engage it instantly.
- (2) Snipers can also support (by fire) infantry movement across streets. They can provide immediate precision fire on enemy machine gun nests and enemy snipers. The best countersniper weapon is the sniper. Snipers are assigned the following supporting missions:

- Delaying and inflicting casualties on advancing enemy
- Observing and reporting potential targets
- Covering (by fire) avenues of approach and obstacles
- Harassing the enemy and causing him to deploy prematurely
- Directing supporting arms fire

The urban environment provides an abundance of secure firing positions that are not highly accessible to countersniping.

- d. Defensive Employment. In defensive operations, the sniper is best employed forward of the FEBA to provide early warning of enemy approach, disrupt it, and if possible, cause the enemy to deploy prematurely. Snipers are employed to:

- Prevent enemy infiltration
- Detect and destroy infiltrators
- Protect unit at the FEBA from surprise attack
- Protect patrols from ambush
- Screen the flanks and rear of the defensive positions.

MCWP 3-35.3 A – 3 Weapons Handling and Firing Techniques

2. Weapons Carries. During MOUT, a Marine often finds himself very unexpectedly engaging targets at close ranges. Weapons carries provide a safe and effective method for handling the service rifle. For additional in-depth discussion of weapons handling and firing techniques, refer

to MCWP 3-01X, Field Firing of the M16A2 Rifle.

- a. **Tactical Carry.** The tactical carry is used when no immediate threat is present. It permits control of the rifle while moving and still allows quick engagement of the enemy. The buttstock of the rifle is placed alongside the body at approximately hip level, and the barrel is angled upward approximately 45 degrees in the general direction of the enemy.

Insert Figure A-4. Tactical Carry here

- b. **Alert Carry.** The alert carry is used when enemy contact is likely. Engagement of the enemy is faster from the alert carry than from the tactical carry. The buttstock of the rifle is placed in the shoulder with the muzzle angled down approximately 45 degrees and pointed in the likely direction of the enemy (Figure A-5).

In the alert carry, the Marine keep both eyes open and scans for any threat with the weapon always in line with the Marines LOS (this is called "guns 'n' eyeballs"). When a threat is spotted, the Marine quickly snaps his weapon into firing position, looks over the rear sight aperture, and aligns the tip of the front sight post center mass on the target. Once the threat has been eliminated, the Marine returns to the alert carry and continues to scan for targets. Accuracy is the primary goal.

Insert Figure A-5. Alert Carry here

- c. **Ready Carry.** The ready carry is employed when contact with the enemy is imminent. It allows for immediate target engagement. The buttstock of the rifle is in the shoulder with the muzzle of the rifle pointed in the direction of the enemy (Figure A-6). As I the alert carry, sight alignment and sight picture are achieved as the shot is fired. Marines should always strive for a clear tip of the front sight post and center mass hold.

Insert Figure A-6. Ready Carry here

- d. **Short Stocking.** Rifles may be 'short stocked' to increase their maneuverability in an enclosed area and to reduce possible "target indicators" for the enemy (muzzles sticking around corners, for example). The weapon is held in such a manner as to reduce the length of the weapon without sacrificing too much accuracy (Figure A-7). The stock is positioned so that the pistol grip is behind the Marine's head. The Marine may use his index finger or thumb to manipulate the trigger. The handguard of the weapon is placed against the Marine's cheek and a firm stockweld is attained. The Marine should use the tip of the front sight post. Short stocking may be conducted from either side. However, care should be taken not to mask the ejection port cover. The short stocking technique may be used in the tactical, alert, or ready carry.

Insert Figure A-7. Short Stocking here

- e. **Weak-Hand Carries.** Marines may carry their weapon on the weak-hand side to obtain maximum cover and fire from the weak-hand position to avoid exposing themselves. However, firing from the weak-hand position may reduce a Marine's ability to fire accurately. This may be acceptable when Marines are providing supporting fires, but in close kill-or-be-killed engagements, rapid, accurate firing from the strong-hand position is preferred.

3. **Firing Techniques.** The speed and uncertainty of combat require Marines to act without hesitation while achieving accurate target engagement. Several firing techniques are listed below. For an in depth discussion of firing techniques that can be applied to MOUT

operations, see MCWP 3-01 X.

- a. **Pieing.** Pieing is an effective technique for clearing dead space inside rooms and buildings to gain security of hallways, stairwells, mouseholes, and so on. It is conducted by using the ready carry position or short stocking technique. The weapon is aimed at a sector of a window, doorway, corner, or hallway and slowly moved at different angles, sectoring off the window, doorway, corner, or hallway, until each sector is cleared of any threat. As soon as a hostile threat is seen, immediate, accurate fire can be placed on the threat. Figures A-11, A-34, A-35, A-38, and A-49 show examples of the pieing technique.
- b. **Aimed Quick Fire.** The Marine's initial focus is on the target. As the rifle is brought up, the firing eye looks through or just over the rear sight aperture, and the front sight post is used to aim at the target. The Marine fires two quick shots. Focus remains on the front sight post throughout the aiming process. Immediately after target engagement, the Marine scans for additional targets. To scan, perform the following steps:

- (1) Lower the weapon to look over the sight
- (2) Place the trigger finger straight along the receiver
- (3) Scan the area for targets and assess the situation. Wherever the head moves, the muzzle moves (eyes, muzzle, target). Keep both eyes open to increase the field of view.

c. **Pointing Quick Fire.** The pointing system is based on the phenomenon that when a person looks at an object and simultaneously points a finger at it, the finger aligns itself on the point of focus of the eyes with no conscious effort on the part of the individual. When a Marine looks at an object and simultaneously brings his rifle to his shoulder, the rifle in effect becomes an extension of the pointed finger. Consequently, it aligns itself naturally with the object on which the shooter is focusing.

When a target appears, the Marine will keep both eyes open, concentrating intensely on a small, specific focal point near the base of the target mass. The rifle is brought simultaneously to the hollow of the shoulder. The head is held high, stock welded to the jaw. The eyes are 2–3 inches over the top of the sights, staring intently at the target. As soon as the rifle is brought to the shoulder, two quick shots are fired. Focus on the target is not broken during the interval between initially seeing the target and discharging the rifle.

d. **Instinctive Shooting.** There may be situations in which a Marine is surprised and may need to react immediately. If possible, the Marine should engage the threat by using the tip of the front sight post. However, *speed* may be more important. The Marine's weapon and body are quickly "pointed", and the target is engaged. It is important that the body be turned with the weapon in order to achieve a natural point of aim. Simply pointing the weapon will usually result in a miss. Once the first two shots have been fired and the Marine regains the initiative, the weapon should be quickly moved to the Marine's shoulder and the tip of the front post used for sighting subsequent shots.

FM 23-9

Suppressive Fire – Any engagement that does not have a definite or visible target. Firing in the general direction of known or suspected enemy location.

FM 23-31

Suppressive fire is direct or indirect fire aimed near enough to the enemy's position to keep him from placing accurate fire on friendly forces.

MCWP 3-35

Suppression- A tactical task to employ direct or indirect fires, electronic attack, or smoke on enemy personnel, weapons, or equipment to prevent or degrade enemy fires and observation of the friendly forces.

FM 23 – 31 CHAPTER 6, Combat Techniques of Fire (Grenadiers)**6-1. CHARACTERISTICS OF FIRE**

The characteristics of fire discussed in this section are defined as follows:

- a. Trajectory.** This is the curve described in space by the fired round as it travels to its target. The trajectory rises as the sights are elevated.
- b. Line of sight.** This is an imaginary line from the gun to the target, as seen through properly adjusted sights.
- c. Ordinate.** This is the vertical distance at any point between the trajectory and the line of sight.
- d. Maximum Ordinate.** This is the greatest vertical distance between the trajectory and the line of sight; it occurs at the highest point of the trajectory.
- e. Danger Space.** This is the area where the round impact or the shrapnel from the round impact injures personnel or destroys the target.
- f. Dead Space.** This is the area(s) where personnel or targets are safe from direct-fire weapons. Ditches, depressions, and ravines are examples of dead spaces.

6-2. CLASSES OF FIRE

Fire distribution is classified three ways.

- a. With Respect to the Ground.** For the M203 grenade launcher, this class of fire refers only to plunging fire. This is fire that strikes the target from a high angle and confines the danger space—for example, 40-mm grenades fired from the top of a hill follow an arcing trajectory and land in the valley. Figure 6-1 shows an example of plunging fire.
- b. With Respect to the Target.** This includes four ways to distribute fire.
 - (1) *Frontal.* Frontal fire is directed against a target's front, with the target facing or moving toward the firing position.
 - (2) *Flanking.* Flanking fire is directed against the target's flank.
 - (3) *Oblique.* Oblique fire is directed against a target moving or facing at an angle rather than directly toward or perpendicular to the gun.
 - (4) *Enfilade.* Enfilade fire is directed along the length of a target and may be frontal or flanking, depending on which way the target is facing.
- c. With Respect to the Weapon.** This also includes four ways to distribute fire.
 - (1) *Rapid fire point.* Distribute fire against a target with one aim point.
 - (2) *Rapid fire right or left.* Distribute fire right to left or left to right without changing range. Use this against frontal or flanking targets.
 - (3) *Rapid fire searching.* Distribute fire against a deep target, changing elevation, but not direction. Use this fire against enfilade targets.
 - (4) *Rapid fire right or left and searching.* Distribute fire against a target with depth and width, changing elevation and direction. Use this fire against an oblique target.

(1) *Linear targets.* The grenadier sights on what appears to be center of mass. He fires the grenade launcher left and right across the target on successive aiming points (Figure 6-7).

(2) *Deep Targets.* The grenadier first lays on the center of mass of the target. He fires searching fire to the near end and then up to the far end of the target along successive aiming points.

(3) *Linear targets with depth.* The grenadier lays on the target's center of mass. He then moves the grenade launcher left and right across the target, selecting successive aiming points at different ranges.

Section II. FIRE CONTROL

Fire control includes all leader and soldier actions in planning, preparing, and applying fire on a target. The leader selects and designates *targets*, indicating their width and depth or, in the case of targets that are hard to identify, designates the distance from a reference point to the target's center of mass (Figure 6-10). He also designates the midpoint, flanks, or ends of a target unless these locations are obvious to the grenadiers. The grenadiers open fire when ready, adjust and regulate the rate of fire, and shift from one target to another. They cease fire only when the target is neutralized or the leader signals to cease fire.

6-7. METHODS OF FIRE CONTROL

The noise and confusion of battle may limit the methods of fire control used, so the leader must select the method(s) that will best accomplish the mission.

a. Oral Commands. The primary method of fire control is the oral fire command. This method is effective unless noise or distance prevents the grenadier from hearing the leader.

b. Arm-and- Hand Signals. This method of fire control is effective only if the grenadiers know the standard arm-and-hand signals and can see the leader. The leader gets the grenadier's attention, then points to the target. When the grenadier returns the "Ready" signal, the leader commands FIRE.

c. Prearranged Signals. This method of fire control can include visual or sound signals such as those that can be produced by a whistle, pyrotechnics, or casualty-producing device. The SOP must define the signals to be used, and all squad members must understand them. If the leader wants to shift fire at a certain time, he gives a prearranged signal such as smoke or pyrotechnics. When they see this signal, grenadiers shift their fire to a prearranged point.

d. Personal Contact. This method of fire control is the one most frequently used by small-unit leaders. Many situations require the leader to move to individual soldiers to issue orders. If so, he must use cover and concealment to avoid disclosing their positions. Once there, he gets the grenadier's attention, points out the new target, and commands FIRE.

e. Standing Operating Procedure. This method of fire control refers to actions executed without command. The SOP defines these actions and the events that initiate them. Using an SOP simplifies the leader's job of fire control.

f. Range Cards. This method of fire control requires the leader to ensure all range cards are current and accurate. Then he should designate dead spaces, specific targets, no-fire zones, and restricted fire areas. The key to this method is the disciplined grenadier who pays attention to detail and can understand the areas the squad leader wants covered by fire.

6-8. FIRE COMMANDS

Leaders give fire commands to get effective fire on a target quickly and without confusion. When the leader decides to engage a target that is not obvious to the grenadier, he must give the grenadier enough information to effectively engage the target. After he alerts the grenadier, the leader must give a target direction, description, and range; then he must name the method of fire and give the command to fire. Leaders may give initial and subsequent fire commands: initial fire commands initiate fire on a target; subsequent commands adjust, interrupt, or change the rate of fire, or terminate the alert.

6-9 SUPPRESSIVE FIRE

Grenadiers use suppressive fire to prevent the enemy from seeing, shooting at, or tracking a target. Suppressive fire is direct or indirect fire aimed near enough to the enemy's position to keep him from placing accurate fire on friendly forces.

6-10 OVERWATCH FIRE

Grenadiers use overwatch fire to cover other soldiers' movements. While overwatching, grenadiers perform the following tasks:

- a. They support the platoon by covering dead space.
- b. They learn the platoon's route and its plans.
- c. They select likely enemy positions and observe them continuously.
- d. They determine where to find and how to reach the best grenade launcher position.

6-11 AREA and POINT FIRE

Grenadiers deliver point fire and area fire in width, in depth, or both. To distribute fire properly, they must know where to aim, how to adjust their fire, and where to move the grenade launcher.

- a. Point of Aim.** The grenadier must initially aim, fire, and adjust to a certain point on the target. He must adjust boldly, rapidly, and continuously. In most cases, the enemy leader and the communications section are in the center of the enemy's formation. Because soldiers in general tend to bunch up, the enemy troops may also be located near the center of the enemy formation. Unless a greater threat exists elsewhere, the grenadier should use the center of this concentrated target as the initial aiming point. The leader can use binoculars and help the grenadier adjust fire. For area targets, the grenadier should aim where the bursting radius will achieve its fullest effect.
- b. Direction.** The direction the leader gives depends on the type of target and on whether he wants one or two grenade launchers to engage the target. When a pair engage an area target (not a point target), they divide the target, then interlock and distribute their fire over it. After receiving the fire command, the grenadier(s) moves the grenade launcher(s) to aim in the designated direction(s) over the target.

6-12. TARGET ENGAGEMENT

The grenadier may be required to engage multiple targets using various combat techniques of fire for area and point targets.

- a. A grenadier engages a point target using point fire (also called "rapid fire point"). If the target moves after the initial round is fired, the grenadier follows the movement of the target to keep fire on it.
- b. Because an area target is designated by width and depth, the grenadier engages it by aiming and adjusting on the center of its mass, then moving left or right, searching to either flank to achieve the fullest effect of the bursting radius. When his fire reaches the target's flank, the grenadier reverses direction.
- c. The grenadier engages a designated linear target by moving right or left, searching the weapon to distribute fire evenly on the target. He must engage the entire width of a linear target; its midpoint is the point of aim. The grenadier then moves in the opposite direction to cover the rest of the target.
- d. The leader announces the range and extent (depth) of a deep target (in meters) using a reference point to designate its center of mass if the target is hard to identify. The grenadier initially aims on the target's midpoint unless another part is more critical. He engages a deep target with searching fire. He searches down to an aiming point in front of the near end and back up to an aiming point beyond the far end, always trying to gain the fullest effect of the bursting radius.
- e. The leader can fire his rifle to identify a linear target with depth. He should not use the reference point method, because showing the angle of this type of target requires at least two reference points. The grenadier engages the midpoint of this target first, unless some other part of the target presents a greater threat. He moves left or right and searches to the near flank, then back to the far flank.

6-13. LIMITED VISIBILITY

Grenadiers have difficulty detecting and identifying targets in limited visibility, which also affects the leader's ability to control fire. He may instruct the grenadiers to fire without command as soon as targets become visible. Grenadiers should only engage targets they can identify, unless ordered to do otherwise. Leaders should fire tracer ammunition to help the grenadiers locate and engage targets during limited visibility. The center and flanks of the targets may not be clearly defined; each grenadier must observe his leader's tracers and those from other squad weapons and cover what he believes to be the entire target.

6-14. OVERHEAD FIRE

Grenadiers deliver fire over the heads of friendly soldiers in combat ONLY, and then only when the fire command specifies. Terrain and visibility dictate when they can fire overhead safely.

WARNING

DO NOT FIRE OVERHEAD FIRE THROUGH TREES, BECAUSE ROUNDS MAY ARM AT 14 METERS, WHICH IS NEAR ENOUGH TO DEFLECT OFF NEARBY TREES OR STRUCTURES AND INJURE YOU.

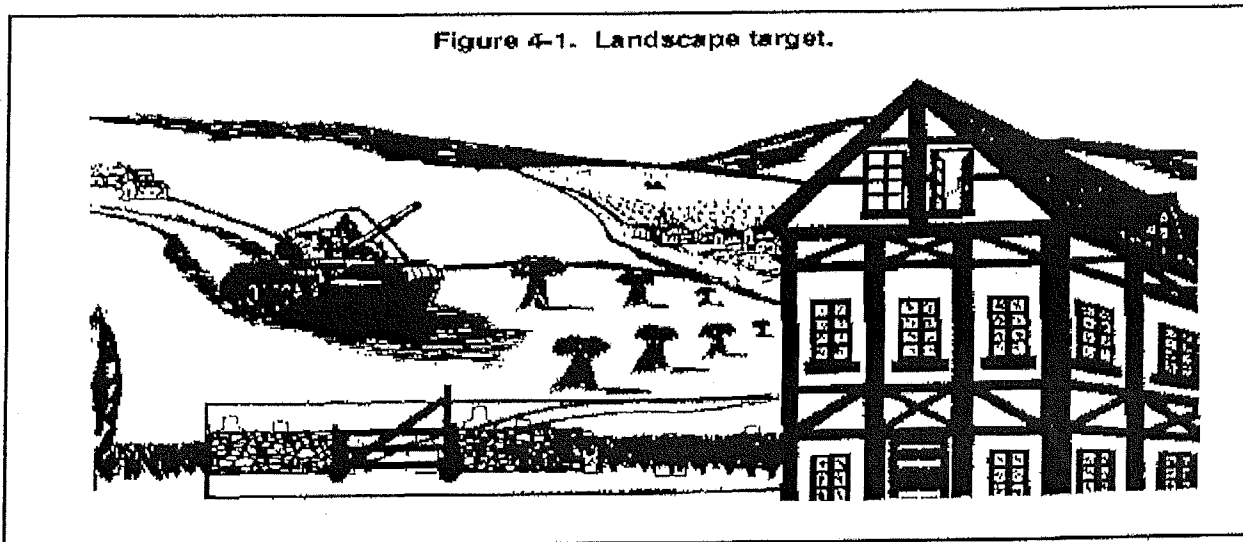
FM 23-9 - Chapter 4 Combat Fire Techniques - Rifleman**Section I. SUPPRESSIVE FIRE**

In many tactical situations, combat rifle fire will be directed to suppress enemy personnel or weapons positions. Rifle fire, which is precisely aimed at a definite point or area target, is suppressive fire. Some situations may require a soldier to place suppressive fire into a wide area such as a wood line, hedgerow, or small building.. While at other times, the target maybe a bunker or window. Suppressive fire is used to control the enemy and the area he occupies. Suppressive fire is employed to kill the enemy or to prevent him from observing the battlefield or effectively using his weapons. When a sustained volume of accurate suppressive fire is placed on enemy locations to contain him, it can be effective even though he cannot be seen. When the enemy is effectively pinned down behind cover, this reduces his ability to deliver fire and allows friendly forces to move.

NATURE OF THE TARGET

Many soldiers have difficulty delivering effective suppressive fire when they cannot see a definite target. They must fire at likely locations or in a general area where the enemy is known to exist. Even though definite targets cannot be seen, most suppressive fire should be well aimed. Figure 4-1, shows a landscape target suitable for suppressive fire training. When this type target is used, trainers must develop a firing program to include areas of engagement and designated target areas that will be credited as sustained effective suppressive fire. At 25 meters, this target provides the firer with an area to suppress without definite targets to engage.

Figure 4-1. Landscape target.

**POINT OF AIM**

Suppressive fire should be well-aimed, sustained, semiautomatic fire. Although lacking a definite target, the soldier must be taught to control and accurately deliver fire within the limits of the suppressed area. The sights are used as when engaging a point-type target -- with the front sight post placed so that each shot impacts within the desired area (window, firing portal, tree line).

RATE OF FIRE

During most phases of live fire (grouping, zeroing, qualifying), shots are delivered using the slow semiautomatic rate of fire (one round every 3 to 10 seconds). During training, this allows for a slow and precise application of the fundamentals. Successful suppressive fire requires that a faster but sustained rate of fire be used. Sometimes firing full automatic bursts (13 rounds per second) for a few seconds may be necessary to gain initial fire superiority. Rapid semiautomatic fire (one round every one or two seconds) allows the firer to sustain a large volume of accurate fire while conserving ammunition. The tactical situation dictates the most useful rate of fire, but the following must be considered:

Applying Fundamentals. As the stress of combat increases, some soldiers may fail to apply the fundamentals of marksmanship. This factor contributes to soldiers firing less accurately and without obtaining the intended results. While some modifications are appropriate, the basic fundamentals should be applied and emphasized regardless of the rate of fire or combat stress.

Making Rapid Magazine Changes. One of the keys to sustained suppressive fire is rapidly reloading the rifle. Rapid magazine changes must be correctly taught and practiced during dry-fire and live-fire exercises until the soldier becomes proficient. Small-unit training exercises must be conducted so that soldiers who are providing suppressive fire practice magazine changes that are staggered. Firing is, therefore, controlled and coordinated so that a continuous volume of accurate suppressive fire is delivered to the target area.

Conserving Ammunition. Soldiers must be taught to make each round count. Automatic fire should be used sparingly and only to gain initial fire Superiority. Depending on the tactical situation, the rate of fire should be adjusted so that a minimum number of rounds are expended. Accurate fire conserves ammunition, while preventing the enemy from placing effective fire on friendly positions.

Section II. RAPID SEMIAUTOMATIC FIRE

Rapid semiautomatic fire delivers a large volume of accurate fire into a target or target area. Increases in speed and volume should be sought only after the soldier has demonstrated expertise and accuracy during slow semiautomatic fire. The rapid application of the four fundamentals will result in a well-aimed shot every one or two seconds. This technique of fire allows a unit to place the most effective volume of fire in a target area while conserving ammunition. It is the most accurate means of delivering suppressive fire.

EFFECTIVENESS OF RAPID FIRE

When a soldier uses rapid semiautomatic fire, he is sacrificing accuracy to deliver a greater volume of fire. The difference in accuracy between slow and rapid semiautomatic fire diminishes with proper training and repeated practice. Training and practice improve the soldier's marksmanship skills to the point that accuracy differences become minimal. There is little difference in the volume of effective fire that would be delivered by units using much less accurate automatic fire.

NOTE: Learning rapid fire techniques also improves the Soldier's response time to short-exposure, multiple, and moving targets.

MODIFICATIONS FOR RAPID FIRE

Trainers must consider the impact of the increased rate of fire on the soldier's ability to properly apply the fundamentals of marksmanship and other combat firing skills. These fundamentals/skills include:

Immediate Action. To maintain an increased rate of suppressive fire, immediate action must be applied quickly. The firer must identify the problem and correct the stoppage immediately. Repeated dry-fire practice, using blanks or dummy rounds, followed by live-fire training and evaluation ensures that soldiers can rapidly apply immediate action while other soldiers initiate fire.

Marksmanship Fundamentals. The four fundamentals are used when firing in the rapid semiautomatic mode. The following differences apply:

Steady position. Good support improves accuracy and reduces recovery time between shots. somewhat tighter grip on the handguards assists in recovery time and in rapidly shifting or distributing fire to subsequent targets. When possible, the rifle should pivot at the point where the nonfiring hand meets the support. The soldier should avoid changing the position of the nonfiring hand on the support, because it is awkward and time-consuming when rapidly firing a series of shots.

Aiming. The aiming process does not change during rapid semiautomatic fire. The firer's head remains on the stock, his firing eye is aligned with the rear aperture, and his focus is on the front sight post.

Breath control Breath control must be modified because the soldier does not have time to take a complete breath between shots. He must hold his breath at some point in the firing process and take shallow breaths between shots.

Trigger squeeze. To maintain the desired rate of fire, the soldier has only a short period to squeeze the trigger (one well-aimed shot every one or two seconds).

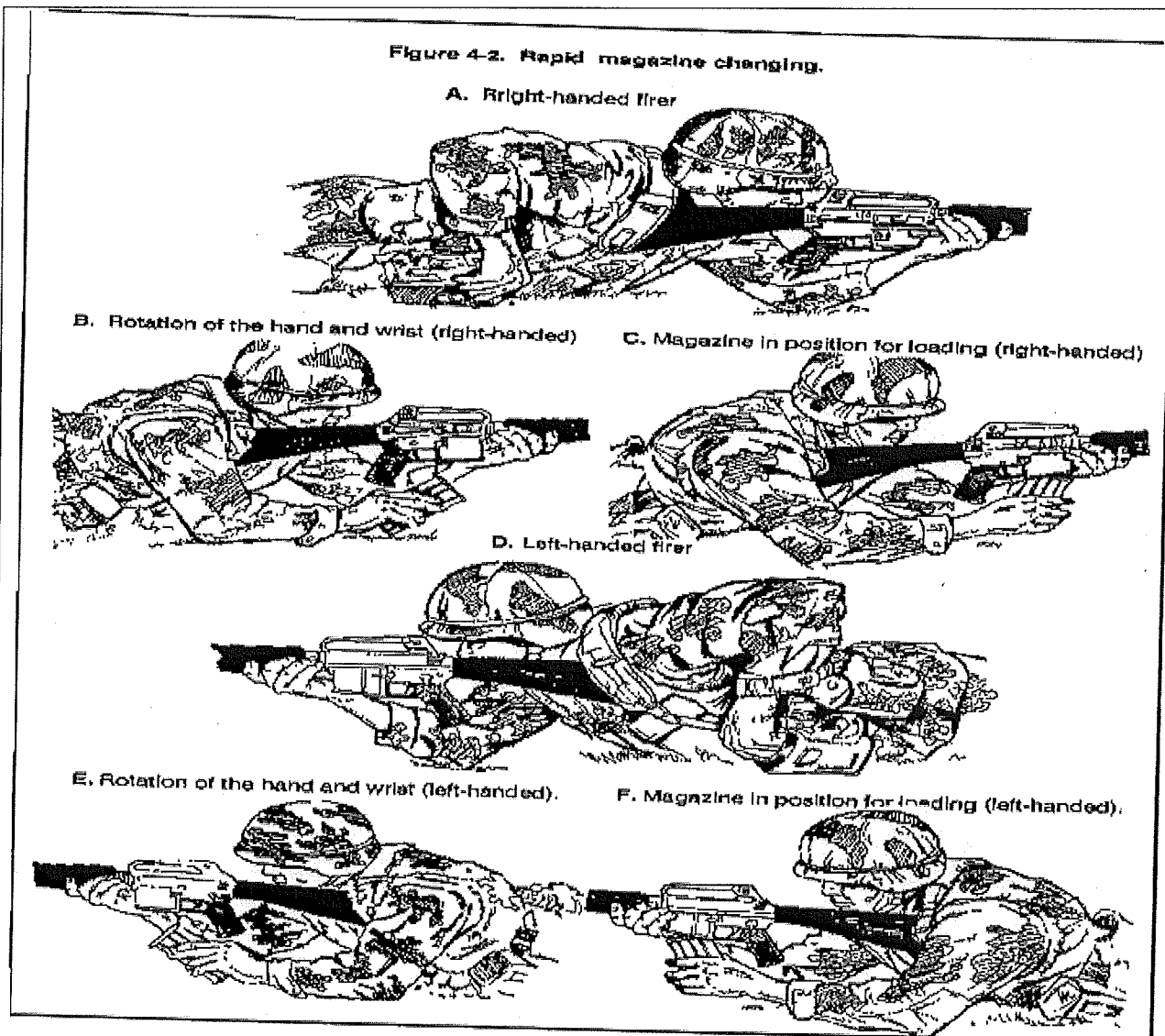
The firer must cause the rifle to fire in a period of about one-half of a second or less and still not anticipate the precise instant of firing. Rapid semiautomatic trigger squeeze is difficult to master. It is important that initial trigger pressure be applied as soon as a target is identified and while the front sight post is being brought to the desired point of aim. When the post reaches the point of aim, final pressure must be applied to cause the rifle to fire almost at once. This added pressure, or final trigger squeeze, must be applied without disturbing the lay of the rifle.

Repeated dry-fire training, using the Weaponeer device, and live-fire practice ensure the soldier can squeeze the trigger and maintain a rapid rate of fire consistently and accurately.

NOTE: When presented with multiple targets, the soldier may fire the first round, release pressure on the trigger to reset the sear, then reapply more pressure to fire the next shot. This technique eliminates the time used in releasing all the trigger pressure. It allows the firer to rapidly deliver subsequent rounds. Training and practice sessions are required for soldiers to become proficient in the technique of rapid trigger squeeze.

Magazine Changes. Rapid magazine changes are an integral part of sustaining rapid semiautomatic suppressive fire. Soldiers must quickly reload their rifles and resume accurate firing.

Magazine handling. Most units establish the soldier's basic load of ammunition and loaded magazines. The number of magazines vary based on the mission and tactical situation. During combat, some magazines are lost, but it is the soldier's responsibility to keep this loss to a minimum. While training a soldier to reload his magazines, the trainer must emphasize the need to account for these magazines.



Rifle loading. Removing a magazine from the firing side ammunition pouch is the same for both right and left-handed firers. Empty magazines must be removed from the rifle before performing the following.

To remove a magazine from the pouch, the magazine is grasped on the long edge with the thumb, and the first and second fingers are placed on the short edge.

The magazine is withdrawn from the ammunition pouch, and the arm is extended forward, rotating the hand and wrist so that the magazine is in position (open end up and long edge to the rear) to load into the rifle. It is loaded into the rifle by inserting the magazine straight up into the magazine well until it is seated. The base of the magazine is tapped with the heel of the hand to ensure the magazine is fully seated.

Removing a magazine from the nonfiring side of the ammunition pouch requires the firer to support the rifle with his firing hand. His nonfiring hand grasps the magazine and loads it into the rifle.

Rapid magazine changing. Training and repeated practice in this procedure improves soldier proficiency. The firer does not move the selector lever to SAFE during a rapid magazine change, but he must maintain a safe Posture during the change.

The following is a step-by-step sequence for rapid magazine changing.

- *Right-handed firer.* Remove the index finger from the trigger and depress the magazine catch button while keeping a secure grip on the rifle with the nonfiring hand (Figure 4-3). Release the pistol grip, grasp and remove the empty magazine with the right (firing) hand, and secure it. Grasp the loaded magazine with the right hand (rounds up and forward). Insert the loaded magazine into the magazine well and tap upward with the palm of the right hand. This ensures that the magazine is fully seated and locked into the rifle. Depress the upper half of the bolt catch with the fingers of the right hand. This allows the bolt to go forward, chambering the first round. If necessary, use the right hand to tap the forward assist to fully chamber the first round. Return the right hand to its original firing position on the pistol grip. Return the index finger to the trigger.
- *Left-handed firer.* Remove the index finger from the trigger and release the pistol grip. Depress the magazine catch button with the index finger of the left (firing) hand. Remove the empty magazine with the left hand and secure it. Grasp the loaded magazine with the left hand (rounds up, bullets forward). Insert the loaded magazine into the magazine well and tap upward with the palm of the left hand. This ensures that the magazine is fully seated and locked into the rifle. Depress the upper half of the bolt catch with a finger of the left hand. This allows the bolt to go forward, chamber the first round. If necessary, use the right hand to tap the forward assist to fully chamber the first round. Return the left hand to its original firing position on the pistol grip. Return the index finger to the trigger. The firer must maintain a safe posture during the change.

Figure 4-3. Magazine release catch button being depressed (right-handed firer).



When loading from the nonfiring side, the previous steps are followed with this exception: the loaded magazine is secured and inserted into the magazine well with the nonfiring hand. The firing hand supports the rifle at the pistol grip. After the magazine is inserted, the firer should shift the rifle's weight to his nonfiring hand and continue with the recommended sequence.

RAPID-FIRE TRAINING

Soldiers should be well trained in all aspects of slow semiautomatic firing before attempting any rapid-fire training. Those who display a lack of knowledge of the fundamental skills should not advance to rapid semiautomatic training until these skills are learned. Initial training should focus on the modifications to the fundamentals and other basic combat skills necessary during rapid semiautomatic firing.

Dry-Fire Exercises. Repeated dry-fire exercises are the most efficient means available to ensure soldiers can apply modifications to the fundamentals. Multiple dry-fire exercises are needed, emphasizing a rapid shift in

position and point of aim, followed by breath control and fast trigger squeeze. Blanks or dummy rounds may be used to train rapid magazine changes and the application of immediate action. The soldier should display knowledge and skill during these dry-fire exercises before attempting live fire.

Live-Fire Exercises. There are two types of live-fire exercises.

Individual. Emphasis is on each soldier maintaining a heavy volume of accurate fire. Weapon down time (during immediate action and rapid magazine changes) is kept to a minimum. Firing should begin at shorter ranges, progressing to longer ranges as soldiers display increased proficiency. Exposure or engagement times are shortened and the number of rounds increased to simulate the need for a heavy volume of fire. Downrange feedback is necessary to determine accuracy of fire.

Unit. Rapid semiautomatic fire should be the primary means of delivering fire during a unit LFX. It is the most accurate technique of placing a large volume of fire on poorly defined targets or target areas. Emphasis should be on staggered rapid magazine changes, maintaining a continuous volume of fire and conserving ammunition.

Section III. AUTOMATIC FIRE

Automatic fire delivers the maximum amount of rounds into a target area. It should be trained only after the soldier has demonstrated expertise during slow and rapid semiautomatic fire. Automatic fire involves the rapid application of the four fundamentals while delivering from 3 to 13 rounds per second into a designated area. This technique of fire allows a unit to place the most fire in a target area (when conserving ammunition is not a consideration). It is a specialized technique of delivering suppressive fire and may not apply to most combat engagements. The M16A1 rifle has a full automatic setting; (The M16A2 uses a three-round burst capability.) Soldiers must be taught the advantages and disadvantages of automatic firing so they know when it should be used. Without this knowledge, in a life-threatening situation the soldier will tend to switch to the automatic/burst mode. This fire can be effective in some situations. It is vital for the unit to train and practice the appropriate use of automatic fire.

EFFECTIVENESS OF AUTOMATIC FIRE

Automatic fire is inherently less accurate than semiautomatic fire. The first automatic shot fired may be on target, but recoil and high-cyclic rate of fire often combine to place subsequent rounds far from the desired point of impact. Even controlled (three-round burst) automatic fire may place only one round on the target. Because of these inaccuracies, it is difficult to evaluate the effectiveness of automatic fire, and even more difficult to establish absolute guidelines for its use.

Closely spaced multiple targets, appearing at the same time at 50 meters to closer, may be engaged effectively with automatic/burst fire. More widely spaced targets appearing at greater distances should be engaged with semiautomatic fire.

The M16A1 and M16A2 rifles should normally be employed in the semiautomatic mode. Depending on the tactical situation, the following conditions would be factors against the use of automatic fire:

- Ammunition is in short supply or resupply may be difficult.
- Single targets are being engaged.
- Widely spaced multiple targets are being engaged.
- The distance to the target is beyond 50 meters.
- The effect of bullets on the target cannot be observed. . Artificial support is not available.
- Targets may be effectively engaged using semiautomatic fire.

In some combat situations, the use of automatic fire can improve survivability and enhance mission accomplishment. Clearing buildings, final assaults, FPF, and ambushes may require the limited use of automatic fire. Depending on the tactical situation, the following conditions may favor the use of automatic fire:

- Enough available ammunition. Problems are not anticipated with resupply.
- Closely spaced multiple targets appear at 50 meters or less.
- Maximum fire is immediately
- Leaders can maintain adequate control over rifles firing on automatic.
- Good artificial support is available
- The initial sound of gunfire disperses closely spaced targets.

Trainers must ensure soldiers understand the capabilities and limitations of automatic fire. They must know when it should and should not be used.

MODIFICATIONS FOR AUTOMATIC FIRE POSITIONS

Trainers must consider the impact of the greatly increased rate of fire on the soldier's ability to properly apply the fundamentals of marksmanship and other combat firing skills. These fundamentals/skills include:

Immediate Action. To maintain automatic fire, immediate action must be applied quickly. The firer must identify the problem and correct it immediately. Repeated dry-fire practice, using blanks or dummy rounds, followed by live-fire training and evaluation ensures that soldiers can rapidly apply immediate action.

Marksmanship Fundamentals. The four fundamentals are used when firing in the automatic mode. The following differences apply:

Steady position. Maximum use of available artificial support is necessary during automatic fire. The rifle should be gripped more firmly and pulled into the shoulder more securely than when firing in the semiautomatic mode. This support and increased grip help to offset the progressive displacement of weapon/target alignment caused by recoil. To provide maximum stability, prone and supported positions are best. One possible modification involves forming a S-inch loop with the sling at the upper sling swivel, grasping this loop with the nonfiring hand, and pulling down and to the rear while firing. Another modification involves grasping the small of the stock with the nonfiring hand, and applying pressure down and to the rear while firing. If a bipod is not available, sandbags may be used to support the rifle. The nonfiring hand may be positioned on the rifle wherever it provides the most stability and flexibility. The goal is to maintain weapon stability and minimize recoil.

Aiming. The aiming process does not change during automatic fire. The firer's head remains on the stock, his firing eye stays aligned with the rear sight aperture, and his focus is on the front sight post. Although recoil may disrupt this process, the firer must try to apply the aiming techniques throughout recoil.

Breath control. Breath control must be modified because the firer will not have the time to breathe between shots. He must hold his breath for each burst and adapt his breathing cycle, taking breaths between bursts.

Trigger squeeze. Training and repeated dry-fire practice will aid the soldier in applying proper trigger squeeze during automatic firing. Live-fire exercises will enable him to improve this skill.

NOTE: The trigger is not slapped or jerked. It is squeezed and pressure is quickly released.

- M16A1. Trigger squeeze is applied in the normal manner up to the instant the rifle fires. Because three-round bursts are the most effective rate of fire, pressure on the trigger should be released as soon as possible. The index finger should remain on the trigger, but a quick release of pressure is necessary to prevent an excessive amount of rounds from being fired in one burst. With much dry-fire practice, the soldier can become proficient at delivering three-round bursts with the squeeze/release
- M16A2. Trigger squeeze is applied in the normal manner up to the instant the rifle fires. Using the burst-mode, the firer holds the trigger to the rear until three rounds are fired. He then releases pressure on the trigger until it resets, then reapplies pressure for the next three-round burst.

NOTE: Depending on the position of the burst cam when the selector is moved to the burst mode, the rifle may fire one, two, or three rounds when the trigger is held to the rear the first time. If the rifle fires only one or two

rounds, the firer must quickly release pressure on the trigger and squeeze again, holding it to the rear until a three-round burst is completed.

Magazine Changes. Rapid magazine changes are vital in maintaining automatic fire. (See SECTION II. RAPID SEMIAUTOMATIC FIRE, Magazine Handling, for detailed information on rapid magazine changes.)

TRAINING OF AUTOMATIC FIRE TECHNIQUES

Soldiers should be well trained in all aspects of slow semiautomatic firing before attempting any automatic training. Those who display a lack of knowledge of the fundamental skills should not advance to automatic fire training until these skills are learned. Initial training should focus on the modifications to the fundamentals and other basic combat skills necessary during automatic firing.

Dry-Fire Exercises. Repeated dry-fire exercises are the most efficient means available to ensure soldiers can apply these modifications. Multiple dry-fire exercises are needed, emphasizing a stable position and point of aim, followed by breath control and the appropriate trigger squeeze. Blanks or dummy rounds may be used to train trigger squeeze, rapid magazine changes, and application of immediate action. The soldier should display knowledge and skill during these exercises before attempting live fire.

Live-Fire Exercises. There are two types of live-fire exercises.

Individual. Emphasis is on each individual maintaining a heavy volume of fire. Weapon down time (during immediate action and rapid magazine changes) is held to a minimum. Firing can begin at 25 meters, progressing to 50 meters as soldiers display increased proficiency. Exposure or engagement times, as well as ranges, are varied to best simulate the need for a heavy volume of fire. Downrange feedback is necessary to determine effectiveness of fire. The course of fire should allow the soldier to decide whether he should engage a given target or area with automatic or semiautomatic fire.

A soldier's zero during automatic fire may be different than his semiautomatic (battlesight) zero. This is due to the tendency of the lightweight M16 barrel to respond to external pressure such as the bipod or pulling on the sling. However, it is recommended that the battlesight zero be retained on the rifle and holdoff used to place automatic fire on the target. This holdoff training requires downrange feedback and should be conducted before other live-fire exercises.

The soldier can begin by loading and firing one round from an automatic fire position. Three of these rounds, treated as a single group, can establish where the first shot of a three-round burst will probably strike. Loading and firing two rounds simulates the dispersion of the second shot of a three-round burst. Finally, several three-round bursts should be fired to refine any necessary holdoff to center these larger groups on the desired point of impact.

Unit. Unit LFXs should include the careful use of automatic fire. Emphasis should be on staggered rapid magazine changes, maintaining a continuous volume of heavy fire, and conserving ammunition.

Section IV. QUICK FIRE

The two main techniques of directing fire with a rifle are to aim using the sights; and to use weapon alignment, instinct, bullet strike, or tracers to direct the fire. The preferred technique is to use the sights, but sometimes quick reflex action is needed to survive. Quick fire is a technique used to deliver fast, effective fire on surprise personnel targets at close ranges (25 meters or less). Quick-fire procedures have also been referred to as "instinct firing" or "quick kill."

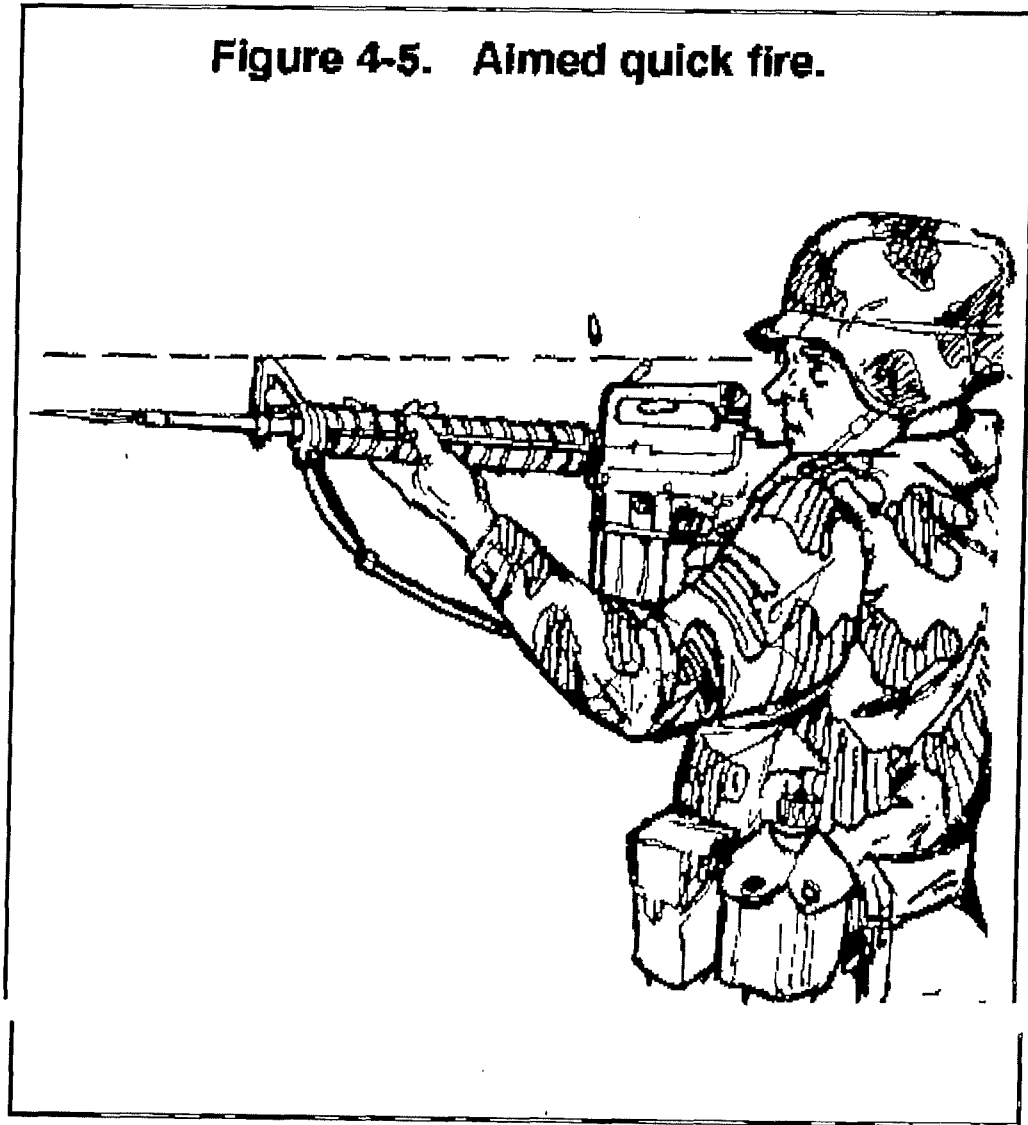
EFFECTIVENESS OF QUICK FIRE

Quick-fire techniques are appropriate for soldiers who are presented with close, suddenly appearing, surprise enemy targets; or when close engagement is imminent. Fire may be delivered in the SEMIAUTO or BURST/AUTO mode. For example, a point man in a patrol may carry the weapon on BURST/AUTO. This may

also be required when clearing a room or bunker. Initial training should be in the SEMI mode. Two techniques of delivering quick fire are--

Aimed. When presented with a target, the soldier brings the rifle up to his shoulder and quickly fires a single shot. His firing eye looks through or just over the rear sight aperture, and he uses the front sight post to aim at the target (Figure 4-5). Using this technique, a target at 25 meters or less maybe accurately engaged in one second or less.

Figure 4-5. Aimed quick fire.



Pointed. When presented with a target, the soldier keeps the rifle at his side and quickly fires a single shot or burst. He keeps both eyes open and uses his instinct and peripheral vision to line up the rifle with the target (Figure 4-6). Using this technique, a target at 15 meters or less may be engaged in less than one second.

Figure 4-6. Pointed quick fire.



The difference in speed of delivery between these two techniques is small.. Pointed quick fire can be used to fire a shot about one-tenth of a second faster than aimed quick fire. The difference in accuracy, however, is more pronounced. A soldier well trained in pointed quick fire can hit an E-type silhouette target at 15 meters, although the shot may strike anywhere on the target. A soldier well trained in aimed quick fire can hit an E-type silhouette target at 25 meters, with the shot or burst striking 5 inches from the center of mass.

The key to the successful employment of either technique is practice. Both pointed and aimed quick fire must be repeatedly practiced during dry-fire training. Live-fire exercises provide further skill enhancement and illustrate the difference in accuracy between the two techniques. Tactical considerations dictate which technique is most effective in a given situation, and when single shot versus burst fire is used.

Pointed and aimed quick fire should be used only when a target cannot be engaged fast enough using the sights in a normal manner. These techniques should be limited to targets appearing at 25 meters or less.

MODIFICATIONS FOR QUICK—FIRE TECHNIQUES

Quick-fire techniques require major modifications to the four fundamentals of marksmanship. These modifications represent a significant departure from the normal applications of the four fundamentals. Initial training in these differences, followed by repeated dry-fire exercises, will be necessary to prepare the soldier for live fire.

Steady Position. The quickness of shot delivery prevents the soldier from assuming a stable firing position.

He must fire from his present position when the target appears. If the soldier is moving, he must stop. Adjustments for stability and support cannot be made before the round being fired.

Aimed. The butt of the rifle is pulled into the pocket of the shoulder as the cheek comes in contact with the stock. Both hands firmly grip the rifle, applying rearward pressure. The firing eye looks through or just over the rear sight aperture (Figure 4-5). The firer's sight is in focus and placed on the target.

Pointed. The rifle is pulled into the soldier's side and both hands firmly grip the rifle, applying rearward pressure (Figure 4.6).

Aiming. This fundamental must be highly modified because the soldier may not have time to look through the rear sight, find the front sight, and align it with the target.

Aimed. The soldier's initial focus is on the target. As the rifle is brought up, the firing eye looks through or just over the rear sight aperture at the target. Using his peripheral vision, the soldier locates the front sight post and brings it to the center of the target. When the front sight post is in focus, the shot is fired. Focus remains on the front sight post throughout the aiming process.

Pointed The soldier's focus is placed on the center or slightly below the center of the target as the rifle is aligned with it and is fired. The soldier's instinctive pointing ability and peripheral vision are used to aid in proper alignment.

NOTE: When using either aiming technique, bullets may tend to impact above the desired location. Repeated live-fire practice is necessary to determine the best aim point on the target or the best focus. Such practice should begin with the soldier using a center mass aim/focus.

Breath Control. This fundamental has little application to the first shot of quick fire. The round must be fired before a conscious decision can be made about breathing. If subsequent shots are necessary, breathing must not interfere with the necessity to fire quickly. When possible, use short, shallow breaths.

Trigger Squeeze. Initial pressure is applied as weapon alignment is moved toward the target. Trigger squeeze is exerted so that when weapon/target alignment is achieved, the round is fired at once. The soldier requires much training and practice to perfect this rapid squeezing of the trigger.

TRAINING OF QUICK- FIRE TECHNIQUES

Initial training should focus on the major modifications to the fundamentals during quick fire. Dry-Fire Exercises. This dry-fire exercise requires no elaborate preparations or range facilities, yet it provides the soldier with an opportunity to learn and practice quick-fire techniques. Repeated dry-fire exercises ensure soldiers can apply the modifications to the fundamentals. Multiple dry-fire exercises are needed, emphasizing a consistent firing position and weapon alignment with the target, followed by rapid trigger squeeze. No more than one second should elapse between the appearance of the target and a bullet striking it. One example of a dry-fire exercise is:

The trainer/coach places an E-type silhouette target 15 meters in front of the soldier. The soldier stands facing the general direction of the target (vary direction to simulate targets appearing at different locations), holding his rifle at or above waist level. His firing hand should be on the pistol grip; the nonfiring hand cradling the rifle under the handguards.

The trainer/coach should stand slightly behind the soldier, out of his field of view. The trainer/coach claps his hands, signaling target appearance. Immediately after clapping his hands, the trainer/coach counts out loud "one thousand one."

The soldier must either point or aim, squeeze the trigger, and bear the hammer fall before the trainer/coach finishes speaking (about one second or less).

NOTE: When using the aiming technique, the soldier holds his aim and confirms alignment of the rifle with the target. He keeps the rifle pointed toward the target after the hammer falls and looks through the sights to check his actual point of aim for that shot.

Live-Fire Exercises. There are two types of live-fire exercises.

Individual. Emphasis is on engaging each target in one second or less. The previously described timing technique may be used, or pop-up targets set to lock in the full upright position may be used. Pop-up targets require about one second to move from the down to the full up position. Targets set to lock in the upright position must be engaged as they are being raised to "kill" them. This gives the soldier a one-second time limit. At 15 meters (the maximum recommended range), an E-type silhouette engaged using pointed quick fire may be hit anywhere. Using aimed quick fire at the same target, hits should fall within a 1a-inch circle located center of target.

NOTE: Repeated live-fire exercises are necessary to train the soldier. If 5.56-mm service ammunition is in short supply, the 5.56-mm practice ammunition and M2 bolt or the .22-caliber rim fire adapter device may be used.

Unit. Unit MOUT LFXs should include the use of quick fire. Targets should be presented at 25 meters or less and soldiers must engage them within one second.

Section V. MOPP FIRING

All soldiers must effectively fire their weapons to accomplish combat missions in an NBC environment. With proper training and practice, soldiers can gain confidence in their ability to effectively hit targets in full MOPP equipment. MOPP firing proficiency must be a part of every unit's training program.

EFFECTS OF MOPP EQUIPMENT ON FIRING

Firing weapons is only part of overall NBC training. Soldiers must first be familiar with NBC equipment, its use, and proper wear before they progress to learning the techniques of MOPP firing. Trainers must consider the impact of MOPP equipment (hood/ mask, gloves, overgarments) on the soldier's ability to properly apply the fundamentals of marksmanship and combat firing skills.

Immediate Action. Under normal conditions a soldier should be able to *clear* a stoppage in three to five seconds. Under full MOPP, however, this may take as long as ten seconds to successfully complete. Dry-fire practice under these conditions is necessary to reduce time and streamline actions. Hood/mask and gloves must be worn. Care must be taken not to snag or damage the gloves or dislodge the hood/mask during movements. Applying immediate action to a variety of stoppages during dry fire must be practiced using dummy or blank ammunition until such actions can be performed by instinct.

Target Detection. Techniques and principles outlined in Chapter 3 remain valid for target detection while in MOPP, but considerations must be made for limiting factors imposed by MOPP equipment.

Vision is limited to what can be seen through the mask lenses/faceplate. Peripheral vision is severely restricted. The lenses/faceplate may be scratched or partly fogged, thus further restricting vision. Soldiers requiring corrective lenses must be issued insert lenses before training.

Scanning movement may be restricted by the hood/mask. Any of these factors could adversely affect the soldier's ability to quickly and accurately detect targets. Additional skill practice should be conducted.

Marksmanship Fundamentals. Although the four marksmanship fundamentals remain valid during MOPP firing, some modifications may be needed to accommodate the equipment.

Steady position. Due to the added bulk of the overgarments, firing positions may need adjustment for stability and comfort. Dry and live firing while standing, crouching, or squatting may be necessary to reduce body

contact with contaminated ground or foliage. A consistent spot/stock weld is difficult to maintain due to the shape of the protective masks. This requires the firer to hold his head in an awkward position to place the eye behind the sight.

Aiming. The wearing of a protective mask may force firers to rotate (cant) the rifle a certain amount to see through the rear aperture. The weapon should be rotated the least amount to properly see through and line up the sights, as previously discussed in Chapter 3. The center tip of the front sight post should be placed on the ideal aiming point. This ideal aiming procedure should be the initial procedure taught and practiced. If this cannot be achieved, a canted sight picture may be practiced.

Breath control Breathing is restricted and more difficult while wearing the protective mask. Physical exertion can produce labored breathing and make settling down into a normal breath control routine much more difficult. More physical effort is needed to move around when encumbered by MOPP equipment, which can increase the breath rate. All of these factors make holding and controlling the breath to produce a well-aimed shot more energy- and time-consuming. Emphasis must be placed on rapid target engagement during the limited amount of time a firer can control his breath.

Trigger squeeze. Grasping the pistol grip and squeezing the trigger with the index finger are altered when the firer is wearing MOPP gloves. The action of the trigger finger is restricted, and the fit of the glove may require the release of the swing-down trigger guard. Because the trigger feels different, control differs from that used in bare-handed firing. This difference cannot be accurately predicted. Dry-fire training using dime (washer) exercises is necessary to ensure the firer knows the changes he will encounter during live fire.

Section VI. MOVING TARGET ENGAGEMENT

The enemy normally moves by rushes from one covered or concealed position to another. While making the rush, the enemy soldier presents a rapidly moving target. However, for a brief time as he begins, movement is slow since many steps are needed to gain speed. Many steps are needed to slow down at the new position. A moving target is open to aimed fire both times.

MOVING TARGET TECHNIQUES

There are two primary techniques of engaging moving targets.

Tracking. Tracking is a more accurate technique of engaging targets by experienced firers. It involves the establishment and maintaining of the aiming point in relationship to the target and maintaining that sight picture (moving with the target) while squeezing the trigger. As the target moves, this technique puts the firer in position for a second shot if the first one misses.

Trapping. Trapping is the setting up of an aiming point forward of the target and along the target path. The trigger is squeezed as the target comes into the sights. This is a technique that works on targets with slow lateral movement. It does not require tracking skills. It does require that the firer know precisely when the rifle is going to fire. Some soldiers can squeeze the trigger without reacting to the rifle firing, and they may fire better using this technique.

Another technique is to use a modified 25-meter scaled timed- fire silhouette. Trainers evaluate performance based on where shot groups are placed when the lead rule is applied. This target can be used for both the M16A1 and M16A2 rifles.

MOVING TARGET FUNDAMENTALS

The fundamentals needed to hit moving targets are similar to those needed to hit stationary targets. The main skill is to engage moving targets with the least changes to procedures. Another consideration is that soldiers in a combat defensive position do not know if their next target will be stationary or moving -they must fire

immediately at whatever targets occur.

The fundamentals for engaging stationary targets are steady position, aiming, breath control, and trigger squeeze. They are also used to engage moving targets. Considering the environment and the variables of the rifle and ammunition, the well-trained soldier should be able to hit 300-meter stationary silhouette targets with a .5 PH. When the target has lateral movement, hits at 150 meters may be seven out of ten times, which is a good performance. Therefore, twice as much variability, twice as much dispersion, and a few more erratic shots are expected when soldiers are trained to hit moving targets.

The procedures used to engage moving targets vary as the angle and speed of the target vary. For example, when a moving target is moving directly at the firer, the same procedures are used as would be used if the target were stationary. However, if it is a close, fast-moving target at a 90-degree angle, the rifle and entire upper body of the firer must be free from support so that the target can be tracked. To hit moving targets, the firer must move the rifle smoothly and steadily as the target moves. The front sight post is placed with the trailing edge at target center, breath is held, and the trigger is squeezed. Several factors complicate this process.

Steady position. When firing from a firing position, the firer is in the standard supported position and is flexible enough to track any target in his sector. When a moving target is moving directly at the firer, directly away, or at a slight angle, the target is engaged without changing the firing position. When targets have much lateral movement, only minor changes are needed to allow for effective target engagement. Most moving targets are missed in the horizontal plane (firing in front of or behind the target) and not in the vertical plane (firing too low or too high). Therefore, a smooth track is needed on the target, even if the support arm must be lifted. Other adjustments include the following:

-- *Nonfiring hand.* The grip of the nonfiring hand may need to be increased and more pressure applied to the rear. This helps to maintain positive control of the rifle and steady it for rapid trigger action.

-- *Nonfiring elbow.* The elbow is lifted from the support position only to maintain a smooth track.

-- *Grip of the tight hand.* Rearward pressure may be applied to the pistol grip to steady the rifle during trigger squeeze.

-- *Firing elbow.* The firing elbow is lifted from support only to help maintain a smooth track.

NOTE: The rifle pocket on the shoulder and the stock weld are the same for stationary targets.

Aiming. The trailing edge of the front sight post is at target center.

Breath control. Breathing is locked at the moment of trigger squeeze.

Trigger squeeze. Rearward pressure on the handguard and pistol grip is applied to hold the rifle steady while pressure is applied to the trigger. The trigger is squeezed fast (almost a controlled jerk). Heavy pressure is applied on the trigger (at least half the pressure it takes to make the rifle fire) before squeezing the trigger.

SINGLE-LEAD RULE FOR MOVING TARGETS

A target moving directly toward the firer can be engaged the same way as a stationary target. However, to hit a target moving laterally, the firer places the trailing edge of the front sight post at target center. The single-lead rule automatically increases the lead as the range to the target increases.

Target Distance. The front sight post covers only a small part of close-in targets, providing for target hits on close targets moving at any angle and any speed. However, if the lead rule is applied on more distant targets moving at a slight angle - for example, 5 degrees at 100 meters - the bullet strikes forward of target center, about 4 inches with standard sights and about 7 inches with LLLSS sights. Therefore, soldiers are taught to fire

at targets as though they are stationary until lateral movement is observed (15 degrees).

The rule provides for many speed-angle combinations that place the bullet within 2 inches of target center. Since the soldier is expected to fire a 12-inch group on moving targets at 100 meters, the rule provides for hits on the majority of targets. Even the worst case (a 90-degree target moving at 8 mph) would result in the shot-group center being located 9.8 inches behind target center. If bullets were evenly distributed within a 12-inch group, this would result in hitting the target 40 percent of the time.

FM 23-14, CHAPTER 6 - COMBAT TECHNIQUES OF FIRE – SAW Gunner

Section I. INTRODUCTION

Before the automatic rifle can be employed to its full potential, the soldier must know and be trained on characteristics of fire, classes of fire, types of targets, and application of fire.

6-1. CHARACTERISTICS OF FIRE

Each automatic rifleman must know the effects of bullets when fired. Factors influencing the path and strike of rounds are not limited to applying the fundamentals. They include the velocity of the round, gravity, terrain, atmospheric conditions, and the innate differences between each round.

a. Trajectory. The trajectory is the path of the bullet in flight (Figure 6-1). The automatic rifleman must know the M249 AR's trajectory to effectively fire the weapon throughout its full range. The path of the bullet is almost flat at ranges up to ~400 meters; then it begins to curve, and the curve becomes greater as the range increases.

b. Maximum Ordinate. This is the highest point the trajectory reaches between the muzzle of the weapon and the base of the target. It always occurs about two-thirds of the distance from the weapon to the target. The maximum ordinate increases as the range increases (Figure 6-1).

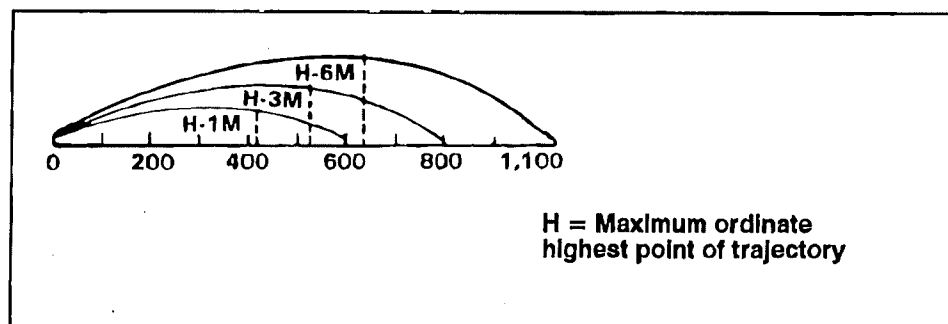


Figure 6-1. Trajectory and maximum ordinate.

c. Cone of Fire. When several rounds are fired in a burst from an M249 AR, each round takes a slightly different trajectory. The pattern these rounds form on the way to the target is called a cone of fire (Figure 6-2). This is caused primarily by vibration of the weapon and variations in ammunition and atmospheric conditions.

d. Beaten Zone. The beaten zone (Figure 6-2) is the elliptical pattern formed by the rounds striking the ground or the target. The size and shape of the beaten zone changes when the range to the target changes or when the weapon is fired on different types of terrain. On uniformly sloping or level terrain, the beaten zone is long and narrow. As the range to the target increases, the beaten zone becomes shorter and wider. When fire is delivered on terrain sloping down and away from the weapon, the beaten zone becomes longer. When fire is delivered on rising terrain, the beaten zone becomes shorter. The terrain has little effect on the width of the beaten zone.

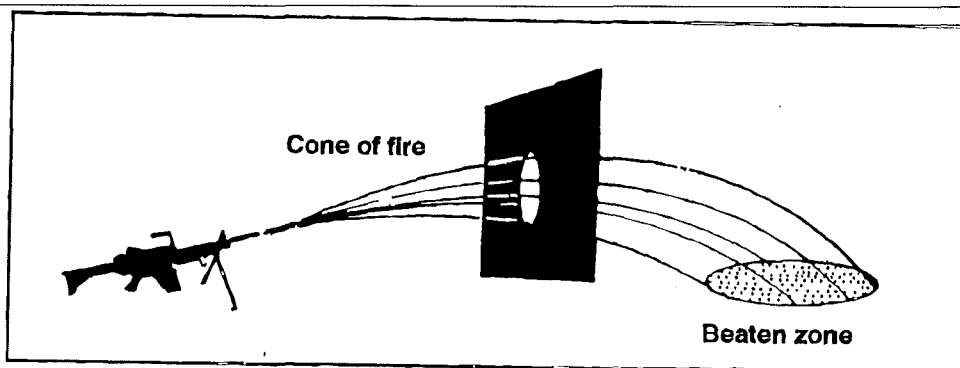


Figure 6-2. Cone of fire and beaten zone.

e. Danger Space. This is the space between the weapon and the target where the trajectory does not rise above 1.8 meters (the average height of a standing soldier). This includes the area of the beaten zone. When the M249 is fired on level or uniformly sloping terrain at a target less than 700 meters away, the trajectory will not rise above the average height of a standing soldier. When targets are engaged on level or uniformly sloping terrain at ranges greater than 700 meters, the trajectory will rise above the average height of a standing soldier. Therefore, not all the distance between the weapon and the target is danger Space.

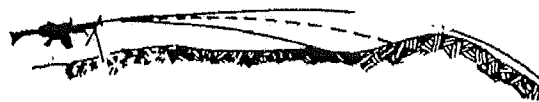
6-2. CLASSES OF FIRE

Automatic rifle fire is classified with respect to the ground, the target, and the weapon.

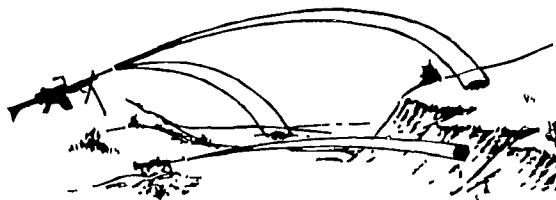
a. Fire with respect to the ground (Figure 6-3) includes grazing and plunging fires.

(1) *Grazing fire.* This occurs when the center of the cone of fire does not rise more than 1 meter above the ground. When firing on level or uniformly sloping terrain, the automatic rifleman can obtain a maximum of 600 meters of grazing fire.

(2) *Plunging fire.* This occurs when the danger space is confined to the beaten zone. Plunging fire occurs when firing at long ranges, from high ground to low ground, into abruptly rising ground, or across uneven terrain, resulting in a loss of grazing fire at any point along the trajectory.



Grazing fire



Plunging fire

Figure 6-3. Classes of fire with respect to the ground.

b. Fire with respect to the target includes frontal, flanking, oblique, and enfilade fires.

(1) *Frontal fire.* This is when the long axis of the beaten zone is at a right angle to the front of the target. An example is when firing at the front of a target.

(2) *Flanking Fire.* This is firing at the side of a target.

(3) *Oblique fire.* This is when the long axis of the beaten zone is at an angle other than a right angle to

the front of the target.

(4) *Enfilade fire*. This is when the long axis of the beaten zone coincides or nearly coincides with the long axis of the target. This type of fire is either frontal or flanking. It is the most desirable type of fire with respect to a target, because it makes maximum use of the beaten zone.

c. Fire with respect to the weapon (Figure 6-6) includes fixed, traversing, searching, and traversing and searching fires

(1) *Fixed fire*. This is fire delivered against a point target when the depth and width of the beaten zone will cover the target. This means only one aiming point is necessary to provide coverage of the target.

(2) *Traversing fire*. This is fire distributed in width by successive changes in direction. The automatic rifleman selects successive aiming points throughout the width of the target. These aiming points must close enough to ensure adequate coverage but not so close to waste ammunition.

(3) *Searching fire*. This is fire distributed in depth by successive changes in elevation. The automatic rifleman selects successive aiming points, depth. The changes in each aiming point depends on the range and slope of the ground.

(4) *Traversing and searching fire*. This is fire distributed in width and depth by successive changes in direction and elevation. Combining traversing and searching fires provides good coverage of the target. Adjustments are made in the same manner as described for traversing and searching fire.

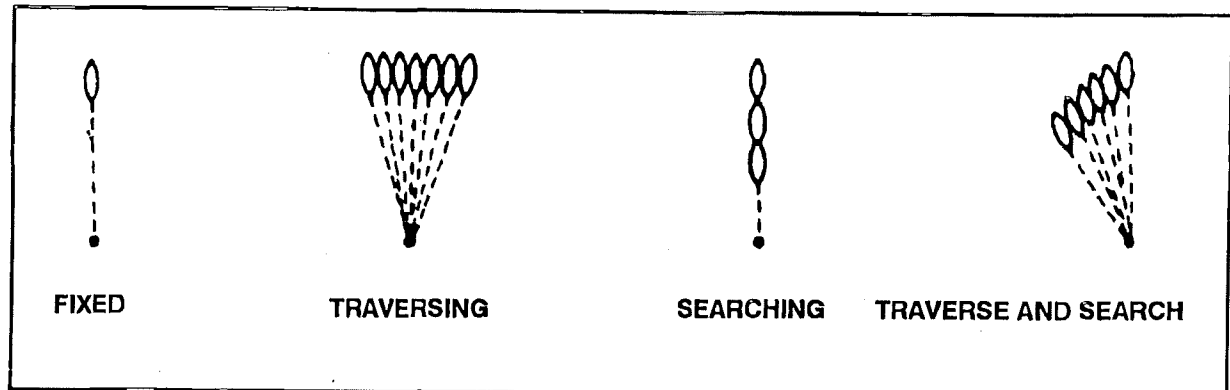


Figure 6-6. Classes of fire with respect to the weapon.

Section II. APPLICATION OF FIRE

Application of fire consists of the methods the automatic rifleman uses to cover a target area. Training these methods of applying fire can be accomplished only after the soldiers have learned how to recognize the different types of targets they may find in combat, how to distribute and concentrate their fire, and how to maintain the proper rate of fire. Normally, the automatic rifleman will be exposed to two types of targets in the squad sector: enemy soldiers and supporting automatic weapons. These targets have priority and should be engaged immediately.

6-3. TYPES OF TARGETS

Targets presented to the automatic rifleman in combat will usually be enemy troops in various formations, which will require distribution and concentration of fire. Targets with width and depth must be thoroughly covered by fire.

a. **Point Targets.** These require the use of a single aiming point. Examples of point targets are enemy soldiers, bunkers, weapons emplacements, and lightly armored vehicles. Fixed fire is delivered at point targets.

b. **Area Targets.** These may have considerable width and depth and may require extensive traversing and searching fire. These include targets in which the exact location of the enemy is unknown. The following are varieties of area targets likely to be engaged.

(1) Linear targets have sufficient width to require successive aiming points (traversing fire). The beaten zone effectively covers the depth of the target area. Traversing fire is delivered at linear targets.

(2) Deep targets require successive aiming points (searching fire). Searching fire is delivered at deep targets.

(3) Linear targets with depth have sufficient width requiring successive aiming points in which the beaten zone does not cover the depth of the target area. A combined change in direction and elevation (traversing and searching) is necessary to effectively cover the target with fire. Traversing and searching fire is delivered at linear targets with depth.

6-4. DISTRIBUTION, CONCENTRATION, AND RATE OF FIRE

The size and nature of the target determine how the automatic rifleman applies his fire. He must manipulate the M249 AR to move the beaten zone throughout the target area. The rate of fire must be controlled to adequately cover the target but not waste ammunition or destroy the barrel.

a. Distributed fire is delivered in width and depth such as at an enemy formation.

b. Concentrated fire is delivered at a point target such as an automatic weapon or an enemy fighting position.

c. The rates of fire that can be used with the M249 AR are sustained, rapid, and cyclic. These rates enable leaders to control and sustain fire and prevent the destruction of barrels. More than anything else, the size of the target and ammunition supply dictate the selection of the rate of fire.

(1) Sustained fire for the M249 automatic rifleman is 85 rounds per minute in bursts of 3 rounds. This allows the automatic rifle to be fired indefinitely without damage to the barrel from overheating. This is the normal rate of fire for the automatic rifleman.

(2) Rapid fire for the M249 automatic rifleman is 200 rounds per minute in bursts of 3 rounds. This provides for an exceptionally high volume of fire-but for only a short period.

(3) Cyclic fire uses the most ammunition that can be used in one minute. The cyclic rate of fire with the M249 AR is achieved when the trigger is held to the rear and ammunition is fed into the weapon uninterrupted for one minute. Normal cyclic rate of fire is 850 rounds.

6-5. TARGET ENGAGEMENT

The automatic rifleman engages targets throughout his sector on his own under the direct control of a leader. He must know how to effectively engage all types of targets either by himself or in conjunction with another automatic rifleman.

a. Single Automatic Rifleman.

(1) *Point target.* When engaging a point target, the automatic rifleman uses fixed fire (Figure 6-10). If the target moves after the initial burst, the automatic rifleman adjusts fire onto the target by following its movement.

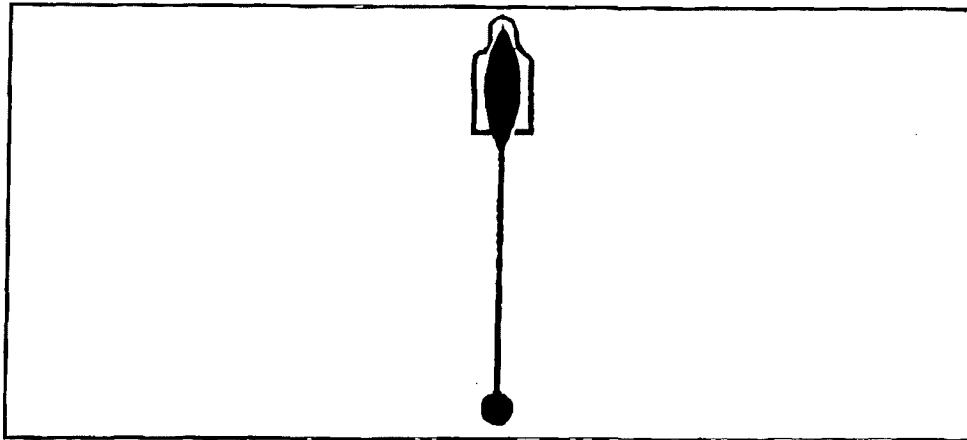


Figure 6-10. Engagement of point target.

(2) *Area target.* When engaging an area target, an automatic rifleman fires in the center of mass, then traverses and searches to either flank (Figure 6-11). Upon reaching the flank, he reverses direction and traverses and searches in the opposite direction. A leader may indicate the width and depth of the target.

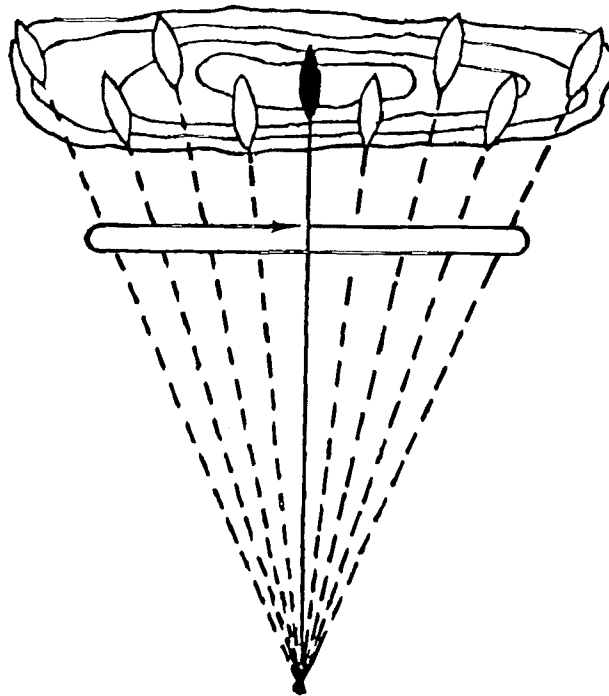


Figure 6-11. Engagement of area target.

(3) *Linear target.* When engaging a linear target, the automatic rifleman traverses the weapon to distribute fire evenly onto the target. He must cover the entire width of a linear target. The initial point of aim is on the midpoint. The automatic rifleman then manipulates to cover the rest of the target. If a linear target is hard to identify, a leader may designate the target by using a reference point (Figure 6-12, page 6-10). When this method is used, the leader determines the center of mass of the target and announces the number of meters from the reference point that will cause the automatic rifleman to aim on the center of mass. The reference point maybe within or adjacent to the target (Figure 6-13, page 6-10); however, it should be on line with the target for best effect. After the command to fire has been given, the leader maintains and controls the fire by subsequent fire commands.



Figure 6-12. Engagement of hard-to-identify targets with a reference point within the target area.



Figure 6-13. Engagement of hard-to-identify targets with a reference point within the target area.

(4) *Deep target.* When engaging a deep target, the automatic rifleman must use searching fire. If the range is announced, he initially aims on the midpoint of a deep target unless another portion of the target is more critical or presents a greater threat. The automatic rifleman then searches down to one aiming point in front of the near end and back up to one aiming point beyond the far end. If a deep target is hard to identify, its center of mass may be designated by using reference points. The extent (depth) of the target is always given in meters.

(5) *Linear target with depth.* When engaging a linear target with depth, the automatic rifleman uses traversing and searching fire. He begins engagement at the midpoint of the target unless another portion of the target is more critical or presents a greater threat. He traverses and searches to the near flank, then back to the far flank. When engaging hard-to-identify linear targets with depth, he designates the flanks and midpoint with rifle fire. The reference-point method is not used because at least two reference points are required to show the angle of the target.

b. Pair of Automatic Riflemen.

(1) *Area Targets.* When using pairs of M249s to engage area targets, the automatic rifleman on the right fires on the right half, and the automatic rifleman on the left fires on the left half. The point of initial aim and adjustment for both automatic riflemen is on the midpoint. After adjusting fire on the center of mass, both automatic riflemen distribute fire by applying direction and elevation changes that give the most effective coverage of the target area. The right automatic rifleman traverses to the right, applies the necessary amount of search, and fires a burst. He traverses and searches up and down until the right flank of the area target has been reached. The left automatic rifleman traverses and searches to the left flank in the same way. Both automatic riflemen then reverse the direction of manipulation and return to the center of mass, firing a burst after each combined direction and elevation change (Figure 6-14).

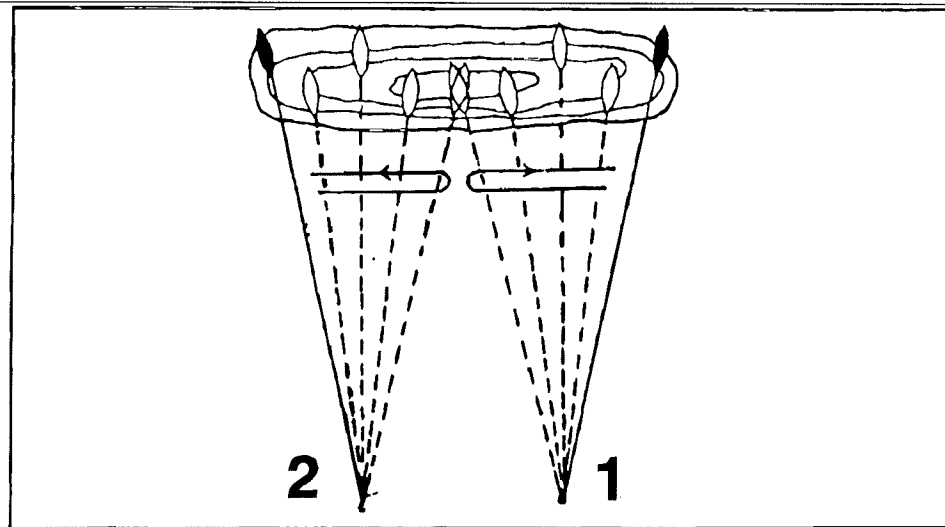


Figure 6.14. Engagement of area targets with a pair of automatic riflemen.

(2) *Linear Target.* When using a pair of M249s to engage a linear target, the target is divided at midpoint with the automatic rifleman on the right of the target firing on the right half, and the automatic rifleman on the left of the target firing on the left half (Figure 6-15).

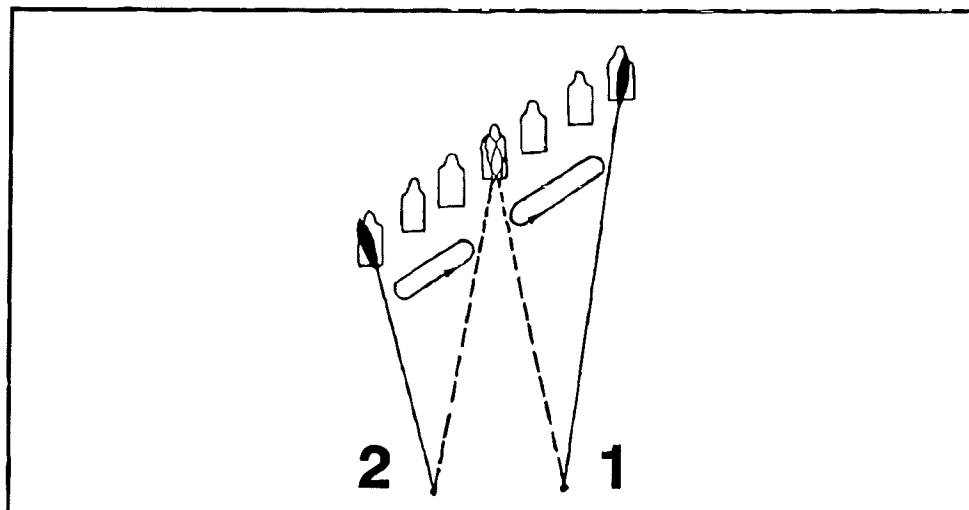


Figure 6-15. Engagement of linear targets with a pair of automatic riflemen.

(a) Both automatic riflemen aim on the midpoint initially. After adjusting on the midpoint, the automatic rifleman on the right traverses right, firing a burst after each change in direction until the rounds reach one aiming point beyond the right flank (this ensures complete target coverage). The automatic rifleman on the left traverses to the left flank in the same way. Both automatic riflemen then reverse their directions and return to the midpoint. The automatic rifleman must select aiming points for each burst rather than "spray" the target area.

(b) If one part of the target is a greater threat, fire can be concentrated on the greater threat by dividing the target unevenly. This special division of the target is done with fire commands. To preclude confusion, the automatic riflemen initially aim on the midpoint regardless of the special division to be made.

(3) *Deep Targets.* When using a pair of M249s to engage a deep target, the initial point of aim is also on the midpoint for both automatic riflemen. Normally, the automatic rifleman on the right has the near half and the automatic rifleman on the left has the far half. Since enfilade fire is being used, they do not adjust

on the midpoint of the target, because the long beaten zone compensates for any range errors. After the initial burst, the automatic rifleman on the right searches down to one aiming point in front of the near end of the target, and the automatic rifleman on the left searches up to one aiming point beyond the far end. Both automatic riflemen then reverse their direction of search and return to the midpoint (Figure 6-16).

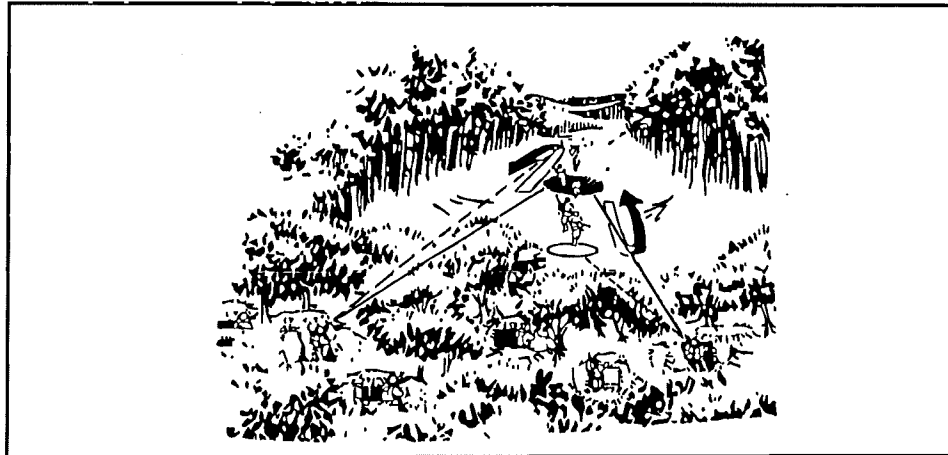


Figure 6-16. Engagement of deep targets with a pair of automatic riflemen.

(4) *Linear Target with Depth.* When using a pair of M249s to engage a linear target with depth, the initial point of aim and the extent of manipulation for both automatic riflemen is the same as those prescribed for linear targets (Figure 6-17).

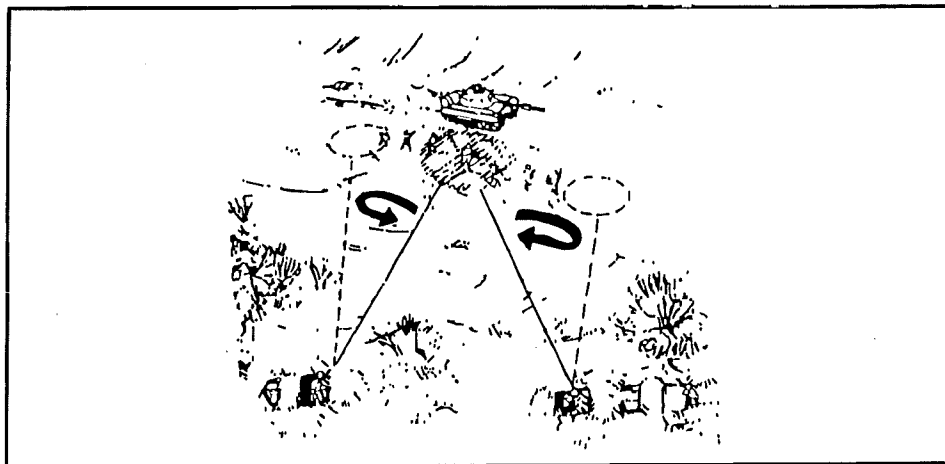


Figure 6-17. Engagement of linear target with depth with a pair of automatic riflemen.

6-6. TARGET ENGAGEMENT DURING LIMITED VISIBILITY

Automatic riflemen have problems detecting and identifying targets during limited visibility. The leader's ability to control the fires of his weapons is also reduced. Therefore, he may instruct the automatic riflemen to fire without command when targets present themselves.

- a. Automatic riflemen should engage targets only when they can identify the targets, unless ordered to do otherwise. For example, if one automatic rifleman detects a target and engages it, the other automatic rifleman observes the area fired upon and adds his fire only if he can identify the target or if ordered to fire.
- b. Tracer ammunition helps an automatic rifleman engage targets during limited visibility and should be used, if possible. If firing unaided, automatic riflemen must be trained to fire low at first and adjust upward. This overcomes the tendency to fire high.

c. When two or more automatic riflemen are engaging linear targets; linear targets with depth, or deep targets, they do not engage these targets as they would when visibility is good. With limited visibility, the center and flanks of these targets may not be clearly defined; therefore, each automatic rifleman observes his tracers and covers what he believes to be the entire target.

Section III. PREDETERMINED FIRES

Predetermined fires organize the battlefield for the automatic riflemen. They allow the leader and automatic riflemen to select potential targets or target areas that will most likely be engaged or that have tactical significance. This includes dismounted enemy avenues of approach, likely positions for automatic weapons, and probable enemy assault positions. The automatic riflemen do this by using sectors of fire, final protective lines, or a principal direction of fire and selected target areas. This preparation maximizes the effectiveness of the automatic rifle during good as well as limited visibility. It enhances fire control by reducing the time required to identify targets, determine range, and manipulate the weapon onto the target. Abbreviated fire commands and previously recorded data enable the automatic rifleman to aim or adjust fire on the target quickly and accurately. Selected targets should be fired on in daylight whenever practical to confirm data. The range card identifies the targets and provides a record of firing data.

6-7. TERMINOLOGY

Several terms are associated with predetermined fire that every automatic rifleman needs to know.

- a. **Sector of Fire.** A sector of fire is an area to be covered by fire that is assigned to an individual, a weapon, or a unit. Automatic riflemen are normally assigned a primary and a secondary sector of fire.
- b. **Final Protective Fire.** An FPF is an immediately available prearranged barrier of fire to stop enemy movement across defensive lines or areas.
- c. **Final Protective Line.** An FPL is a predetermined line along which grazing fire is placed to stop an enemy assault. If an FPL is assigned, the M249 is sighted along it except when other targets are being engaged. An FPL becomes the M249's part of the unit's final protective fires. An FPL is fixed in direction and elevation; however, a small shift for search must be employed to prevent the enemy from crawling under the FPL and to compensate for irregularities in the terrain or the sinking of the bipod legs into soft soil during firing. Fire must be delivered during all conditions of visibility.
- d. **Principal Direction of Fire.** A PDF is a direction of fire assigned priority to cover an area that has good fields of fire or has a likely dismounted avenue of approach. It also provides mutual support to an adjacent unit. Weapons are sighted using the PDF if an FPL has not been assigned. If a PDF is assigned and other targets are not being engaged, weapons remain on the PDF. A PDF has the following characteristics.
 - (1) It is used only if an FPL is not assigned; it then becomes the M249's part of the unit's final protective fires.
 - (2) When the target has width, direction is determined by aiming on one edge of the target area and noting the amount of traverse necessary to cover the entire target.
 - (3) The automatic rifleman is responsible for the entire wedge-shaped area from the muzzle of the weapon to the target, but elevation may be fixed for a priority portion of the target.
- e. **Grazing Fire.** A good FPL covers the maximum area with grazing fire. Grazing fire can be obtained over various types of terrain out to a maximum of 600 meters. To obtain the maximum extent of grazing fire over level or uniformly sloping terrain, the automatic rifleman sets the rear sight at 600 meters. He then selects a point on the ground that he estimates to be 600 meters from the weapon, and he aims, fires, and adjusts on that point. To prevent enemy soldiers from crawling under grazing fire, he searches (downward) by lowering the muzzle of the weapon. To do this, the automatic rifleman separates his elbows.
- f. **Dead Space.** The extent of grazing fire and the extent of dead space may be determined in two ways. In the preferred method, the weapon is adjusted for elevation and direction. A member of the squad then walks along the FPL while the automatic rifleman aims through the sights. In places where the soldier's waist (midsection) falls below the automatic rifleman's point of aim, dead space exists. Arm-and-hand signals must be used to control the soldier who is walking and to obtain an accurate account of the dead space and its location. Another method is to observe the flight of tracer ammunition from a position behind and to the flank of the weapon.
- g. **Fire Control.** Predetermined targets, including the FPL or PDF, are engaged on order or by SOP. The

signal for calling for these fires is normally stated in the defense order. Fires on predetermined targets maybe controlled by arm-and-hand signals; voice commands, or pyrotechnic devices. Automatic riflemen fire the FPL or PDF at the sustained rate of fire unless the situation calls for a higher rate. When engaging other predetermined targets, the sustained rate of fire is also used unless a different rate is ordered.

h. **Primary Sector of Fire.** The primary sector of fire is the area to be covered by an individual or unit.

i. **Secondary Sector of Fire.** The secondary sector of fire is the same area covered by the same individual or unit after it has moved to a different location.

Section IV. FIRE CONTROL

Fire control includes all actions of the leader and soldiers in planning, preparing, and applying fire on a target. The leader selects and designates targets. He also designates the midpoint and flanks or ends of a target, unless they are obvious to the automatic rifleman. It is the automatic rifleman's responsibility to open fire at the instant desired, and then to adjust fire, regulate the rate of fire, shift from one target to another, and cease fire. When firing, the automatic rifleman should continue to fire until the target is neutralized or until signaled to do otherwise by the leader,

6-9. METHODS OF FIRE CONTROL

The noise and confusion of battle may limit the use of some of these methods; therefore, the leader must select a method or combination of methods that will accomplish the mission.

a. **Oral.** This can be an effective method of control, but sometimes the leader may be too far away from the automatic rifleman, or the noise of the battle may make it impossible for him to hear. The primary means of the oral fire control method is the issuance of a fire command.

b. **Arm-and-Hand Signals.** This is an effective method when the automatic rifleman can see the leader. All automatic riflemen must know the standard arm-and-hand signals. The leader gets the automatic rifleman's attention and then points to the target. When the automatic rifleman returns the READY signal, the leader commands FIRE.

c. **Prearranged Signals.** These are either visual or sound signals such as casualty-producing devices, pyrotechnics, whistle blasts, or tracers. These signals should be included in SOPs. If the leader wants to shift fire at a certain time, he gives a prearranged signal such as smoke or pyrotechnics. Upon seeing the signal, the automatic rifleman shifts his fire to a prearranged point.

d. **Personal Contact.** In many situations, the leader must issue orders directly to individual soldiers. This method is used more than any other by small-unit leaders. The leader must use maximum cover and concealment to keep from disclosing the position or himself.

e. **Standing Operating Procedures.** SOPs are actions to be executed without command that are developed during the training of the squads. Their use eliminates many commands and simplifies the leader's fire control. SOPs for certain actions and commands can be developed to make automatic riflemen more effective. Some examples follow.

(1) **Observation.** The automatic riflemen continuously observe their sectors.

(2) **Fire.** Automatic riflemen open fire without command on appropriate targets that appear within their sectors.

(3) **Check.** While firing, the automatic riflemen periodically check with the leader for instructions.

(4) **Return Fire.** The automatic riflemen return enemy fire without order, concentrating on enemy automatic weapons.

(5) **Shift Fire.** Automatic riflemen shift their fires without command when more dangerous targets appear.

(6) **Rate of Fire.** When automatic riflemen engage a target, they initially fire at the rate necessary to gain and maintain fire superiority.

(7) **Mutual Support.** When two or more automatic riflemen are engaging the same target and one stops firing the other increases the rate of fire and covers the entire target. When only one automatic rifleman is required to engage a target and the leader has alerted two or more, the automatic rifleman not firing aims on the target and follows the movements of the target so that he can fire instantly should the other M249 AR malfunction or cease fire before the target has been eliminated.

f. **Range Cards.** When using this method of fire control, the leader must ensure all range cards are current and accurate. Once this is done, the leader may designate certain targets for certain weapons with the use of limiting stakes or with fire commands. He should also designate no-fire zones or restricted fire areas to others. The key factor in this method of fire control is that automatic riflemen must be well

disciplined and pay attention to detail.

6-10. FIRE COMMANDS

A fire command is given to deliver effective fire on a target quickly and without confusion. When the leader decides to engage a target that is not obvious to the squad, he must provide them with the information they need to effectively engage the target. He must alert the soldiers; give a target direction, description, and range; name the method of fire; and give the command to fire. There are initial fire commands and subsequent fire commands.

a. **Initial Fire Commands.** Initial fire commands are given to adjust onto the target, change the rate of fire after a fire mission is in progress, interrupt fire, or terminate the alert.

b. **Elements.** Fire commands for all direct-fire weapons follow a pattern that includes similar elements. There are six elements in the fire command for the M249 AR: alert, direction, description, range, method of fire, and command to open fire. The automatic riflemen repeat each element of fire command as it is given.

(1) **Alert.** This element prepares the automatic riflemen for further instructions. The leader may alert both automatic riflemen in the squad and may have only one fire, depending upon the situation. To alert and have both automatic riflemen fire, the leader announces "Automatic riflemen." If he desires to alert both automatic riflemen but have only one fire, he announces "Automatic rifleman, Alpha Team." In all cases, upon receiving the alert, the automatic riflemen load their M249 ARs and place them on FIRE.

(2) **Direction.** This element indicates the general direction to the target and may be given in one or a combination of the following methods.

(a) **Orally.** The leader orally gives the direction to the target in relation to the position of the automatic rifleman (for example, FRONT, LEFT FRONT, RIGHT FRONT).

(b) **Pointing.** The leader designates a small or obscure target by pointing with his finger or aiming with a weapon. When he points with his finger, a soldier standing behind him should be able to look over his shoulder and sight along his arm and index finger to locate the target. When aiming his weapon at a target, a soldier looking through the sights should be able to see the target.

(c) **Tracer ammunition.** Tracer ammunition is a quick and sure method of designating a target that is not clearly visible. When using this method, the leader should first give the general direction in order to direct the automatic rifleman's attention to the target area. To prevent the loss of surprise when using tracer ammunition, the leader does not fire until he has given all elements of the fire command except the command to fire. The leader may fire his individual weapon or fire one or more bursts from a machine gun. The firing of the tracer(s) then becomes the last element of the fire command and is the signal to open fire.

NOTE: Soldiers must be aware that with the night vision device, "white out" may occur when firing tracer ammunition at night or when exposed to other external light sources. Lens cover may reduce this effect.

c. **Subsequent Fire Commands.** These fire commands are used to make adjustments in direction and elevation, to change rates of fire after a fire mission is in progress, to interrupt fires, or to terminate the alert. If the automatic rifleman fails to properly engage a target, the leader must promptly correct him by announcing or signaling the desired changes. When these changes are given, the automatic rifleman makes the corrections and resumes firing without further command.

Section VI. ADVANCED AUTOMATIC RIFLE MARKSMANSHIP

Once the automatic rifleman masters the four fundamentals of automatic rifle marksmanship in the prone position and fighting position, he needs practice in applying the fundamentals in alternate positions and at targets that will most likely replicate the battlefield.

6-14. ALTERNATE FIRING POSITIONS

All automatic riflemen must master the bipod-supported prone and fighting positions to be effective. But it is equally important that they know other positions. Each automatic rifleman must be trained to assume different positions quickly during various combat conditions. The situation ultimately determines the position. The automatic rifleman must establish his position so that he can effectively observe and engage the target yet minimize his exposure from enemy fire.

a. **Shoulder-Firing Position.** This position is usually used to engage targets at ranges less than 100 meters when no other position can be assumed or the situation dictates its use (Figure 6-25). It is the

least stable of all positions, because the M249 AR is an open-bolt weapon that can be fired only on automatic. It is most often used in the final stages of the assault. To assume this position, the automatic rifleman

- (1) Puts the bipod legs down so that he is prepared to assume the prone position when required.
- (2) Puts his left foot well forward of the right. Leans forward at the waist toward the target with his knees bent, transferring his weight to his left foot before and during firing. This helps counter the recoil.
- (3) Grasps the handguard firmly with his left hand. His left elbow is as nearly under the M249 as possible.
- (4) With his right hand, places the butt of the M249 AR into the pocket of his right shoulder. Grasps the pistol grip firmly and pulls the weapon into his shoulder. Holds his right elbow horizontal to the ground or slightly above to form a good pocket in his shoulder. He does not use the shoulder rest.
- (5) Lets his right arm absorb most of the weight of the weapon. Shifts his feet until he is aiming naturally at the target and obtains a good stockweld.
- (6) Uses his left hand on the handguard to counter the tendency of the M249 AR to climb during burst fire.
- (7) If there is not enough time to aim using the sights, applies quick-fire techniques. Looks through or just over the rear sight and uses the front sight post to aim at the target. Places the front sight post below the target (center base) and keeps his focus on the front sight post.



Figure 6-25. Shoulder firing position.

b. Underarm Firing Position. This position is used almost exclusively when moving and in and around the objective during the assault (Figure 6-26). To assume this position, the automatic rifleman-

- (1) Puts the bipod legs down for instant use in the prone position if necessary.
- (2) Faces the target with his feet spread about shoulder width apart.
- (3) Places his left foot in front of the right with most of his weight on his left foot.
- (4) Bends both legs at the knees and leans forward at the waist.
- (5) With his right hand, firmly grasps the pistol grip, and with his right forearm holds the stock firmly against the side of his body at a point between his armpit and waist.
- (6) With his left hand, grasps the handguard firmly.
- (7) Points his left foot in the direction of the target while his right foot provides stability.

- (8) Depresses the muzzle of the M249 AR slightly so the strike of rounds can be observed. This reduces shooting high and takes advantage of ricochets.
- (9) Leans toward the target before and during firing.



Figure 6-26. Underarm firing position.

c. **Hip Firing Position.** This position is used when closing with the enemy, when a heavy volume of fire in the target area is required, and when rapid movement is not necessary (Figure 6-27). The only differences between this position and the underarm position are-

- (1) The rear of the stock is held firmly against the forward position of the right thigh.
- (2) The arms are extended fully downward.



Figure 6-27. Hip firing position.

6-15. MOVEMENT, SPEED, AND ALIGNMENT

The automatic rifleman must keep up with the other soldiers of the assaulting element through individual movement techniques. To do this, he moves as rapidly as possible, consistent with his ability to fire accurately and maintain alignment.

6-16. RELOADING

The automatic rifleman must reload rapidly to avoid lulls in the firing. This can be achieved by practicing and by applying the following techniques.

- a. Before the assault, the automatic rifleman conducts prefire checks on the weapon. He inspects ammunition to ensure that it is clean and serviceable, and he checks the box for serviceability.
- b. During the assault, the automatic rifleman must continue moving forward and reload as rapidly as possible. The sling allows the automatic rifleman to reload using both hands.

6-17. ALTERNATE FIRING POSITION EXERCISES

The assault fire exercise challenges the automatic rifleman. It consists of point and area targets under a variety of conditions replicating the battlefield. These exercises, which involve fire and maneuver, must be carefully controlled for safety purposes.

- a. **Objectives.** This exercise gives the automatic rifleman practice on engaging targets as quickly as possible, using any of the alternate firing positions.
- b. **Organization.** The unit is assembled in the bleachers, given instructions, and briefed on training that will be conducted while they are on the range. After the briefing, they are organized into firing orders and moved to firing lanes. Lanes are conducted and used IAW local range policies.
- c. **Ammunition.** This exercise requires a total of 75 rounds of 5.56-mm linked ammunition. The automatic rifleman is allowed two 3-round bursts per exposure, and he is also required to conduct at least one rapid reload during the exercise. The commander has the option as to when the rapid reload may take place. Ammunition is configured into two belts of any size that requires the automatic rifleman to reload.
- d. **Firing Sequence.** The sequence of firing is conducted IAW Firing Table V. The suggested sequence of firing is as follows.
 - (1) *Task 1, Dry fire walk-through.* Upon his arrival at the firing position, the automatic rifleman walks through his respective lane to become familiar with the targets. No ammunition is fired at this time. When he returns, he draws his ammunition.

NOTE: Commanders should ensure that ammunition is used in such a manner that it requires the automatic rifleman to rapidly reload sometime during his movement phases.

(2) *Task 2, Engage single E-type silhouette from the hip firing position.* After being issued the ammunition, the automatic rifleman begins his movement. When targets are exposed, he uses the hip firing technique. He will be given a single exposed target at a distance of 25 meters, with an exposure time of 5 seconds for each target.

(3) *Task 3, Engage single E-type silhouettes from the underarm firing position.* As the automatic rifleman continues to move through the course, he will then be given two single exposed E-type silhouettes at distances of 50 and 25 meters, where he will engage each silhouette using the underarm-firing position. The exposure time for these targets will be 5 seconds per target.

(4) *Task 4, Engage single E-type silhouettes from the shoulder firing position.* Once the automatic rifleman reaches the shoulder firing position, he will be given three single exposed E-type silhouettes at distances of 25, 50, and 75 meters. The exposure time for each target will be 5 seconds.

NOTE: The commander may integrate firing, under NBC conditions for selected tasks while negotiating the course, or he may conduct the course during limited visibility unaided.

MCWP 3-35, Military Operations on Urbanized Terrain Appendix A**Section II
Weapons Handling and Firing Techniques**

2. Weapons Carries. During MOUT, a Marine often finds himself very unexpectedly engaging targets at close ranges. Weapons carries provide a safe and effective method for handling the service rifle. For additional in-depth discussion of weapons handling and firing techniques, refer to MCWP 3-01X, *Field Firing of the M16A2 Rifle*.

a. Tactical Carry. The tactical carry is used when no immediate threat is present. It permits control of the rifle while moving and still allows quick engagement of the enemy. The buttstock of the rifle is placed alongside the body at approximately hip level, and the barrel is angled upward approximately 45 degrees in the general direction of the enemy.

b. Alert Carry. The alert carry is used when enemy contact is likely. Engagement of the enemy is faster from the alert carry than from the tactical carry. The buttstock of the rifle is placed in the shoulder with the muzzle angled down approximately 45 degrees and pointed in the likely direction of the enemy. In the alert carry, the Marine keeps both eyes open and scans for any threat with the weapon always in line with the Marine's LOS (this is called "guns 'n' eyeballs"). When a threat is spotted, the Marine quickly snaps his weapon into a firing position, looks over the rear sight aperture, and aligns the tip of the front sight post center mass on the target. Once the threat has been eliminated, the Marine returns to the alert carry and continues to scan for targets. Accuracy is the primary goal.

c. Ready Carry. The ready carry is employed when contact with the enemy is imminent. It allows for immediate target engagement. The buttstock of the rifle is in the shoulder with the muzzle of the rifle pointed in the direction of the enemy (Figure A-6). As in the alert carry, sight alignment and sight picture are achieved as the shot is fired. Marines should always strive for a clear tip of the front sight post and center mass hold.



Figure A-G. Ready Carry

d. Short Stocking. Rifles may be "short stocked" to increase their maneuverability in an enclosed area and to reduce possible "target indicators" for the enemy (muzzles sticking around corners, for example). The weapon is held in such a manner as to reduce the length of the weapon without sacrificing too much accuracy (Figure A- 7). The stock is positioned so that the pistol grip is behind the Marine's head. The Marine may use his index finger or thumb to manipulate the trigger. The handguard of the weapon is placed against the Marine's cheek, and a firm stockweld is attained. The Marine should use the tip of the front sight post. Short stocking may be conducted from either side. However, care should be taken not to mask the ejection port cover. The short stocking technique may be used in the tactical, alert, or ready carry.

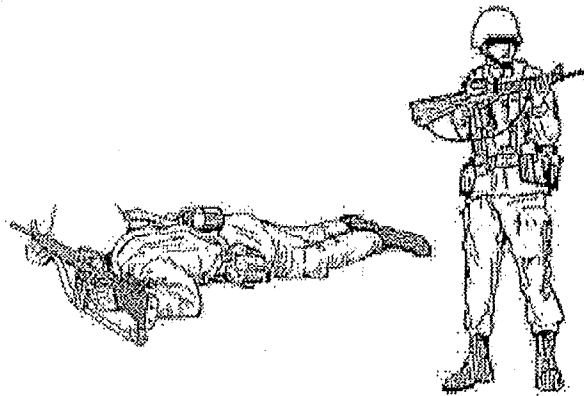


Figure A-7. Short Stocking

e. Weak-Hand Carries. Marines may carry their weapon on the weak-hand side to obtain maximum cover and fire from the weak-hand position to avoid exposing themselves. However, firing from the weak-hand position may reduce a Marine's ability to fire accurately. This may be acceptable when Marines are providing supporting fires, but in close kill-or-be-killed engagements, rapid, accurate firing from the strong-hand position is preferred.

3. Firing Techniques. The speed and uncertainty of combat require Marines to act without hesitation while achieving accurate target engagement. Several firing techniques are listed below. For an in-depth discussion of firing techniques that can be applied to MOUT operations, see MCWP 3-01X.

a. Pieing. Pieing is an effective technique for clearing dead space inside rooms and buildings to gain security of hallways, stairwells, mouseholes, and so on. It is conducted by using the ready carry position or short stocking technique. The weapon is aimed at a sector of a window, doorway, corner, or hallway and slowly moved at different angles, sectoring off the window, doorway, corner, or hallway until each sector is cleared of any threat. As soon as a hostile threat is seen, immediate, accurate fire can be placed on the threat.

b. Aimed Quick Fire. The Marine's initial focus is on the target. As the rifle is brought up, the firing eye looks through or just over the rear sight aperture, and the front sight post is used to aim at the target. The Marine fires two quick shots. Focus remains on the front sight post throughout the aiming process.

Immediately after target engagement, the Marine scans for additional targets. To scan, perform the following steps:

- (1) Lower the weapon to look over the sights.
- (2) Place the trigger finger straight along the receiver.
- (3) Scan the area for targets and assess the situation. Wherever the head moves, the muzzle moves (eyes, muzzle, target). Keep both eyes open to increase the field of view.

c. Pointing Quick Fire. The pointing system is based on the phenomenon that when a person looks at an object and simultaneously points a finger at it, the finger aligns itself on the point of focus of the eyes with no conscious effort on the part of the individual. When a Marine looks at an object and simultaneously brings his rifle to his shoulder, the rifle in effect becomes an extension of the pointed finger. Consequently, it aligns itself naturally with the object on which the shooter is focusing.

When a target appears, the Marine will keep both eyes open, concentrating intensely on a small, specific focal point near the base of the target mass. The rifle is brought simultaneously to the hollow of the shoulder. The head is held high, stock welded to the jaw. The eyes are 2 - 3 inches over the top of the sights, staring intently at the target. As soon as the rifle is brought to the shoulder, two quick shots are fired. Focus on the target is not broken during the interval between initially seeing the target and discharging the rifle.

d. Instinctive Shooting. There may be situations in which a Marine is surprised and may need to react immediately. If possible, the Marine should engage the threat by using the tip of the front sight post. However, *speed* may be more important. The Marine's weapon and body are quickly "pointed," and the target is engaged. It is important that the body be turned with the weapon in order to achieve a natural point of aim. Simply pointing the weapon will usually result in a miss. Once the first two shots have been fired and the Marine regains the initiative, the weapon should be quickly moved to the Marine's shoulder and the tip of the front post used for sighting subsequent shots.

MCWP 3-35, Military Operations on Urbanized Terrain Appendix A, p30

d. After the grenade explodes, Shooter Number One steps across the threshold and clears his immediate area (Figure A-33). He engages targets from the ready carry position. Shooter Number Two follows immediately behind Shooter Number One, buttonhooks, and clears his area.

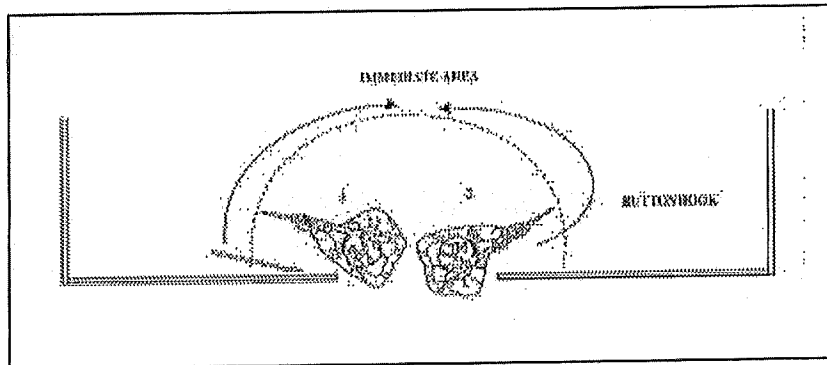


Figure A-33. Shooters Enter the Room

e. Both shooters clear the immediate area and along their respective walls, starting from the nearest respective corner and continuing to the farthest respective corner (Figure A-34). Shooters use the pieing technique to systematically clear the room by sector. (See Paragraph 3.a. of this appendix.) C

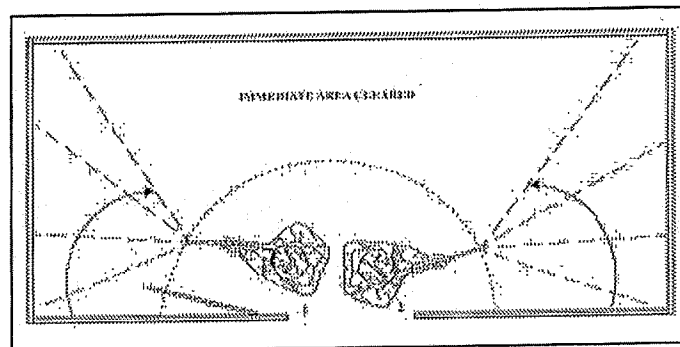


Figure A-34. Clearing a Room

f. Both shooters then establish a dominant position in the room one step away from the wall and two steps into the room and clear the room by sector, pieing to the opposite side of the room (Figure A-35). Meanwhile, the covering team (two-man team) in position outside the room being cleared provides security.

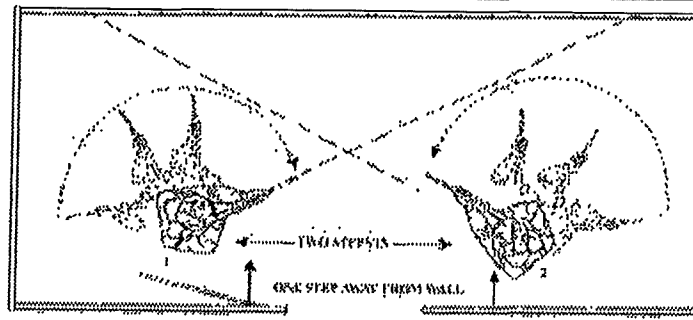


Figure A-35. Clearing a Room (Continued)

g. Another option for entering a room (situation dependent): If Shooter Number One of the clearing team enters a room without Shooter Number Two immediately following him (this could be due to room size, entering the room through a narrow opening, or a number of factors caused by the situation), then Shooter Number One will position himself inside the room to the left or right of the door and quickly scan the entire room. He then gives the command to Shooter Number Two, "NEXT MAN IN, **LEFT (RIGHT)**." Shooter Number Two shouts, "COMING IN, **LEFT (RIGHT)**," enters the room, positions himself up against the wall to the left (right) of the entrance as designated, and scans the room. Once in position, the clearing team leader can call in additional members with the "NEXT MAN IN" command, as the situation dictates. It is critical that all assault element members tell each other where they are to avoid fratricide.

h. When the clearing team has cleared the room and is ready to exit the room, it uses the following voice alerts. Once a room has been cleared, the clearing team yells, "CLEAR," to inform the covering team. Before leaving the room and rejoining the covering team, the clearing team yells, "COMING **OUT**" and waits to hear the covering team yell, "ALL CLEAR." The clearing team then executes its movement out of the room. The assault element then marks the room according to unit SOP.

When moving up or down a staircase, the appropriate team yells, "COMING **UP**" or "COMING **DOWN**." As before, it waits for the response "ALL CLEAR" before executing movement and rejoining its element. When exiting a building, the clearing team or assault element yells, "COMING **OUT**" and waits for the support force or covering team to respond with "ALL CLEAR."

20. Clearing a Room, Door Closed, Split Positions

a. Before opening a door, Shooter Number Two of the clearing team positions himself opposite Shooter Number One on the other side of the door and away from the wall in a safe position that allows Shooter Number One to shoot the door-opening mechanism (Figure A-36). This positioning allows Shooter Number Two to be in position to immediately move to a wall position opposite Shooter Number One. No matter what method is used to open the door, pivoting (see Paragraph 3.a. of this appendix) while maintaining eye-muzzle-target contact. Shooter Number Two is kneeling, and Shooter Number One is still standing (Figure A-38). Both shooters clear their respective sector of fire.

If a grenade was thrown: After the explosion, Shooter Number One yells, "MOVE," and both shooters pivot from their respective positions toward each other, immediately enter the room, and buttonhook (Figures A-38, A-39A, and A-39B). Shooter Number Two goes from kneeling to standing as he pivots. Both shooters clear their respective sector of fire.

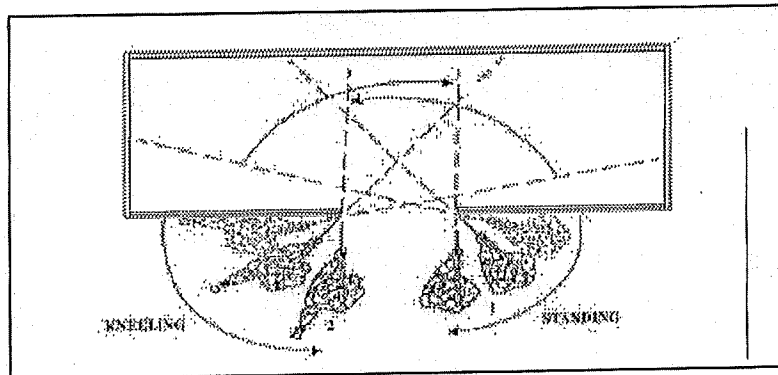


Figure A-38. Shooters Clear Sectors of Fire From Doorway

d. If no grenade was thrown: After scanning is completed, Shooter Number Two stands up and yells, "READY," and Shooter Number One Yells, "MOVE." Both shooters enter the room together (Figure A-39A).

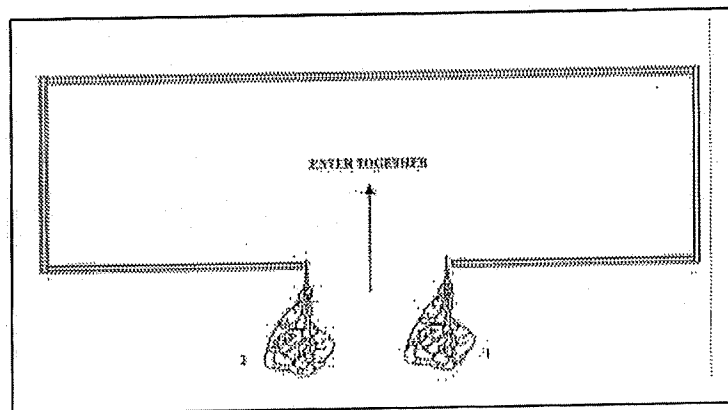


Figure A-39A. Shooters Enter the Room Together

e. Both shooters pass through the doorway together and immediately face respective corners, using the adjacent wall for cover. Both shooters buttonhook their respective areas (Figure A-39B). At this point, clearing the room is the same as discussed in Paragraphs 19.e. - 19.h.

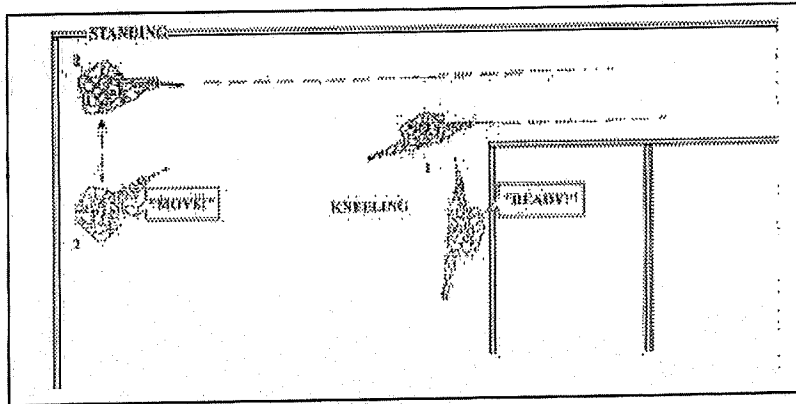


Figure A-46. Clearing an L-Shaped Hallway (Continued)

24. Clearing a T-Shaped Hallway. After entering a room or building, the clearing team may find a T-shaped hallway that should be cleared. The following procedures are used:

- a. Both shooters approach the T-shaped intersection together, pieing their individual sectors while maintaining eye-muzzle-target contact (Figure A-47).
- b. Both shooters move to dominant positions without entering the intersection.

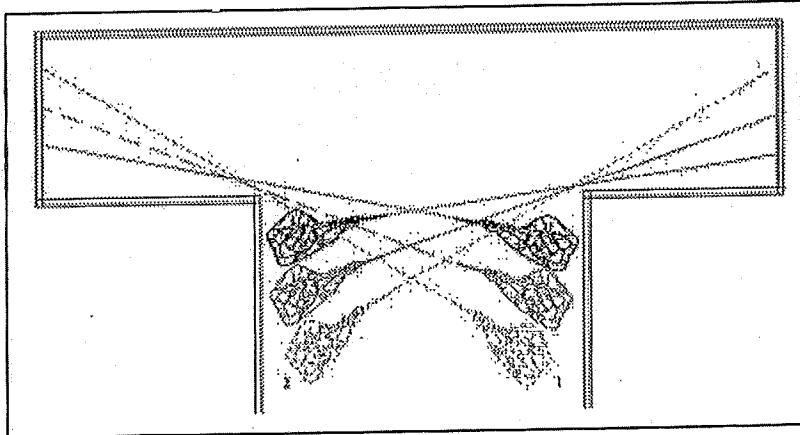


Figure A-47. Positioning To Clear a T-Shaped Hallway

- c. Shooter Number One clears his sector of fire and then says, "READY!" (Figure A-48).
- d. Shooter Number Two clears his sector of fire and then says, "MOVE!"
- e. Both shooters buttonhook into their next positions.

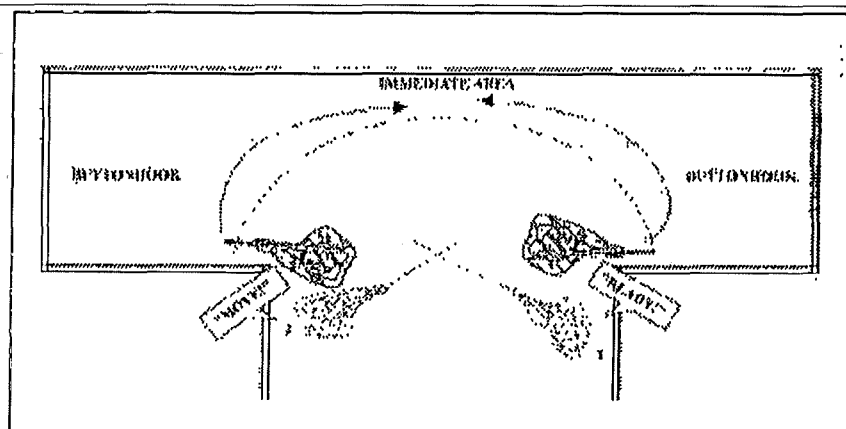


Figure A-48. Clearing a T-Shaped Hallway

f. Both shooters clear their immediate areas along their respective walls, starting from the nearest respective corner and continuing to the farthest respective corner (Figure A-49).

g. Both shooters establish dominant positions that give them control of the hallway and the doorways leading into hallways. The covering team can then be called forward to provide security while the clearing team clears one end of the hallway and associated rooms. The clearing team then clears the other end of the hallway.

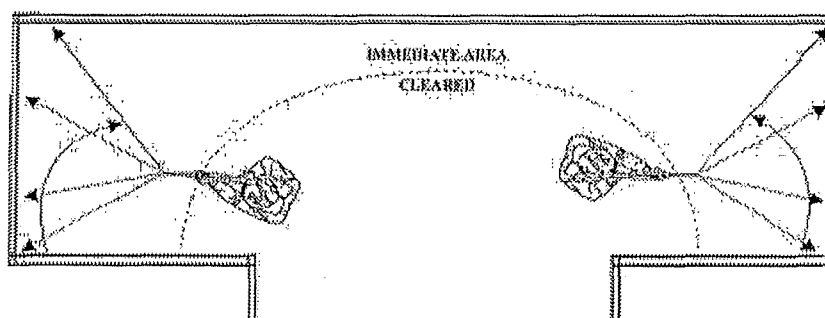


Figure A-49. Clearing a T-Shaped Hallway (Continued)

25. Clearing a Stairwell. After entering a building, the assault element may encounter stairwells. The following procedures are used:

a. Shooter Number One leads upstairs, one step ahead of Shooter Number Two (Figure A-50). Upon reaching the point just before he can be engaged from above, Shooter Number One turns around and covers overhead. From this point, Shooter Number One ascends the stairs, moving backward while covering behind and above.

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18. Hand Grenades. Combat in built-up areas (mainly during the attack) requires extensive use of hand grenades. The Marine should throw a grenade before entering rooms or negotiating staircases, mouseholes, and so on. This usually requires the use of both hands and employs both the overhand and underhand methods of throwing.

a. Two techniques may be used in the throwing of a grenade. The *preferred technique* involves throwing the grenade hard enough that it bounces or skips around, making it difficult to pick up. The hard-throw, skip/bounce technique may be used by Marines in training and combat. The *least preferred technique*, which involves cooking-off the grenade for two seconds then throwing it to prevent the enemy from grabbing the grenade and tossing it back, may be used by Marines, as appropriate, during actual combat but not in training.

b. Nonverbal or verbal alerts are used, as appropriate, before throwing a grenade. A visual showing (preferred) of the grenade to be thrown is made to assault element members, and a visual acknowledgment from them is received. A nonverbal alert may ensure that the enemy is surprised when the grenade is thrown. If the situation demands, a voice alert can be used, but the element of surprise may be lost. When or if a voice alert is used, the voice alert is "FRAG OUT;" when an enemy grenade has been identified, friendly forces shout, "GRENADE."

c. The construction material used in the building being cleared influences the use of grenades. In some situations, concussion grenades may be preferred over fragmentary grenades during offensive operations or when defending from hasty defensive positions. If the walls of a building are made of thin material, such as sheetrock or thin ply board, the Marine should either lie flat on the floor with his helmet pointing toward the area of detonation or move away from any wall that might be penetrated by grenade fragments.

d. Marines should throw grenades into an opening before entering a building to eliminate any enemy that might be near the entrance (Figure A-26). Using the M203 grenade launcher is the best method for putting a grenade in an upper story window.

e. When a hand grenade must be used, the Marine throwing the grenade should stand close to the building, using it for cover. At the same time, the individual and the rest of the element should have a planned area to which they can move for safety if the grenade does not go through the window, but falls back to the ground.

f. The Marine throwing the grenade should step out far enough to lob the grenade into the upper story opening. The Marine's weapon should be kept in the nonthrowing hand so that it can be used if needed. The weapon should never be laid down outside or inside the building. Once the grenade has been thrown into the opening, assaulting forces should move swiftly to enter the building. This technique should be employed only when the window has already been broken. Otherwise, the chances are high that the thrown grenade will bounce off of the window and fall back onto the ground without going into the room.

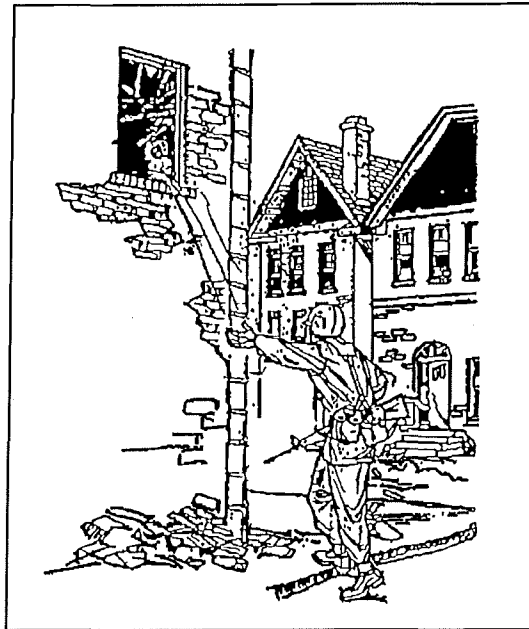


Figure A-26. Hand Grenade Thrown Through Window

WARNING: After throwing the grenade, the Marine should immediately announce, "FRAG OUT," to indicate that a grenade has been thrown. He then takes cover because the grenade may bounce back or be thrown back, or the enemy may fire at him.

g. If Marines must enter the building by using the stairs, they first look for booby traps. Then they throw a grenade through the stairwell door, let it detonate, and move quickly inside. They can use the staircase for cover.

h. The best way to enter a building is to breach the exterior wall. Again, a grenade should be thrown through the hole while using all available cover, such as the lower corner of the building (Figure A-27).

i. Another way to enter a room is to blast mouseholes with demolitions. In moving from room to room through mouseholes, Marines should use grenades to clear the room as they do in moving through open doorways.

j. Although buildings are best cleared from the top down, this is not always possible. While clearing the bottom floor of a building, Marines may encounter stairs that must also be cleared. Once again, grenades play an important role. Before climbing the stairs from the bottom floor, Marines should first inspect for booby traps then toss a grenade to the head of the stairs, if appropriate (Figure A-28). The use of a grenade in these situations is based on stair/building construction and building layout. *Throwing grenades up staircases is extremely dangerous, and extreme caution and common sense should be used.* In most situations, throwing a grenade up a staircase is not recommended. (Again, the grenade is being used in the initial building entry or clearing of the bottom floor of a building having a staircase.) If a grenade is thrown too hard or the staircase is too steep, the grenade can roll back down the staircase. For this reason, if a grenade is thrown, it should be thrown underhand to reduce the risk of it bouncing back and rolling down the stairs. A nonverbal or, as appropriate, voice alert is used when throwing the grenade. Once the first grenade has detonated, another grenade should be thrown over and behind the staircase banister and into the hallway,

destroying any enemy hiding to the rear.



Figure A-27. Entering Through a Breached Hole

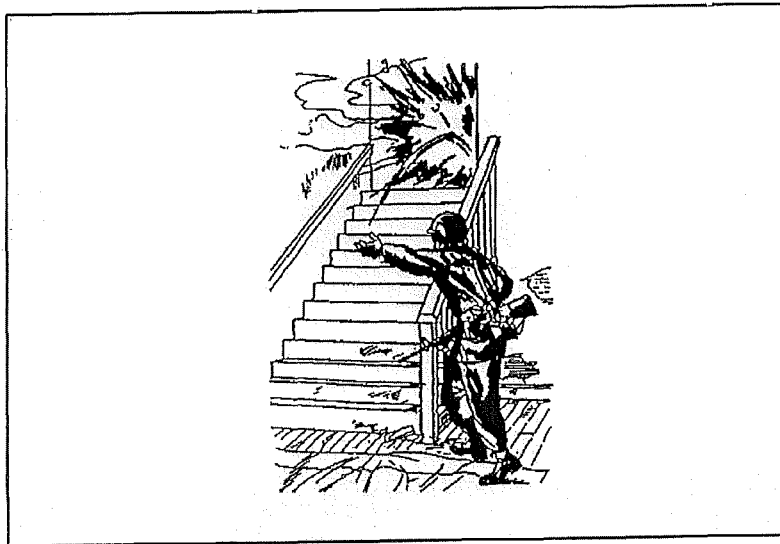


Figure A-28. Tossing a Grenade Up a Stairway

MCWP 3-35, Military Operations on Urbanized Terrain Appendix A**Section VI
Firing Positions**

Whether a unit is attacking, defending, or conducting retrograde operations, its success or failure depends on the ability of the individual Marine to place accurate fire on the enemy while providing the least exposure to return fire. Consequently, Marines should immediately seek and properly use firing positions.

26. Hasty Firing Position. A hasty firing position is one that is normally occupied in the attack or the early stages of the defense. It is a position from which a Marine can place fire on the enemy while using available cover for protection from return fire. The Marine may occupy this position voluntarily, or he may be forced to occupy it because of enemy fire. In either case, the position lacks preparation before occupation. Some of the more common hasty firing positions in a built-up area involve firing around corners of buildings, firing from behind walls, firing from windows, firing from unprepared loopholes, and firing from the peak of a roof.

a. **Corners of Buildings.** The corner of a building provides cover for a hasty firing position if used properly.

(1) The shooter should be capable of both right-handed and left-handed firing of his weapon (using the "short stocking" technique) to be effective around corners. Short stocking the weapon will prevent the muzzle from protruding and keep the weapon ready to fire the instant visual contact with the enemy is made. Furthermore, it reduces the Marine's exposure as a target. (Figure A-51)

(2) A common mistake made when firing around corners is firing from the standing position. The shooter exposes himself at the height the enemy would expect a target to appear and risks exposing the entire length of his body as a target for the enemy.

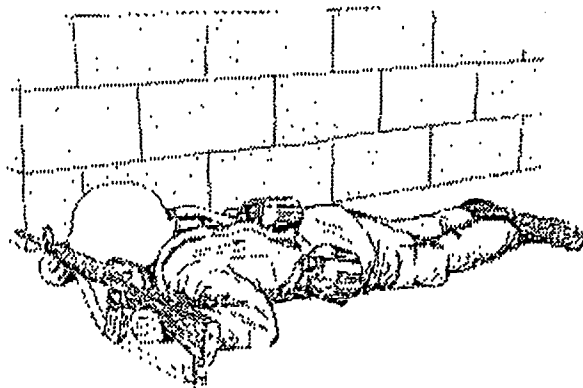


Figure A-51. Firing, Using Either Hand, Around the Corner of a Building

b. Walls. When firing from behind walls, a Marine should fire around cover not over it (Figure A-52). Marines in this situation should be able to fire from the right or left shoulder. When firing from behind cover, a Marine should remain far enough back from that cover so that the weapon does not extend beyond it. This aids in weapon retention by ensuring that no enemy on the other side of the wall can get control of the barrel.

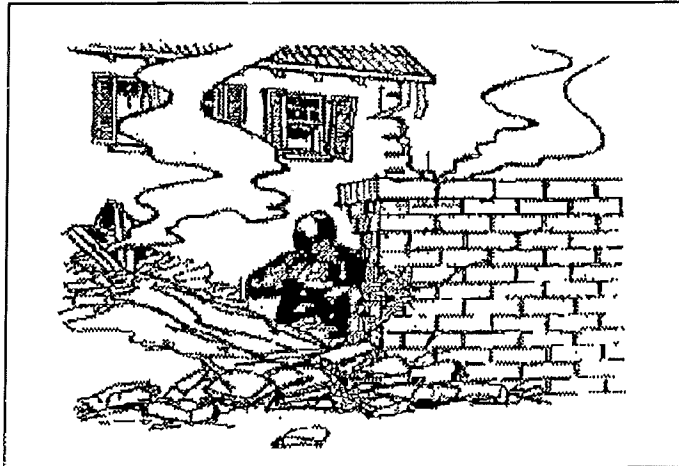


Figure A-52. Firing Around Cover

c. Windows. In a built-up area, windows provide convenient firing ports. A Marine should avoid firing from the standing position because it exposes most of his body to return fire from the enemy and could silhouette him against a light-colored interior beyond the window. This is an obvious indicator of the firer's position, especially at night when the muzzle flash can easily be observed. When using the proper method of firing from a window (Figure A-53), the Marine is well back into the room to prevent the muzzle flash from being seen, and he is kneeling to limit exposure and avoid silhouetting himself.

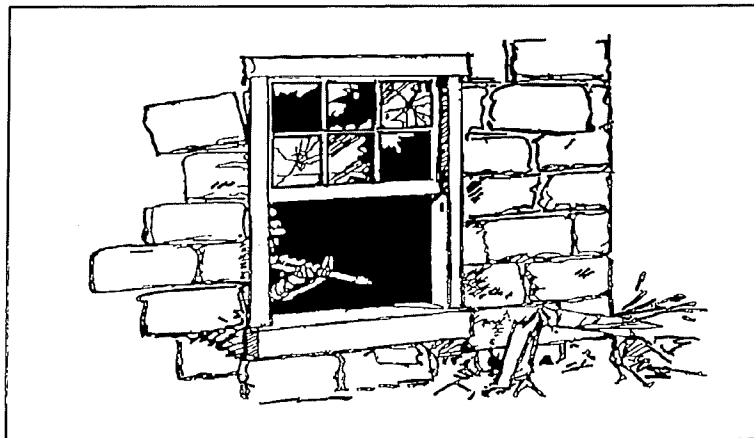


Figure A-53. Firing From a Window

d. Loopholes. A Marine may fire through a hole torn in the wall and avoid windows (Figure A-54). He stays well back from the loophole so the muzzle of the weapon does not protrude beyond the wall and the muzzle flash is concealed.

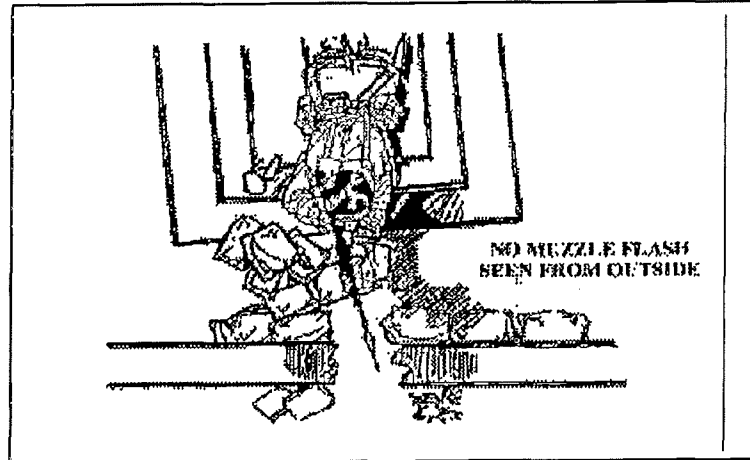


Figure A-54. Firing From a Loophole

e. Roof. The peak of a roof provides a vantage point for snipers that increases their field of vision and the ranges at which they can engage targets (Figure A-55). A chimney, a smokestack, or any other object protruding from the roof of a building can reduce the size of the exposed target and should be used.

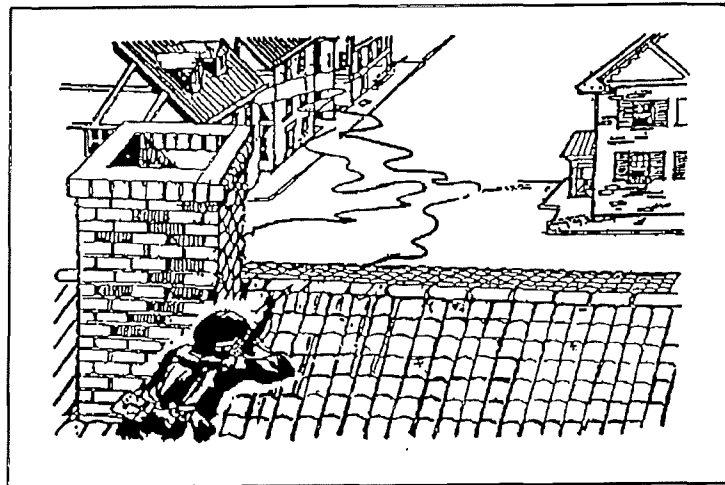


Figure A-55. Firing From the Peak of a Roof

f. No Position Available. When a Marine is subjected to enemy fire and none of the positions mentioned are available, he should try to expose as little of himself as possible. When a Marine is in an open area between buildings (a street or alley) with no cover available and he is fired upon by an enemy from one of the buildings to his front, he should lie prone...

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c. A chimney or other protruding structure provides a base from which a sniper position can be prepared. Part of the roofing material is removed to allow the sniper to fire around the chimney. He should stand inside the building on the beams or on a platform with only his head and shoulders above the roof (behind the chimney). Sandbags placed on the sides of the position protect the sniper's flanks.

d. When the roof has no protruding structure to provide protection, the sniper position should be prepared from underneath on the enemy side of the roof. The position is reinforced with sandbags, and a small piece of roofing material should be removed to allow the sniper to engage targets in his sector. The missing piece of roofing material should be the only sign that a position exists. Other pieces of roofing should be removed to deceive the enemy as to the true sniper position. The sniper should be invisible from outside the building, and the muzzle flash should be hidden from view.

e. Some rules and considerations for selecting and occupying individual firing positions are:

- (1) Make maximum use of available cover and concealment.
- (2) Avoid firing over cover; when possible, fire around it.
- (3) Avoid silhouetting against light-colored buildings, the skyline, and so on.
- (4) Carefully select a new firing position before leaving an old one.
- (5) Avoid setting a pattern; fire from both barricaded and unbarricaded windows.
- (6) Keep exposure time to a minimum.
- (7) Begin improving a hasty position immediately after occupation.
- (8) Use construction material that is readily available in the built-up area for prepared positions.
- (9) Remember that positions that provide cover at ground level may not provide cover on higher floors.

f. In attacking a built-up area" recoilless weapon and ATGM crews may be hampered in choosing firing positions by the backblast of their weapons. They may not have enough time to knock out walls in buildings and clear backblast areas. They should select positions that allow the backblast to escape, such as corner windows where the round fired goes out one window and the backblast escapes from another. The corner of a building can be improved with sandbags to create a firing position (Figure A-59).



Figure A-59. Corner Firing Position

g. The rifle squad is often reinforced with attached antitank weapons during an attack on and in defense of a built-up area. Therefore, the rifle squad leader should be able to choose good firing positions for the antitank weapons under his control.

h. Various principles for employing antitank weapons have universal applications, such as making maximum use of available cover, trying to achieve mutual support, and allowing for the backblast when positioning recoilless weapons, TOWs, Dragons, and AT4s.

i. Operating in a built-up area presents new considerations. Marines should select numerous alternate positions, particularly when the structure does not provide cover from small-arms fire. They should position their weapons in the shadows and within the building.

j. Recoilless weapons and ATGMs firing from the top of a building can use the chimney for cover (Figure A-60). The rear of this position should be reinforced with sandbags.

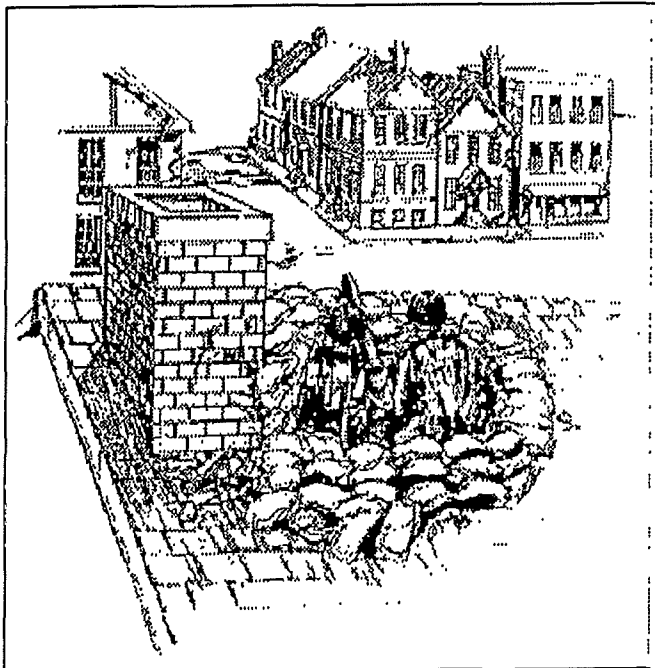


Figure A-60. Antitank Weapon Firing From a Rooftop

k. When selecting firing positions for recoilless weapons and ATGMs, Marines should make maximum use of rubble, corners of buildings, and destroyed vehicles to provide cover for the crew. Recoilless weapons and ATGMs can also be moved along rooftops to obtain a better firing angle from which to engage enemy armor. When buildings are elevated off the ground, positions can be prepared using a building for overhead cover (Figure A-61). The backblast under the building must not damage or collapse the building or injure the crew.

Note: When firing from a slope, ensure that the angle of the launcher relative to the ground or firing platform is not greater than 20 degrees. When firing within a building, ensure that the enclosure is at least 10 feet by 15 feet, is clear of debris and loose objects, and has windows, doors, or holes in the walls to allow the backblast to escape.

l. The machine gun can be emplaced almost anywhere. In the attack, windows and doors offer ready-made firing ports (Figure A-62). For this reason, the enemy normally has windows and doors under observation and fire; they should therefore be avoided. Any openings in walls that were created during the fighting may be used. When other holes are not present, small explosive charges can create loopholes (Figure A-63). Regardless of what openings are used, machine guns should be sited within the building and in the shadows.

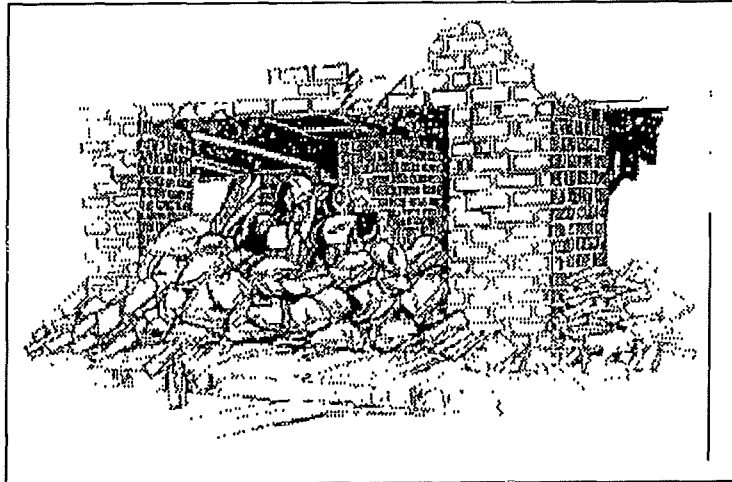


Figure A-61. Prepared Positions Using a Building for Overhead Cover

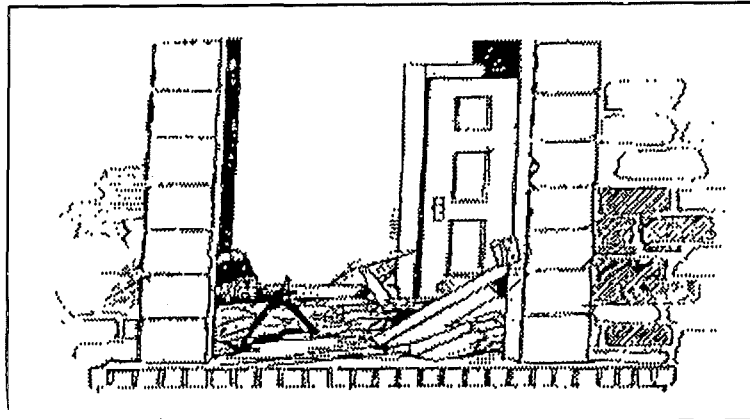


Figure A-62. Emplacement of a Machine Gun in a Doorway

m. Upon occupying a building, Marines board up all windows and doors. By leaving small gaps between the slats, Marines can use windows and doors as good alternate firing positions;

n. Loopholes should be used extensively in the defense. They should not be constructed in any logical pattern, nor should they all be at floor or tabletop level. Varying their height and location makes them hard to pinpoint and identify. Dummy loopholes, knocked-off shingles, or holes that are cut but not intended to be used as firing positions aid in deception. Loopholes located behind shrubbery, under doorjambs, and under the eaves of a building are hard to detect.

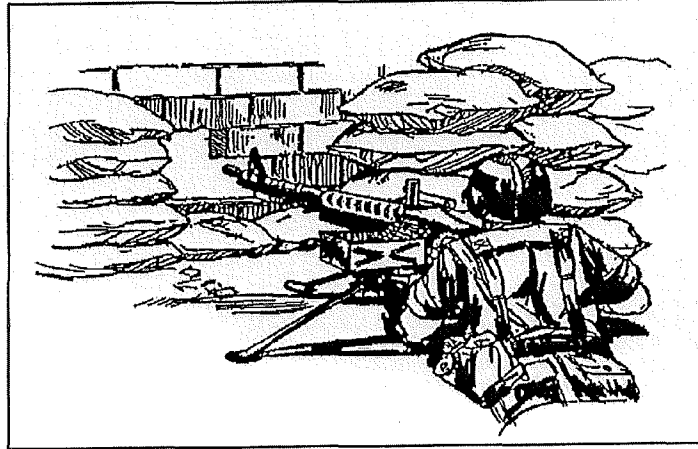


Figure A-63. Use of a Loophole With a Machine Gun

o. Increased fields of fire can be obtained by locating the machine gun in the corner of the building or sandbagging it under a building (Figure A-64). Available materials, such as desks, overstuffed chairs, couches, and other items of furniture, should be integrated into the construction of bunkers to add both cover and concealment (Figure A-65).

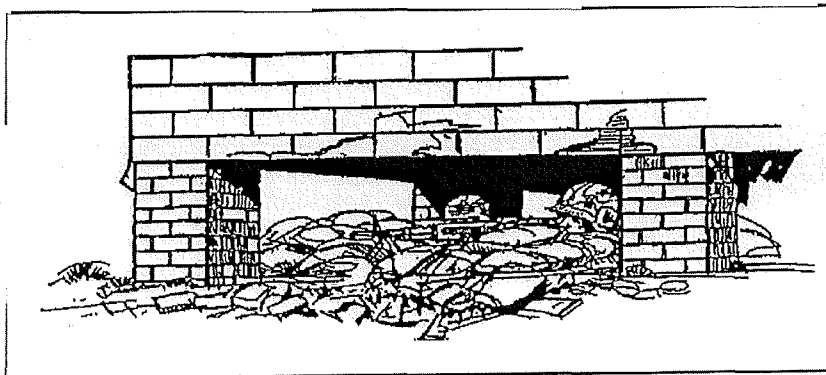


Figure A-64. Sandbagged Machine Gun Emplacement Under a Building

p. Although grazing fire is desirable when employing the machine gun, it may not always be practical or possible. Where destroyed vehicles, rubble, and other obstructions restrict the fields of grazing fire, the gun can be elevated to a position from which it can deliver plunging fire over obstacles. Firing from loopholes on the second or third story may be necessary. A firing platform can be built under the roof (Figure A-66) and a loophole constructed. Again, the exact location of the position should be concealed by knocking off shingles in isolated patches over the entire roof.

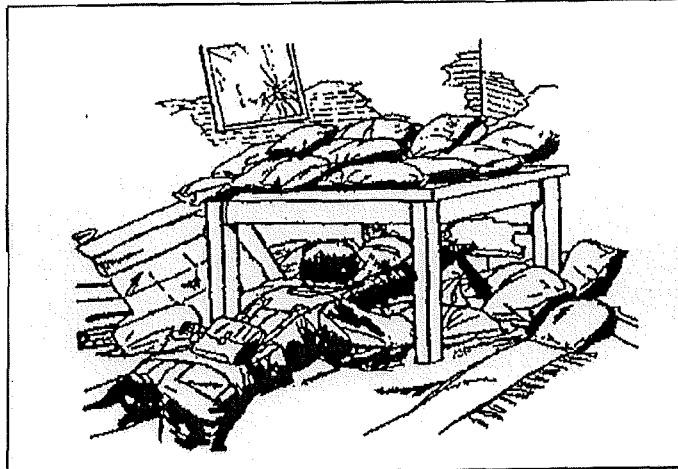


Figure A-65. Corner Machine Gun Bunker

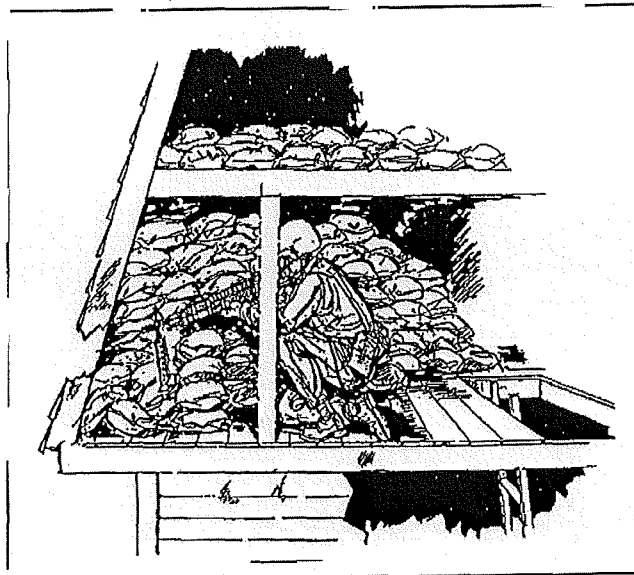


Figure A-66. Firing Platform Built Under a Roof

28. Target Acquisition. Built-up areas provide unique challenges to acquiring targets. Buildings mask movement and the effects of direct and indirect fires. Also, the rubble from destroyed buildings provides concealment and protection for attackers and defenders alike, making target acquisition difficult.

a. The techniques of patrolling and using OPs apply in the city as well as in wooded terrain. These techniques enable units to locate the enemy, to develop targets for direct and indirect fires in the defense, and to find uncovered avenues of approach in the offense.

b. Most weapons and vehicles produce recognizable signatures. These come from design features or from the environment in which the equipment is used. For example, firing a tank main gun in dry, dusty, and debris-covered streets raises a dust cloud; a tank being driven in built-up areas produces more noise than one moving through an open field; people moving through rubble on a street or in

the halls of a damaged building create more noise than in a wooded area. Marines should learn to recognize signatures so they can locate and identify targets. Seeing and hearing assist in detecting and identifying signatures that lead to target location, identification, and rapid engagement. Marines should look for targets in areas where they are most likely to be employed.

c. Target acquisition should be continuous, whether halted or moving. Built-up areas provide both the attacker and defender with good cover and concealment but usually favor the defender. This makes rapid and accurate target acquisition extremely important.

d. When a unit is moving and enemy contact is likely, the unit should employ an overwatching element. This principle applies in built-up areas as it does in other kinds of terrain except that in built-up areas the overwatching element should observe both the upper floors of buildings and the street level.

e. Stealth should be used when moving in built-up areas because little distance separates attackers from defenders. Only hand and arm signals should be used until contact is made. The unit should stop periodically to listen and observe to ensure that it is not being followed or that the enemy is not moving parallel to the unit's flank for an ambush. Routes should be carefully chosen so that buildings and piles of rubble can be used to mask the unit's movement.

f. Observation duties should be clearly issued to squad members to ensure all-around security as they move. This security continues at the halt. All of the senses should be used to acquire targets, especially hearing and smelling. Marines soon recognize the sounds of vehicles and people moving through streets that are littered with rubble. The smell of fuel, cologne, or food cooking can disclose enemy positions.

g. Ops are "positions from which military observations are made, or fire directed and adjusted, and which possess appropriate communications" (Joint Pub 1-02). They are positions from which Marines can watch and listen to enemy activity in a specific sector. They warn the unit of enemy approach and should be positioned in the upper floors of buildings to give Marines a better vantage point than they would have at street level.

h. In the defense, a platoon leader positions OPs for local security as ordered by the company commander. The platoon leader selects the general location, but the squad leader establishes the OP. Normally, there is at least one OP per platoon. An OP consists of two to four men and is within small-arms supporting range of the platoon. Leaders look for positions that allow good observation of the target sector. Ideally, an OP has a field of observation that overlaps those of adjacent OPs. The position selected for the OP should provide cover and concealment for units moving to and from the OP. The upper floors of houses or other buildings should be used. The squad leader should not routinely select obvious positions such as water towers or church steeples because those positions naturally attract the enemy's attention.

i. The Marine should be taught how to scan a target area from OPs or from fighting positions. Use of proper scanning techniques enables observers to quickly locate and identify targets. The Marine searches quickly without optics for obvious targets, using all of his senses to detect target signatures. If no targets are found and time permits, he makes a more detailed search (using binoculars, if available) of the terrain in the assigned sector using the 50-meter method. First, he searches a strip 50 meters deep from right to left. He then searches a strip from left to right that is farther out, overlapping the first strip. This process is continued until the entire sector has been searched. In the city core or core periphery where the observer is faced with multistory buildings, the

overlapping sectors may extend up rather than out.

j. Marines who man OPs and other positions should employ target acquisition devices. These devices include binoculars, image intensification devices, and thermal sights. All of these devices can enhance the unit's ability to detect and engage targets, especially at night or during periods of reduced visibility.

k. Target acquisition techniques used at night are similar to those used during the day. At night, whether using daylight optics or the unaided eye, the observer should not look directly

MCWP 3-35, Military Operations on Urbanized Terrain Appendix B, Employment and Effects of Weapons

1. Effectiveness of Weapons and Demolitions. The characteristics and nature of combat in built-up areas affect the results and employment of weapons. Leaders at all levels must consider the following factors in various combinations when choosing weapons to employ.

a. Hard, smooth, flat surfaces are characteristic of urban targets. Rounds rarely impact perpendicular to these flat surfaces, but rather tend to impact at some angle of obliquity. This reduces the effect of a round and increases the threat of ricochets. The tendency of rounds to strike glancing blows against hard surfaces means that up to 25 percent of impact-fuzed explosive rounds may not detonate when fired into rubble areas.

b. Engagement ranges in MOUT are close. Studies and historical analyses have shown that only 5 percent of all targets are more than 100 meters away. About 90 percent of all targets are located 50 meters or less from the identifying Marine. Few personnel targets will be visible beyond 50 meters, and most occur at 35 meters or less. Minimum arming ranges and unit safety from backblast or fragmentation effects must be considered.

c. Engagement times are short because of the close fight. Enemy personnel present only fleeting targets. Enemy-held buildings or structures are normally covered by mutually supporting fires and often cannot be engaged with deliberate, well-aimed shots without prolonging exposure to their observation and weapons.

d. Depression and elevation limits for some weapons create dead space. Tall buildings form deep canyons that are often safe from indirect fires. Some weapons, such as the M203, can fire rounds to ricochet behind cover and inflict casualties. Target engagement from oblique angles, both horizontal and vertical, demands superior marksmanship skills.

e. Smoke from burning buildings, dust from explosions, shadows from tall buildings, and the lack of light penetrating inner rooms all combine to reduce visibility and to increase a sense of isolation. Added to this is the masking of fires caused by rubble and manmade structures. Targets, even at close range, tend to be indistinct.

f. Urban fighting often leads to confused melees with several small units attacking on converging axes. The risks from friendly fires, ricochets, and fratricide must be considered during the planning phase of operations, and control measures must be continually adjusted to lower these risks. Marines and leaders must maintain a sense of situational awareness and clearly mark their progress in accordance with unit SOPs to avoid fratricide.

g. The firer and target may each be inside or outside the same or separate buildings. The enclosed nature of combat in built-up areas means that a weapon's signature effect, such as a muzzle blast or backblast, must be considered, as well as the round's impact on the target.

h. Usually the manmade structure that is protecting the enemy must be attacked before enemy personnel inside can be engaged. Therefore, weapons and demolitions can be chosen for employment based on their effects against masonry and concrete rather than against enemy personnel.

i. Modern engineering and design improvements mean that most large buildings constructed since World War II are resilient to the blast effects of bomb and artillery attack. Even though modern buildings may burn easily, they often retain their structural integrity and remain standing. Once high-rise buildings burn out, they are still useful to the military and are almost impossible to damage further. A large structure can take 24 to 48 hours to burn out and become cool enough for people to enter.

j. The most common worldwide building type is the 12- to 24-inch brick building.

2. M16 Rifle and M249 Squad Automatic Weapon. The M16A2 rifle and the M249 squad automatic weapon are the most common weapons used in combat in built-up areas. The M16A2 rifle and the M249 are used to kill enemy personnel, to suppress enemy fire and observation, and to penetrate light cover. Leaders can use 5.56-mm tracer fire to designate targets for other weapons.

a. Employment. Close combat is the predominant characteristic of urban engagements. Marine riflemen must be able to hit small, fleeting targets from bunker apertures, windows, and loopholes. This requires pinpoint accuracy with weapons fired in the semiautomatic mode. Killing an enemy through an 8-inch loophole at a range of 50 meters is a challenge, but one that may be common in combat in built-up areas.

(1) When fighting and engaging targets inside buildings, the weapons handling and firing techniques discussed in Appendix A are used.

(2) Within built-up areas, burning debris, reduced ambient light, strong shadow patterns of varying density, and smoke all limit the effectiveness of night vision and sighting devices. Aiming stakes and noise/light booby traps coupled with night vision goggles and firing techniques can be used in the defense. During the offense, night vision goggles and illumination munitions can be used. Any Marine using night vision goggles should be teamed with at least one Marine not wearing them.

b. Weapon Penetration. The penetration that can be achieved with a 5.56-mm round depends on the range to the target and the type of material being fired against. Single 5.56-mm rounds are not effective against structural materials (as opposed to partitions) when fired at close range—the closer the range, the less the penetration.

(1) For the 5.56-mm round, maximum penetration occurs at 200 meters. At ranges of less than 25 meters, penetration is greatly reduced. At 10 meters, penetration by the M16 round is poor as a result of the tremendous stress placed on this high-speed round, which causes it to yaw upon striking a target. Stress causes the projectile to break up, and the resulting fragments are often too small to penetrate.

(2) Even with reduced penetration at short ranges, interior walls made of thin wood paneling, sheetrock, or plaster offer no protection against 5.56-mm rounds. Common office furniture such as desks and chairs cannot stop these rounds, but a layer of books 18 to 24 inches thick can.

(3) Wooden-framed buildings and single cinder-block walls offer little protection from 5.56-mm rounds. When clearing such structures, Marines must ensure that friendly casualties do

not result from rounds passing through walls, floors, or ceilings.

(4) Armor-piercing rounds are slightly more effective than ball ammunition in penetrating urban targets at all ranges. They are also more likely to ricochet than ball ammunition, especially when the target presents a high degree of obliquity.

c. Protection. The following common barriers in built-up areas stop a 5.56-mm round fired at less than 50 meters:

- One thickness of sandbags
- A 2-inch concrete wall (unreinforced)
- A 55-gallon drum filled with water or sand
- A small ammunition can filled with sand
- A cinder block filled with sand (block will probably shatter)
- A plate-glass windowpane at a 45-degree angle (glass fragments will be thrown behind the glass)
- A brick veneer
- A car body (5.56-mm round will penetrate but normally not exit).

d. Wall Penetration. Although most structural materials repel single 5.56-mm rounds, continued and concentrated firing can breach some typical urban structures (See Table B-2).

Type	Penetration	Rounds Required
8-inch reinforced concrete	Initial	35
	Loophole	250
14-inch triple brick	Initial	90
	Loophole	160
12-inch cinder block with single-brick veneer	Loophole	60
	Breach hole	250
9-inch double brick	Initial	70
	Loophole	120
16-inch tree trunk or log wall	Initial ¹	1 to 3
12-inch cinder block (filled w/sand)	Loophole	35
24-inch double sandbag wall	Initial ¹	220
3/8-inch mild steel door	Initial ¹	1

Penetration only, no loophole

Table B-2. Structure Penetration Capabilities of the 5.56-mm Round Against Typical Urban Targets (Range 25 to 100 Meters)

(1) The best method for breaching a masonry wall is by firing short bursts (3 - 5 rounds) in a V-shaped pattern. The distance from the gunner to the wall should be minimized for best results—ranges as close as 25 meters are relatively safe from ricochet. Ballistic eye protection, a protective vest, and a helmet should be worn.

(2) Ball ammunition and armor-piercing rounds produce almost the same results, but armor-piercing rounds are more likely to fly back at the firer. The 5.56-mm round can be used to create either a loophole (about 7 inches in diameter) or a breach hole (large enough for a man to enter). When used against reinforced concrete, the M16 rifle and M249 cannot cut the reinforcing bars.

3. Medium/Heavy Machine Guns and Sniper Rifles (7.62 mm and .50 caliber)

a. Machine Guns. In the urban environment, the .50-caliber machine gun and the 7.62-mm M240G machine gun provide high-volume, long-range, automatic fires for the suppression or destruction of targets. They provide final protective fires along fixed lines and can be used to penetrate light structures; the .50-caliber machine gun is most effective in this role. Tracers from both machine guns are likely to start fires, but the .50-caliber tracer is more apt to do so.

(1) Employment. The primary consideration affecting the employment of machine guns within built-up areas is the limited availability of long-range fields of fire. Although machine guns should be emplaced at the lowest level possible, grazing fire at ground level is often obstructed by rubble.

(a) The .50-caliber machine gun is often employed on its vehicular mount during both offensive and defensive operations. If necessary, it can be mounted on the M3 tripod for use in the ground role or in the upper level of buildings. When mounted on a tripod, the .50-caliber machine gun can be used as an accurate, long-range weapon and can supplement sniper fires.

(b) The M240G machine gun is cumbersome, making it difficult to use inside while clearing a building. However, it is useful outside to suppress and isolate enemy defenders. The M240G can be fired from either the shoulder or the hip to provide a high volume of assault and suppressive fires. The use of the long sling to support the weapon and ammunition is preferred.

(c) Because of their reduced penetration power, M240G machine guns are less effective against masonry targets than .50-caliber machine guns. However, their availability and light weight make them well suited to augment heavy machine gun fire, to be used in areas where .50-caliber machine guns cannot be positioned, or as a substitute when heavy machine guns are not available. The M240G machine gun can be employed on its tripod to deliver accurate fire along fixed lines and can then quickly be converted to bipod fire to cover alternate fields of fire.

(2) Penetration. The ability of the 7.62-mm and .50-caliber rounds to penetrate is also affected by the range to the target and type of material against which the rounds are fired. Close ranges affect penetration of the 7.62-mm round less than the 5.56-mm round; the .50-caliber round's penetration is reduced the least..

(a) At 50 meters, the 7.62-mm ball round cannot penetrate a single layer of sandbags. It can penetrate a single layer at 200 meters, but not a double layer. The armor-piercing round does only slightly better against sandbags. It cannot penetrate a double layer but can penetrate up to 10 inches of sand at 600 meters.

(b) The penetration of the 7.62-mm round is best at 600 meters, but most urban targets are

closer. The longest engagement range is usually 200 meters or less. Table B-3 lists the penetration capabilities of a single 7.62-mm (ball) round at closer ranges.

Range (meters)	Pine Board (inches)	Dry, Loose Sand (inches)	Cinder Block (inches)	Concrete (inches)
25	13	5	8	2
100	18	4.5	10	2
200	41	7	8	2

Table B-3. Penetration Capabilities of a Single 7.62-mm (Ball) Round

(c) The .50-caliber round is also optimized for penetration at long ranges (about 800 meters). For hard targets, .50-caliber penetration is affected by obliquity and range. Both armor-piercing and ball ammunition penetrate 14 inches of sand or 28 inches of packed earth at 200 meters if the rounds impact perpendicular to the flat face of the target.

(3) Protection. Barriers that offer protection against 5.56-mm rounds are also effective against 7.62-mm rounds with some exceptions. The 7.62-mm round can penetrate a windowpane at a 45-degree obliquity, a hollow cinder block, or both sides of a car body. It can also easily penetrate wooden-framed buildings. The .50-caliber round can penetrate all of the commonly found urban barriers except a sand-filled 55-gallon drum.

(4) Wall Penetration. Continued and concentrated machine gun fire can breach most typical urban walls. Such fire cannot breach thick reinforced concrete structures or dense natural stone walls. Internal walls, partitions, plaster, floors, ceilings, common office furniture, home appliances, and bedding can be easily penetrated by both 7.62-mm and .50-caliber rounds.

(a) The M240G machine gun can be hard to hold steady enough to repeatedly hit the same point on a wall. The dust created by the bullet strikes also makes precise aiming difficult. Firing with a tripod is usually more effective than without, especially if sandbags are used to steady the weapon. Short bursts of three to five rounds fired in a V-type pattern are best.

(b) Breaching a brick veneer over cinder block presents a special problem for the M240G machine gun. Rounds penetrate the cinder block but leave a net-like structure of unbroken block. Excessive ammunition is required to destroy the net because most rounds only pass through a previously eroded hole. One or two minutes of work with an entrenching tool, crowbar, or ax can remove this web and allow entry through the breach hole.

(c) The .50-caliber machine gun can be fired accurately from the tripod using the single-shot mode. This is the most efficient method for producing a loophole. Automatic fire in three- to five-round bursts in a V-type pattern is more effective in producing a breach.

b. Sniper Rifles. The 7.62-mm match ball ammunition fired from the M-40A1 sniper rifle will perform similarly to the 7.62-mm ball round. The M-82A1A special application sniper rifle (SASR) can fire the .50-caliber armor-piercing incendiary (API) ammunition, which will have the same performance as when fired from the M-2 HB. The M-82A1A also fires the .50-caliber RAUFOSS ammunition, which contains a tungsten penetrator and a more powerful explosive charge than the API ammunition.

When the RAUFOSS penetrator punches through the metal, the explosive detonates inside, acting as an incendiary round. Although the SASR's exact penetration capabilities have yet to be defined, it has penetrated an inch of steel at 2000 yards. Both sniper rifles are organic to the Marine infantry battalion.

4. Grenade Launchers, 40-mm (M203 and MK19). Both the M203 dual-purpose weapon and the MK19 grenade machine gun fire 40-mm HE ~d HE dual-purpose (HEDP) ammunition. Ammunition for these weapons is not interchangeable, but the grenade and fuze assembly that actually hits the target is identical. Both weapons provide point and area destructive fires as well as suppression. The MK19 has a much higher rate of fire and a longer range. The M203 is much lighter and more maneuverable.

a. Employment. The main consideration affecting the employment of 40-mm grenades within built-up areas is the typically short engagement range. The 40-mm grenade has a *minimum arming range* of 14 to 28 meters. If the round strikes an object before it is armed, it will not detonate. Both the HE and EDP rounds have 5-meter burst radii against exposed forces, which means that the *minimum safe firing range for combat* is 33 meters. The 40-mm grenades can be used to suppress the enemy in a building or inflict casualties by firing through apertures or windows. The MK19 can use its high rate of fire to concentrate rounds against light structures. This concentrated fire can create extensive damage. The 40-mm HEDP round can penetrate the armor on the flank, rear, and top of Soviet-made BMPs and BTRs. Marines can use the M203 from upper stories to deliver accurate fire against the top decks of armored vehicles. Multiple hits are normally required to achieve a kill.

b. Weapon Penetration. The 40-mm HEDP grenade has a small shaped charge that penetrates better than the HE round. It also has a thin wire wrapping that bursts into a dense fragmentation pattern, creating casualties out to 5 meters. Because they explode on contact, 40-mm rounds achieve the same penetration regardless of range. Table B- 7 lists the penetration capabilities of the HEDP round.

Target	Penetration (Inches)
Sandbags	20
Sand-filled cinder block	16
Pine logs	12
Armor plate	2

Table B- 7. Penetration Capabilities of the HEDP Round

(1) If projected into an interior room, the 40-mm HEDP can penetrate all interior partition-type walls. It splinters plywood and plaster walls, making a hole large enough to fire a rifle through. It is better to have HEDP rounds pass into a room and explode 011 a far wall, even though much of the round's energy is wasted penetrating the back wall (Figure B-1). The fragmentation produced in the room causes more casualties than the high-explosive jet formed by the shaped charge.

(2) The fragments from the **HEDP** round do not reliably penetrate interior walls. They are

also stopped by office furniture, sandbags, helmets, and protective vests (flak jackets). The M203 dual-purpose weapon has the inherent accuracy to place grenades into windows at 125 meters and bunker apertures at 50 meters. These ranges are significantly reduced as the angle of obliquity increases. Combat experience shows that M203 gunners cannot consistently hit windows at 50 meters when forced to aim and fire quickly.

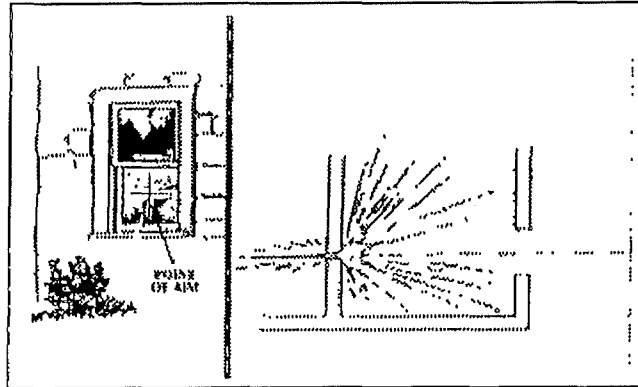


Figure B-1. Aim Point for 40-mm HEDP'

c. Wall Penetration. The M203 cannot reasonably deliver the rounds needed to breach a typical exterior wall. The MK19 can concentrate its fire and achieve wall penetration. Firing from a tripod using a locked-down traversing and elevating mechanism is best for this role. Brick, cinder block, and concrete can be breached by using the MK19; individual HEDP rounds can penetrate 6 to 8 inches of brick. The only material that has proven resistant to concentrated 40-mm fire is dense stone such as that used in some European building construction. No precise data exist as to the number of rounds required to produce loopholes or breach holes with the MK19. However, the rounds' explosive effects are dramatic and should exceed the performance of the .50-caliber machine gun.

5. Light and Medium Recoilless Weapons. Light and medium recoilless weapons are used to attack enemy personnel, field fortifications, and LA Vs. They have limited capability against main battle tanks, especially those equipped with reactive armor, except when attacking from the top, flanks, or rear. This category of weapons includes the AT4, the M47 Dragon, and the SMAW.

a. Employment. Other than defeating LA V s, the most common task for which light recoilless weapons are used is to neutralize fortified firing positions. Because of the design of the warhead and the narrow blast effect, these weapons are not as effective in this role as heavier weapons such as a tank main gun round. Their light weight allows Marines to carry several AT4s. Light recoilless weapons can be fired from the tops of buildings or from areas with extensive ventilation.

(1) Light and medium recoilless weapons with the exception of the SMA W employ shaped-charge warheads. As a result, the hole they punch in walls is often too small to use as a loophole. The fragmentation and spall that these weapons produce are limited. Normally, shaped-charge warheads do not neutralize enemy forces behind walls unless they are located directly in line with the point of impact.

(2) Against structures, shaped-charge weapons should be aimed about 6 inches below or to the side of a firing aperture (Figure B-2). This enhances the probability of killing the enemy

behind the wall. A round that passes through a window wastes much of its energy on the back wall. Because these shaped-charge rounds lack the wire wrapping of the 40-mm HEDP, they burst into few fragments and are often ineffective casualty producers.

(3) Sandbagged emplacements present a different problem (Figure B-3). Because sandbags absorb much of the energy from a shaped charge, the rounds should be aimed at the center of the firing aperture. Even if the round misses the aperture, the bunker wall area near it is usually easiest to penetrate.

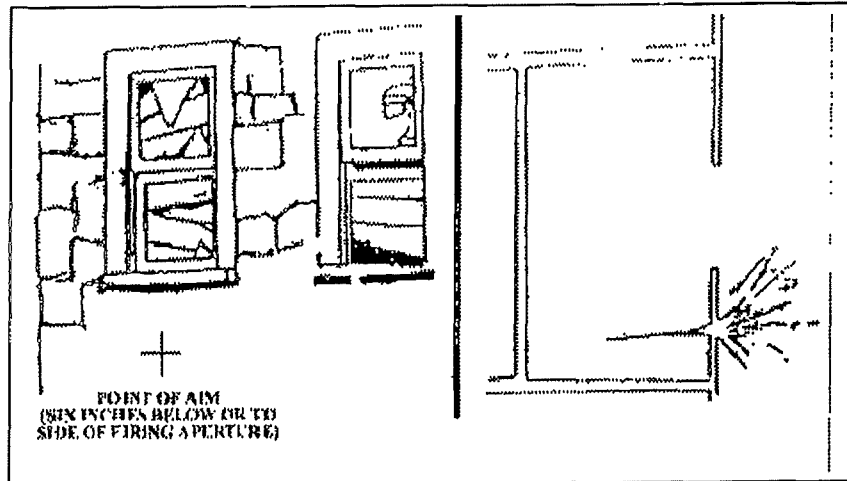


Figure B-2. Point of Aim for a Shaped-Charge Weapon Against a Masonry Structure

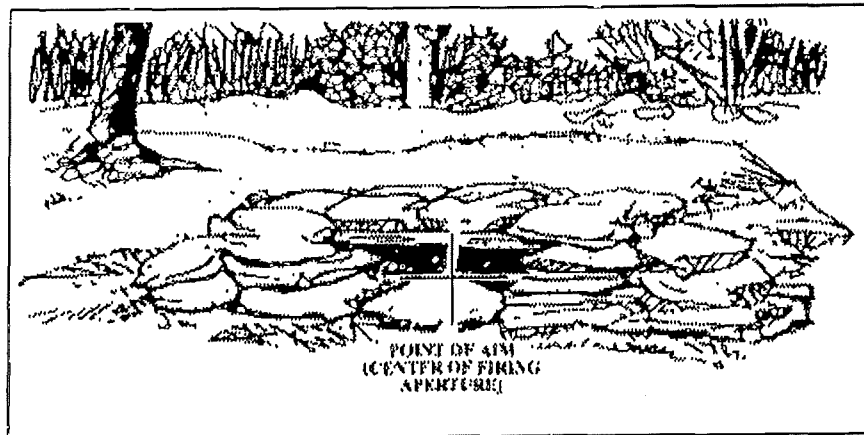


Figure B-3. Point of Aim for Sandbagged Emplacement

(4) Light and medium recoilless weapons obtain their most effective short-range antiarmor shots by firing from upper stories or from the flanks and rear. When firing at main battle tanks, these weapons should always be employed against these weaker areas in volley or paired firing. They normally require multiple hits to achieve a kill on a tank. Flank, top, and rear shots hit the most vulnerable parts of armored vehicles. Firing from upper stories protects the firer from tank main gun and coaxial machine gun fire because tanks cannot sharply elevate their cannons. The BMP-2 *can* elevate its 30-mm cannon to engage targets

in upper stories. The BTR-series armored vehicles *can* also fire into upper stories with their heavy machine gun.

(5) Modern IFVs such as the BMP-2 and the BTR-80 have significantly improved frontal protection against shaped-charge weapons. Many main battle tanks have some form of reactive armor in addition to their thick armor plate. Head-on, ground-level shots against these vehicles have little probability of obtaining a kill. Even without reactive armor, modern main battle tanks are hard to destroy with a light antiarmor weapon.

(6) The easiest technique to improve the probability of hitting and killing an armored vehicle is to increase the firing depression angle. A 45-degree downward firing angle doubles the probability of a first-round hit as compared to a ground-level shot.

b. Backblast. Backblast characteristics must be considered when employing all recoilless weapons. During combat in built-up areas, the backblast area in the open is more hazardous because of the loose rubble and the channeling effect of the narrow streets and alleys. Figure B-4 shows the backblast areas of Marine light recoilless weapons in the open.

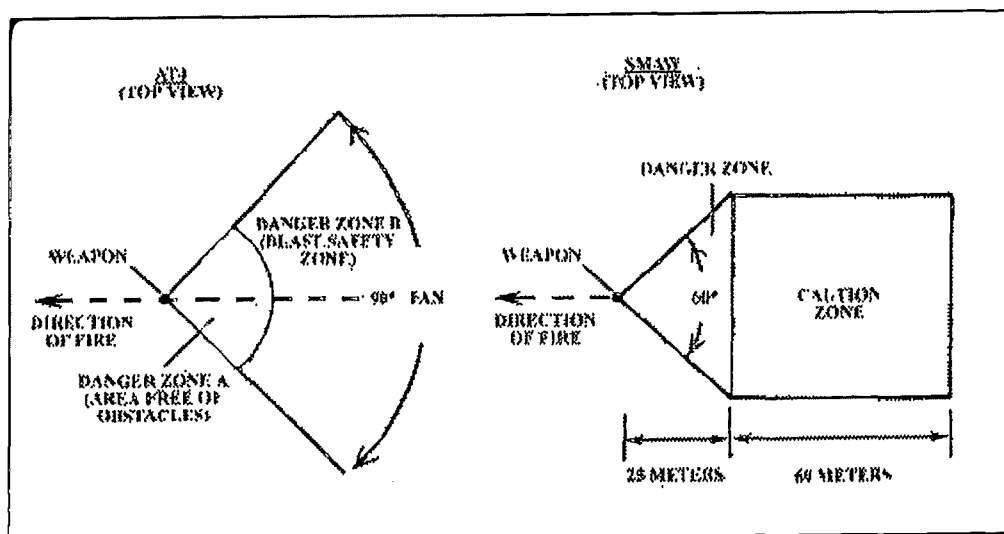


Figure B-4. Backblast Areas of Light Recoilless Weapons in the Open

(1) When firing recoilless weapons in the open, Marines should protect themselves from blast and burn injuries caused by the backblast. All personnel should be out of the danger zone. Anyone not able to vacate the caution zone should be behind cover. Marines in the caution zone should wear helmets, protective vests, and eye protection. The firer and all Marines in the area should wear earplugs.

(2) Extensive testing on the effects of firing recoilless weapons from within enclosures has been conducted since 1948. These tests showed that firing these weapons from enclosures presented no serious hazards, even when the overpressure was enough to produce structural damage to the building. The following were other findings of these tests.

(a) Little hazard exists to the gunnery or crew from any type of flying debris. Loose

items were not hurled around the room.

(b) No substantial degradation occurs to the operator's tracking performance as a result of obscuration or blast overpressure.

(c) The most serious hazard that can be expected is hearing loss. This must be evaluated against the advantage gained in combat from firing from cover. To place this hazard in perspective, a gunner wearing earplugs and firing the loudest combination (the Dragon from within a masonry building) is exposed to less noise hazard than if he fired a LAW or AT4 in the open without earplugs.

(d) The safest place for other Marines in the room with the firer is against the wall from which the weapon is fired. Plastic ignition plugs are a hazard to anyone standing directly behind a LAW or TOW when it is fired.

(e) Firers should take advantage of all available sources of ventilation by opening doors and windows. Ventilation does not reduce the noise hazard, but it helps clear the room of smoke and dust and reduces the effective duration of the overpressure.

(f) The only difference between firing these weapons from enclosures and firing them in the open is the duration of the pressure fluctuation.

(g) Frame buildings, especially small ones, can suffer structural damage to the rear walls, windows, and doors. Large rooms suffer slight damage, if any.

(3) Recoilless weapons fired from within enclosures create some obscuration inside the room but almost none from the gunner's position looking out. Inside the room, obscuration can be intense, but the room remains inhabitable.

(4) The Dragon causes the most structural damage, but only in frame buildings. There does not seem to be any threat of injury to the gunner because the damage is usually to the walls away from the gunner. The most damage and debris is from flying plaster chips and pieces of wood trim. Large chunks of plasterboard can be dislodged from ceilings. The backblast from a LAW, AT4, Dragon, or TOW rarely displaces furniture. Table B-9 shows the test results of structural damage and debris.

Building	Weapon	Damage		Debris Movement
		Structure	Wall Covering	
Masonry	LAW	None	Slight	Slight
	Dragon	None	Slight	Slight
Bunker	Dragon	None	None	None
	TOW	None	None	Leaves and dust disturbed
Small frame	LAW	None	Slight	None
	Dragon	Severe	Severe	None
Medium frame	LAW	None	None	Slight
	Dragon	Slight	Slight	Lamp and chair overturned
Large frame	LAW	None	Slight	Slight
	Dragon	Slight	Moderate	None
	TOW	Slight	Severe	None

Table B-9. Structural. Damage and Debris Movement

(5) To fire a LAW, AT4, or SMAW from inside a room, the following safety precautions must be taken (Figure B-5).

- (a) The building should be of a sturdy construction.
- (b) The ceiling should be at least 7 feet high with loose plaster or ceiling boards removed,
- (c) The floor size should be at least 15 feet by 12 feet. (The larger the room, the better.)
- (d) At least 20 square feet of ventilation (room openings) should exist to the rear or side of the weapon. An open 7- by 3-foot door would provide minimum ventilation.
- (e) All glass should be removed from windows, and small, loose objects should be removed from the room.
- (f) Floors should be wet to prevent dust and dirt from blowing around and obscuring the gunner's vision.
- (g) All personnel in the room should be forward of the rear of the weapon.
- (h) All personnel in the room should wear helmets, protective vests, ballistic eye protection, and earplugs.
- (i) If the gunner is firing from the prone position, his lower body must be perpendicular to the bore of the weapon, or the blast could cause injury to his legs.

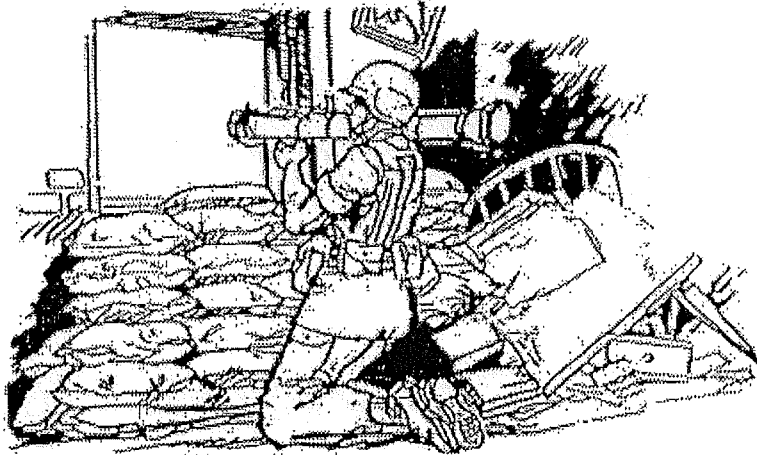


Figure B-5. Firing an AT4 From Inside a Building

c. Weapon Penetration. The most important tasks to be performed against structures are the neutralization of fortified firing positions, personnel, and weapons behind barriers. Recoilless weapons can be used in this role; none, however, are as effective as heavy, direct-fire weapons or standard demolitions. Each recoilless weapon has different penetrating ability against various targets. Penetration does not always mean the destruction of the integrity of a position. Usually only those enemy soldiers directly in the path of the spall from a high-explosive antitank (HEAT) round become casualties. Other soldiers inside a fortification could be deafened, dazed, or shocked but could eventually return to action.

(1) AT4. The AT4 is heavier than the LAW and has a diameter of 84 millimeters, which gives the warhead much greater penetration. The AT4 can penetrate more than 17.5 inches (450 mm) of armor plate. Its warhead produces highly destructive results behind the armor. Tests against typical urban targets are still ongoing, but the AT4 should penetrate at least as well as the 90-mm recoilless rifle, if not better. The AT4 has a *minimum arming distance* of 10 meters, which allows it to be fired successfully against close targets. Firers should be well covered and protected when firing at close targets.

(2) MK153 83-mm SMAW. The SMAW is a lightweight assault weapon that is easily carried and placed into action by one man. It is used against fortified positions, but it is also effective against LAVs. The SMAW has a 9-mm spotting rifle and a 3.8-power telescope that ensure accuracy over ranges common to combat in built-up areas. The SMAW has excellent incapacitating effects for enemies behind walls and inside bunkers and can arm within 10 meters. Its fuze has the ability to distinguish between armor and soft earth, maximizing its capabilities against buildings, bunkers, or light armor. The warhead detonates immediately against hard targets but delays detonation against soft targets and burrows in to explode inside. The SMAW can destroy most bunkers with a single hit. The 83-mm HE warhead can create an 8-inch mousehole in reinforced concrete but will not cut the steel reinforcing bar. The SMAW is an outstanding urban support weapon that can be decisive during an urban assault. The SMAW allows for quick reduction of obstacles and bunkers as well as creation of entry points. SMAWs fired in a volley can be devastating to a building.

d. Wall Breaching. Wall breaching is a common combat task in built-up areas for which light recoilless weapons can be used. Breaching operations improve mobility by providing access to

building interiors without using existing doors or windows. Breaching techniques can also be used to create loopholes for weapons positions or to allow hand grenades to be thrown into defended structures. Breaching holes for unit mobility should be about 24 inches (60 centimeters) in diameter. Loopholes should be about 8 inches (20 centimeters) in diameter. Only the SMAW provides a one-shot wall breaching ability. However, in breaching walls a number of shots should be planned.

(1) Of all the common building materials, heavy stone is the most difficult to penetrate. The AT4 normally will not penetrate a heavy European-style stone wall. Surface cratering is usually the only effect it will have.

(2) Layered brick walls are also difficult to breach with light recoilless weapons. Some brick walls can be penetrated by multiple firings, especially if they are less than three bricks thick. Multiple AT4 rounds fired at the same spot on an 8-inch (double-brick) wall normally produce a loophole. The SMAW produces a hole in brick walls that is often large enough to be a breach hole.

(3) Wooden structural walls offer little resistance to light recoilless weapons. Even heavy timbered walls are penetrated and splintered. Multiple AT4 rounds fired at the same area of a wood-framed wall usually produce a man-sized hole. The SMAW has a devastating effect against wood-framed walls. A single round produces a breach hole as well as significant spall.

(4) Because of its high velocity, the AT4 may penetrate a soft target such as a car body or frame building before exploding.

(5) None of the light recoilless weapons are as effective against structural walls as demolitions or heavier weapons such as tank main guns or field artillery. Of all the light recoilless weapons, the SMAW is the most effective.

6. Antitank Guided Missiles. ATGMs are used mainly to defeat main battle tanks and other armored combat vehicles. They have a moderate capability against bunkers, buildings, and other fortified targets commonly found during combat in built-up areas. This category of weapons includes the TOW and Dragon missiles.

a. Employment. TOWs and Dragons provide overwatch antitank fires during the attack of a built-up area and an extended range capability for the engagement of armor during the defense. Within built-up areas, they are best employed along major thoroughfares and from the upper stories of buildings to attain long-range fields of fire. Their *minimum firing range* of 65 meters could limit firing opportunities in the confines of densely built-up areas.

(1) **Obstacles.** Rubble or other obstacles could interfere with the flight of missiles when fired from street level. At least 3.5 feet (1 meter) of vertical clearance over such obstacles must be maintained. Figure B- 7 shows the most common obstacles to A TGM flight that are found in built-up areas. *Power lines are a special obstacle and present a unique threat to A TGM gunners. If the power in the lines has not been interrupted, the A TGM guidance wires could create a short circuit. This would allow extremely high voltage to pass to the gunner in the brief period before the guidance wires melted. This voltage could either damage the sight and guidance system or injure the gunner. Before any A TGM is fired over a power line, an attempt must be made to determine whether or not the power to that line has been interrupted.*

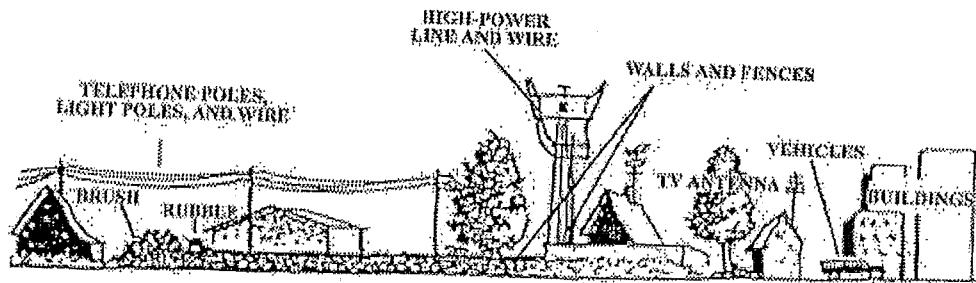


Figure B- 7. Common Obstacles to A TGM Flights

(2) Dead Space. Three aspects of dead space that affect ATOM fires are arming distance, maximum depression, and maximum elevation.

(a) Both the Dragon and TOW missiles have a minimum arming distance of 65 meters, which severely limits their use in built-up areas. Few areas in the inner city permit fires much beyond the minimum arming distance. However, ground-level, long-range fires down streets or rail lines and across parks or plazas are possible. ATGMs may be used effectively from upper stories or roofs of buildings to fire into other buildings.

(b) The TOW is limited much more than the Dragon by its maximum depression and elevation. The maximum depression and elevation limits of the TOW mount could result in dead space and preclude the engagement of close targets (Figure B-8). A target located at the minimum arming range (65 meters) cannot be engaged by a TOW crew located any higher than the sixth floor of a building due to maximum depression limits. At 100 meters, the TOW crew can be located as high as the ninth floor and still engage the target.

(3) Backblast. Backblast for ATGMs is of more concern during combat in built-up areas than in open country. Any loose rubble in the caution zone could be picked up and thrown by the backblast, and the channeling effect of walls and narrow streets is even more pronounced due to the greater backblast. If the ATGM backblast strikes a wall at an angle, it can pick up debris or be deflected and cause injury to unprotected personnel (Figure B-9). Both types of ATGM can be fired from inside some buildings. In addition to the helmet and protective vest, eye protection and earplugs should be worn by all personnel in the room.

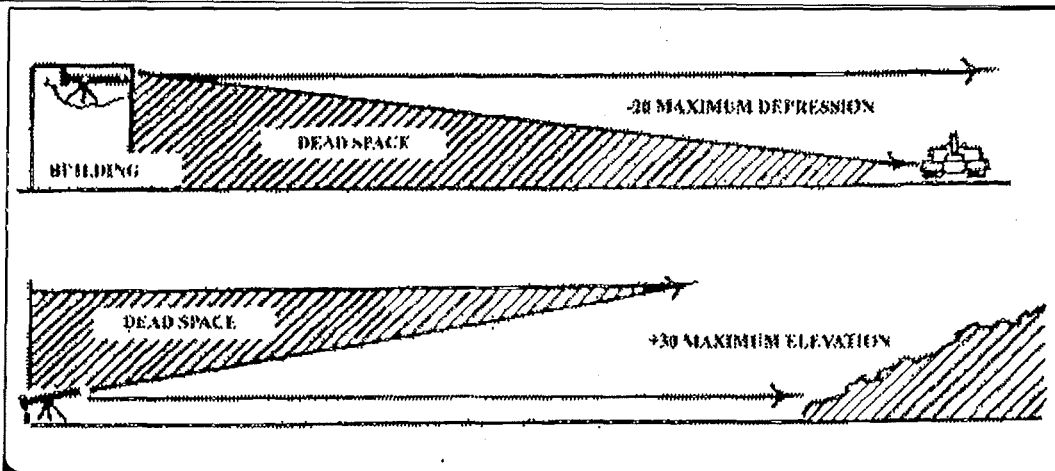


Figure B-8. TOW Maximum Elevation and Depression Limitations

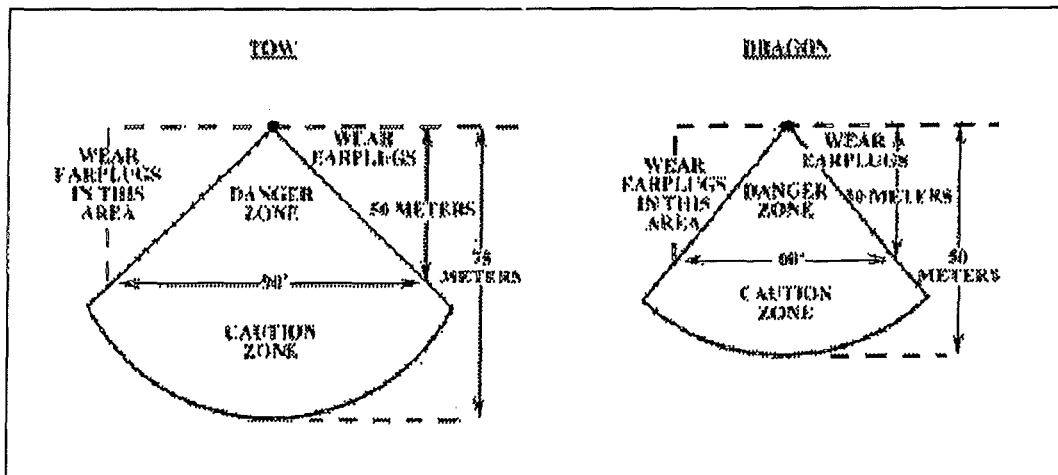


Figure B-9. ATGM Backblast in an Open Street

(a) To fire a TOW from inside a room, the following safety precautions must be taken (Figure B-10):

- The building must be of sturdy construction.
- The ceiling should be at least 7 feet high.
- The floor size of the room should be at least 15 by 15 feet, or larger if possible.
- At least 20 square feet of room ventilation should exist, preferably to the rear of the weapon. An open 7- by 3-foot door is sufficient. Additional ventilation can be created by removing sections of interior partitions.
- All glass must be removed from the windows and all small, loose objects removed from the room.
- All personnel in the room should be forward of the rear of the TOW.
- All personnel in the room should wear ballistic eye protection and earplugs
- A clearance of 9 inches (23 centimeters) must exist between the launch tube and the aperture from which it is fired. (See PM 23-34, *TOW Weapon System*, for more detailed safety information.)

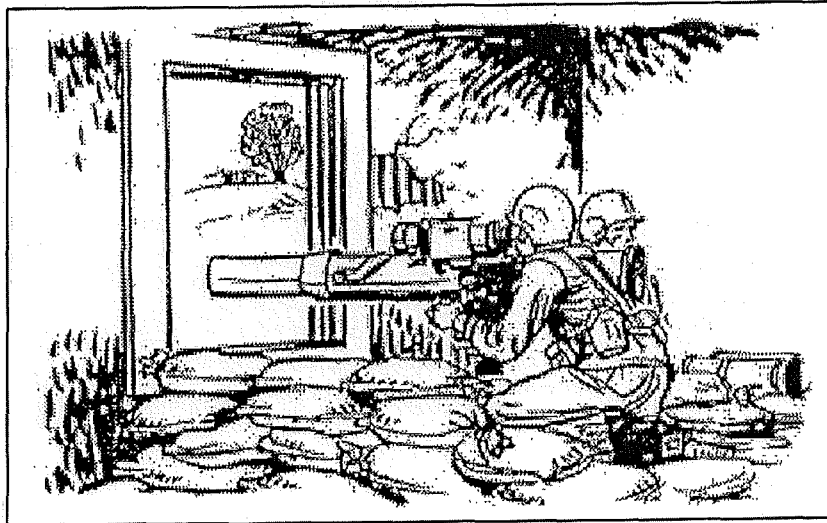


Figure B-10. TOW Fired From Inside a Room

(b) To fire a Dragon from inside a room, the following safety precautions must be taken.

- The building must be of sturdy construction.
- The ceiling should be at least 7 feet high.
- The floor size should be at least 15 by 15 feet, or larger if possible
- At least 20 square feet of ventilation should exist (room openings), preferably to the rear of the weapon. An open 7- by 3-foot door would provide minimum ventilation.
- All glass should be removed from windows, and small, loose objects should be removed from the room.
- The room should be clean or the floors must be wet to prevent dust and dirt (kicked up by the backblast) from obscuring the vision of other soldiers in the room.
- All personnel in the room must be forward of the rear of the weapon.
- All personnel in the room must wear ballistic eye protection and earplugs.
- At least a 6-inch clearance must exist between the launch tube and the aperture from which it is fired.

b. Weapon Penetration. ATGMs can penetrate and destroy heavily armored tanks. They have large warheads that contain shaped charges. Because of their size, these warheads can achieve significant penetration against typical urban targets. Penetration, however, does not mean a concurrent destruction of the structural integrity of a position. The shaped-charge warhead produces relatively little spall. Enemy personnel not standing directly behind or near the point of impact of an ATGM may escape injury.

(1) Standard TOW Missiles. The basic TOW missile can penetrate 8 feet of packed earth, 4 feet of reinforced concrete, or 16 inches of steel plate. The improved TOW (ITOW), the TOW 2, and the TOW 2A have all been modified to improve their penetration. They all penetrate better than the basic TOW. All TOW missiles can defeat triple sandbag walls, double layers of earth-filled 55-gallon drums, and 18-inch log walls.

(2) TOW 2B. The TOW 2B uses a different method of defeating enemy armor. It flies over

the target and fires an explosively formed penetrator down onto the top armor, which is thinner. *Because of this design feature, the TOW 2B missile cannot be used to attack nonmetallic structural targets. When using the TOW 2B missile against enemy armor, gunners must avoid firing directly over other friendly vehicles, disabled vehicles, or large metal objects such as water or oil tanks.*

(3) Dragon Missile. The Dragon missile can penetrate 8 feet of packed earth, 4 feet of concrete, or 13 inches of steel plate. It can attain effective short-range fire from upper stories or from the rear or flanks of a vehicle. These engagements are targeted against the most vulnerable parts of tanks and can entrap tanks in situations where they are unable to counterfire. Elevated firing positions increase the first-round hit probability. Firing down at an angle of 20 degrees increases the chance of a hit by 67 percent at 200 meters. A 45-degree downward angle doubles the first-round hit probability, compared to ~ ground-level shot.

c. Breaching Structural Walls. Firing ATGMs is the least efficient means to defeat structures. Because of their small basic load and high cost, ATGMs are better used against tanks or enemy-fortified firing positions. They can be effective against bunkers or other identified enemy firing positions.

7. Flame Weapons. Flame weapons are characterized by both physical and psychological casualty-producing abilities. Flame does not need to be applied with pinpoint accuracy, but it also must not spread to structures needed by friendly forces. Large fires in built-up areas are catastrophic. If they burn out of control, fires can create an impenetrable barrier for hours. The Marine Corps does not possess flame-generating equipment. However, the M34 WP grenade can be used to ignite and destroy flammable objects, especially wooden structures. The Army's M2AI-7 portable flamethrower is stored in war reserve status as a standard "c" item. Its availability is limited; however, Marines could be issued flame-support weapons for urban operations depending on the status of international agreements on the use of flame weapons that are in effect at the time.

a. Employment. Flame weapons used against fortified positions should be aimed directly at the aperture. Even if the round or burst misses, enough flaming material enters the position to cause casualties and disrupt the enemy occupants. The M34 WP grenade is difficult to throw far or into a small opening such as a bunker aperture. However, its effects are dramatic when thrown into a room or building.

b. Effects. The M34 is used to ignite and destroy flammable objects, especially wooden structures. It is also used to create an immediate smoke cloud to conceal movement across a narrow open space such as a street. Its smoke is not toxic but can cause choking in heavy concentrations.

(1) The grenade's explosion, bright flash, smoke, and burning WP particles all combine to make the M34 one of the most effective psychological weapons available. The M34 hand grenade throws WP fragments up to 35 meters from the point of detonation. These fragments can attach to clothing or skin and continue burning. Because of its weight, most infantrymen can throw this grenade only 30 to 40 meters.

(2) The Marine must avoid injury from friendly use of the M34. The M34 can ignite if the WP inside is exposed to the air. Bullets and shell fragments have been known to strike and rupture M34 grenades; therefore, grenades must be protected from enemy fire.

(3) The M34 WP grenade is an effective weapon against enemy armored vehicles when used in the close confines of combat in built-up areas. It can be thrown or dropped from upper stories onto enemy vehicles. The M34 can be combined with flammable liquids, detonating cords, blasting caps, and fuze igniters to create the eagle fireball, a field-expedient anti armor device. (See FM 21-75, *Combat Skills of the Soldier*, Appendix H.)

(4) The M34 is also excellent as a screening device. A grenade can be thrown from behind cover into an open street or plaza. When it explodes, the enemy's observation is temporarily obscured. Thus, friendly forces can quickly cross the open area-if the enemy fires, it is unaimed and presents less of a danger. If screening smoke is used to cover a squad's movement across short open areas, it will reduce expected casualties from small-arms fire by about 90 percent.

8. Hand Grenades. Hand grenades are used extensively during combat in built-up areas. Smoke grenades are used for screening and signaling. Riot control grenades are used to drive the enemy out of deep fortifications. Fragmentation and concussion grenades are used to clear the enemy out of rooms and basements. Hand grenades are the most-used explosive munition during intense combat in built-up areas. In World War II, it was common for a battalion fighting in a city to use more than 500 hand grenades each day.

a. Employment. Smoke and riot-control grenades have similar employment techniques. Fragmentation grenades are used to produce enemy casualties.

(1) The AN-M8 HC grenade produces a dense white or grey smoke. It burns intensely and cannot be easily extinguished once it ignites. The smoke can be dangerous in heavy concentrations because it makes breathing difficult and causes choking. The M8 grenade is normally used for screening. It produces a slowly building screen of longer duration than the M34 WP grenade without the problem of collateral damage caused by scattered burning particles.

(2) The M18-series smoke grenades produce several different colors of smoke that are used for signaling. Yellow smoke is sometimes difficult to see in built-up areas.

(3) The M7 A3 CS riot control grenade can be used to drive enemy troops out of fortifications when civilian casualties or collateral damage constraints are considerations. Built-up areas often create variable and shifting wind patterns. When using CS grenades, Marines must prevent the irritating smoke from affecting friendly forces. The CS grenade burns intensely and can ignite flammable structures. Enemy troops wearing even rudimentary chemical protective masks can withstand intense concentrations of CS gas.

(4) The MK3A2 offensive hand grenade, commonly referred to as the concussion grenade, produces casualties during close combat while minimizing the danger to friendly personnel. For this reason, it is the preferred hand grenade for use during offensive operations in a MOUT environment. The grenade produces severe concussion effects in enclosed areas. It can be used for light blasting and demolitions and for creating breach holes in interior walls. The concussion produced by the MK3A2 is much greater than that of the fragmentation grenade. It is very effective against enemy soldiers within bunkers, buildings, and underground passages.

(5) The M67 fragmentation grenade is the most commonly available grenade during combat in built-up areas. It provides suppression during room-to-room or house-to-house fighting, and it is used while clearing rooms of enemy personnel. The M67 grenade has a 3- to 5-second delay fuze. When used at close ranges, it can be cooked-off for two seconds to deny the enemy the time to throw it back. The fragmentation grenade can be rolled, bounced, or ricocheted into areas that cannot be reached by 40-mm grenade launchers.

b. Effects. Each type of hand grenade has its own specific effect during combat in built-up areas.

(1) Both HC smoke and CS gas *displace* oxygen from enclosed areas. Gas masks will not prevent this from occurring because they only filter air, not provide oxygen. Smoke grenades produce dense clouds of colored or white smoke that remain stationary in the surrounding area. They can also cause fires if used indiscriminately. If trapped and concentrated within a small space, smoke grenades and CS gas *can suffocate Marines*.

(2) The fragmentation grenade has more varied effects in combat in built-up areas. It produces a large amount of small, high-velocity fragments that can penetrate sheetrock partitions and are lethal at short ranges (15 to 20 meters). Fragments lose their velocity quickly and are less effective beyond 25 meters. The fragments from a fragmentation grenade cannot penetrate a single layer of sandbags, a cinder block, or a brick building, but they can perforate wood-framed and tin buildings if exploded close to their walls.

(3) Inside rooms, fragmentation barriers consisting of common office furniture, mattresses, doors, or books can be effective against the fragmentation grenade. For this reason, a room should never be considered safe just because one or two grenades have been detonated inside. Fragmentation grenades detonated on the floor not only throw fragments laterally, but also send fragments and spall downward to lower floors. Predicting how much spall will occur is difficult because flooring material varies, but wooden floors are usually affected the most.

(4) Some foreign grenades throw fragments that are much larger than those of the U.S.-made M67. Light barriers and interior walls would probably be less effective against these grenades than against the M67. A major problem with the U.S.-made fragmentation grenade is its tendency to bounce back off of hard targets. Grenades are often directed at window openings on the ground floor or second floor. At ranges as close as 20 meters, a thrower's chances of missing a standard 1-meter by 1-meter window are high. The fragmentation grenade normally breaks through standard window glass and enters a room. If the grenade strikes at a sharp angle or the glass is thick plate, the grenade could be deflected without penetrating.

(5) Hand grenades are difficult weapons to use. They involve a high risk of fratricide. Commanders should conduct precombat training with hand grenades as part of normal preparations. Marines must be very careful when throwing hand grenades up stairs to avoid having the grenade roll back down on them.

(6) Once pulled, the pins of both fragmentation and concussion grenades can be replaced if the thrower decides not to use the weapon. This pin replacement must be done carefully

(see FM 23-30, *Grenades and Pyrotechnic Signals*) and prior to the spoon being released or detaching.

(7) An estimate of the situation (METT - T) and existing ROE will dictate what type of grenade will be used to clear each room. Because of the high rate of expenditure of grenades, units should use assault packs to carry additional grenades of all types. Additional grenades can also be carried in empty ammunition or canteen pouches.

9. 25-mm Automatic Gun. The 25-mm automatic gun mounted on the LA V -25 is an effective weapon during combat in built-up areas. The primary roles of LA V -25s during combat in built-up areas are to provide suppressive fire and to breach exterior walls and fortifications.

a. Obliquity. The 25-mm gun produces its best urban target results when fired perpendicular to the hard surface (zero obliquity). In combat in built-up areas, however, finding a covered firing position that permits low-obliquity firing is unlikely unless the streets and gaps between buildings are wide. Most shots impact the target at an angle, which normally reduces penetration. With the armor-piercing, discarding, sabot with tracer (APDS- T) round, an angle of obliquity of up to 20 degrees can actually improve breaching. The rounds tend to dislodge more wall material for each shot but do not penetrate as deeply into the structure.

b. Target Types. The 25-mm gun has different effects when fired against different urban targets.

(1) Reinforced Concrete. Reinforced concrete walls, which are 12 to 20 inches thick, present problems for the 25-mm gun when trying to create breach holes. It is relatively easy to penetrate, fracture, and clear away the concrete, but the reinforcing rods remain in place. These create a 'jail window' effect by preventing entry but allowing grenades or rifle fire to be placed behind the wall. Steel reinforcing rods are normally 3/4 of an inch thick and 6 to 8 inches apart--there is no quick way of cutting these rods. They can be cut with demolition charges, cutting torches, or special power saws. Firing with either APDS-T or high-explosive, incendiary with tracer (HEI-T) rounds from the 25-mm gun will not always cut these rods.

(2) Brick Walls. Brick walls are more easily defeated by the 25-mm gun regardless of their thickness, and they produce the most spall.

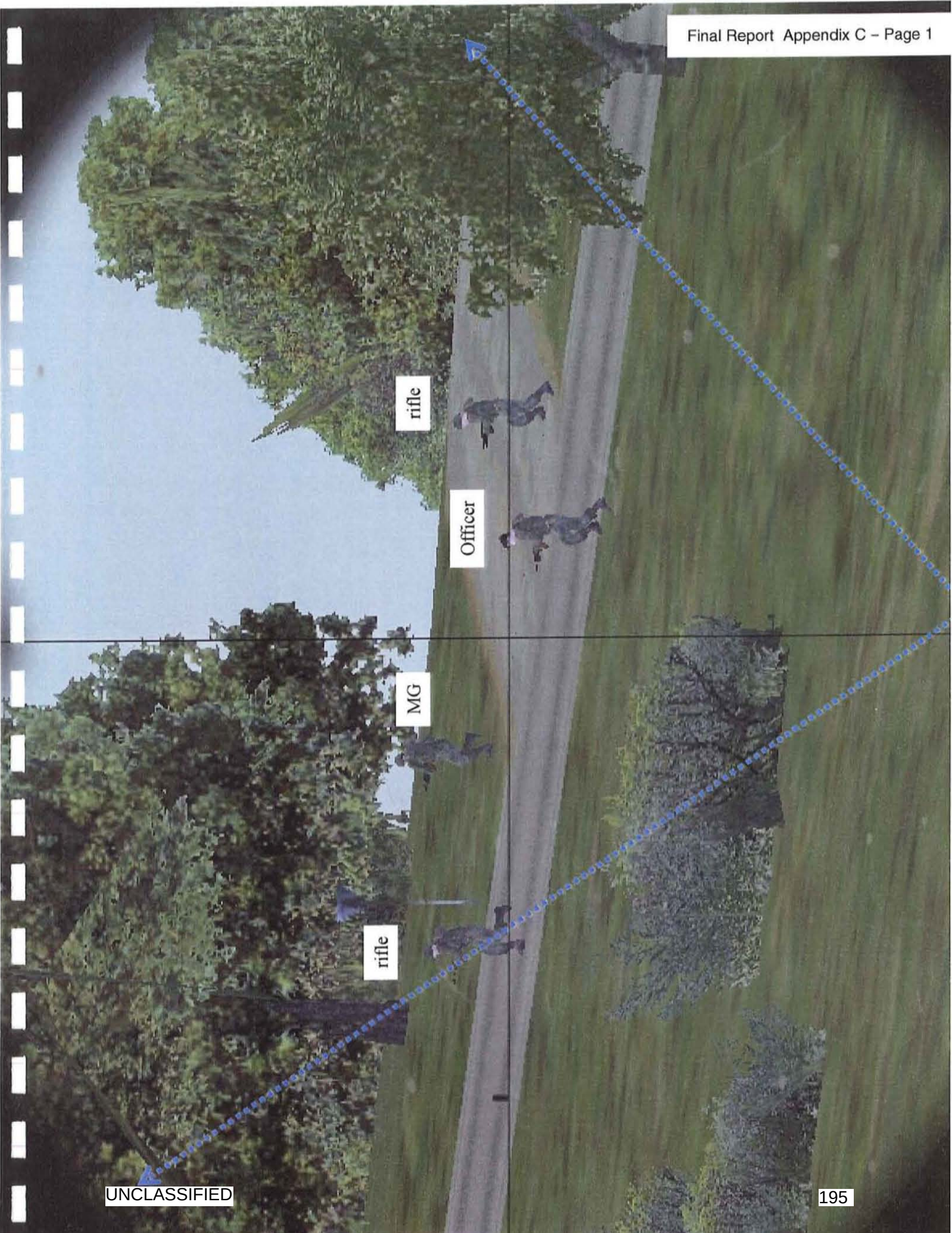
(3) Bunker Walls. The 25-mm gun is devastating when fired against sandbag bunker walls. Obliquity has the least effect on the penetration of bunker walls. Bunkers with earth walls up to 36 inches thick are easily penetrated. At short ranges typical of combat in built-up areas, defeating a bunker should be easy, especially if the 25-mm gun can fire at an aperture.

c. Burst Fire. The 25-mm gun's impact on typical urban targets seems to be magnified if the firing is in short bursts. At close ranges, the gunner might need to shift his point of aim in a spiral pattern to ensure that the second and third bursts enlarge the hole. Even without burst fire, sustained 25-mm gunfire can defeat almost all urban targets.

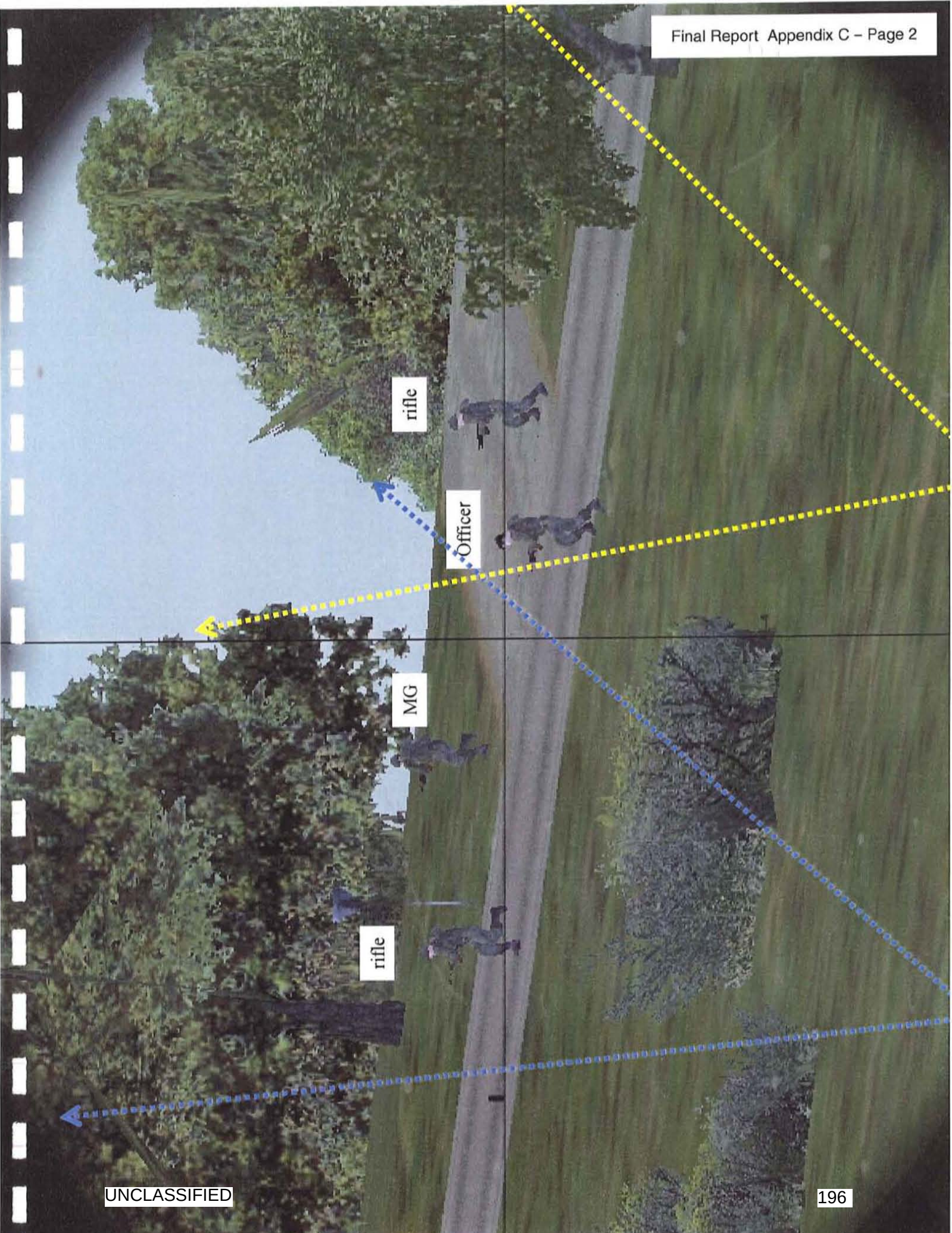
d. Weapon Penetration. The penetration achieved by the two combat rounds (HEI-T and APDS- T) differs slightly, but both are effective.

APPENDIX C

OPEN FIELD SLIDES



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Open Field Movie #5 Inserted Here

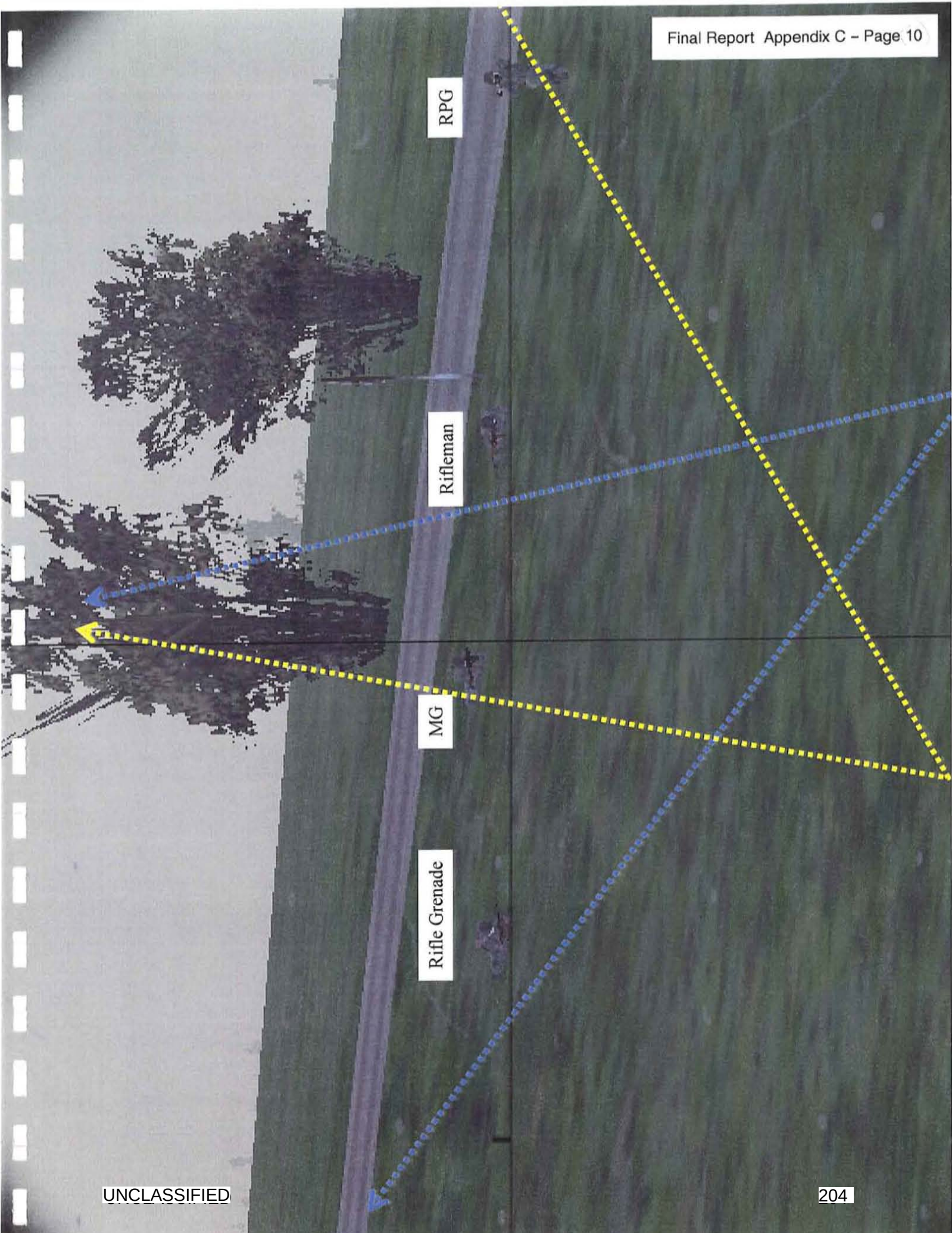
Open Field Movie #6 Inserted Here

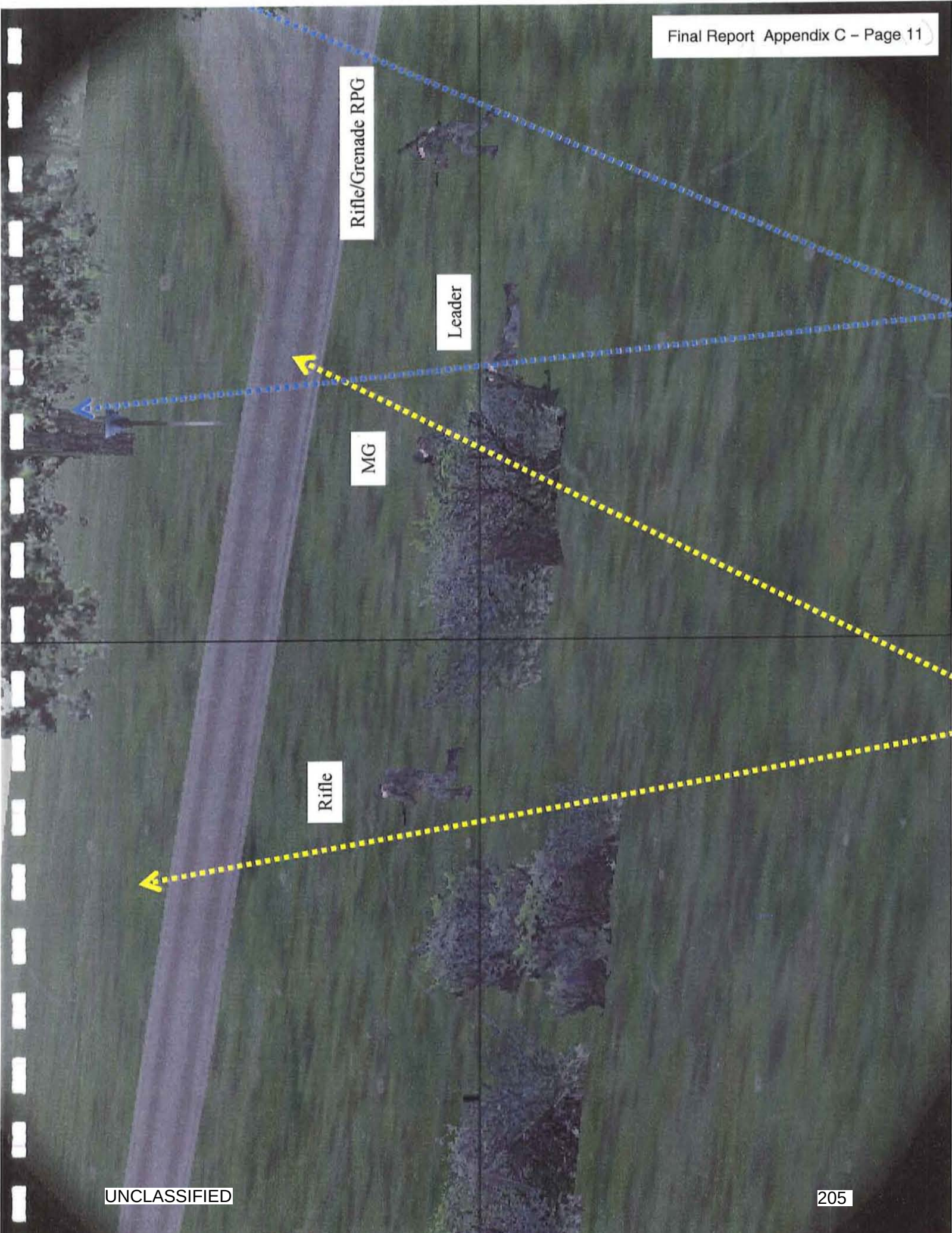
Rifleman - well
placed fire

MG

Officer

UNCLASSIFIED



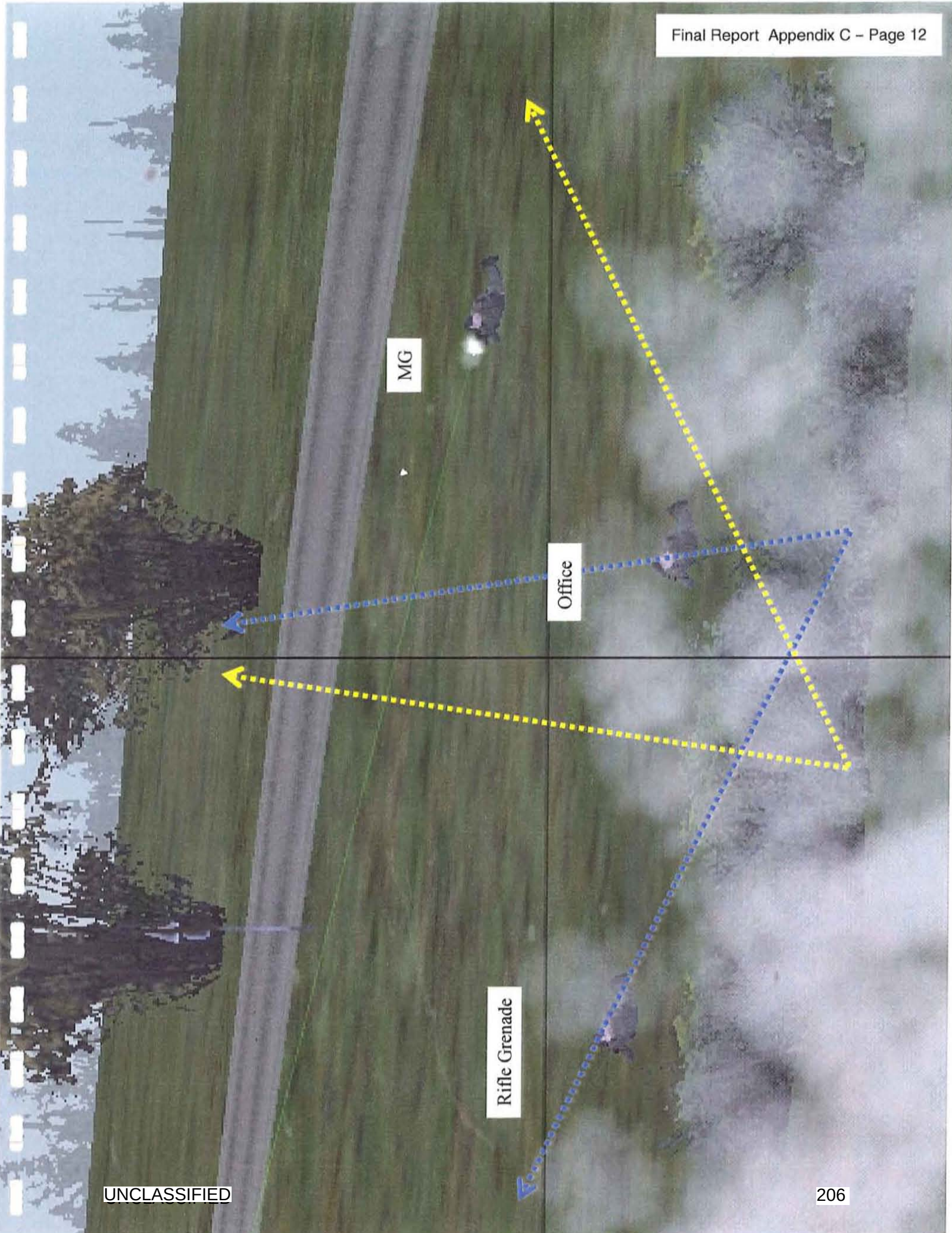


Rifle/Grenade RPG

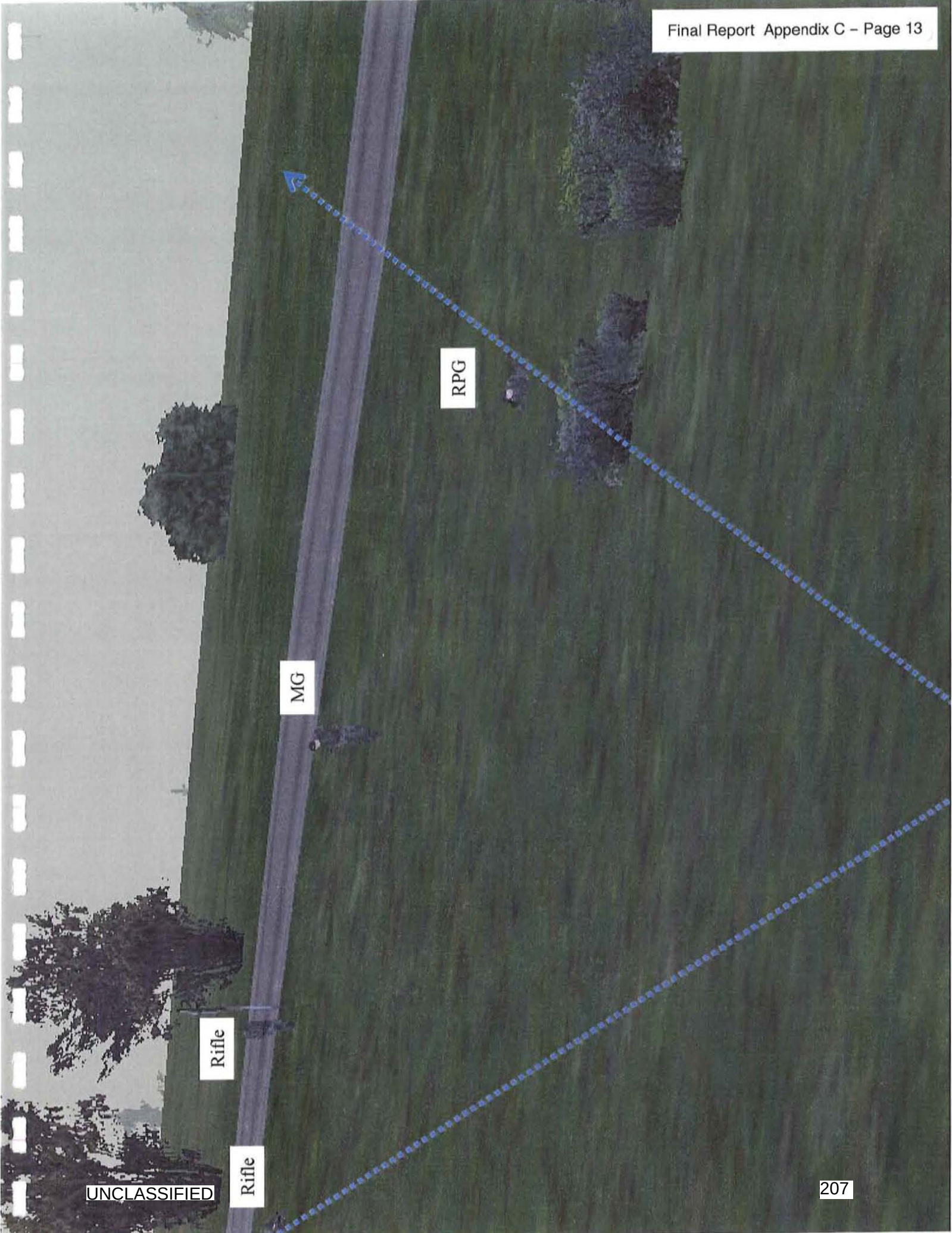
Leader

MG

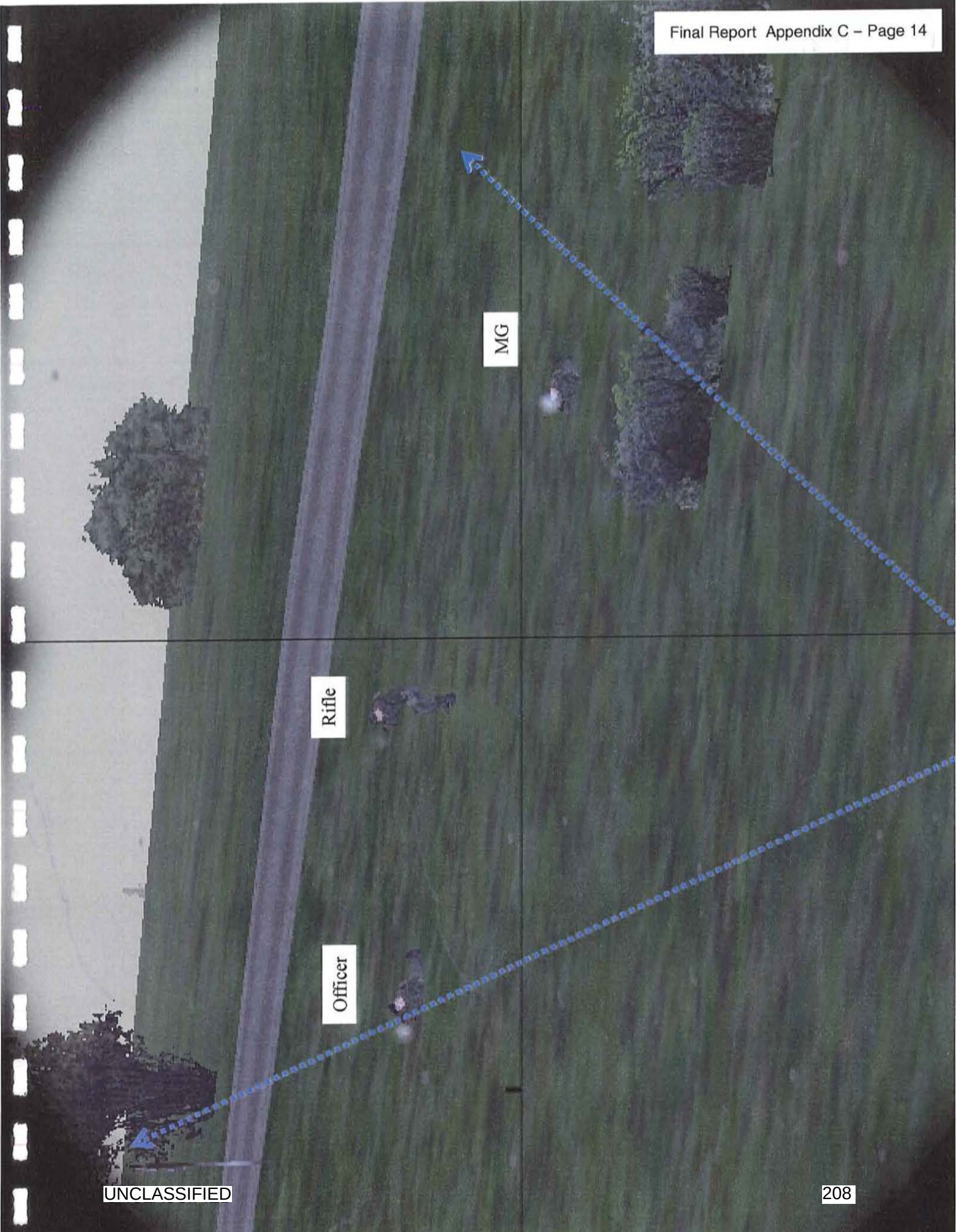
Rifle



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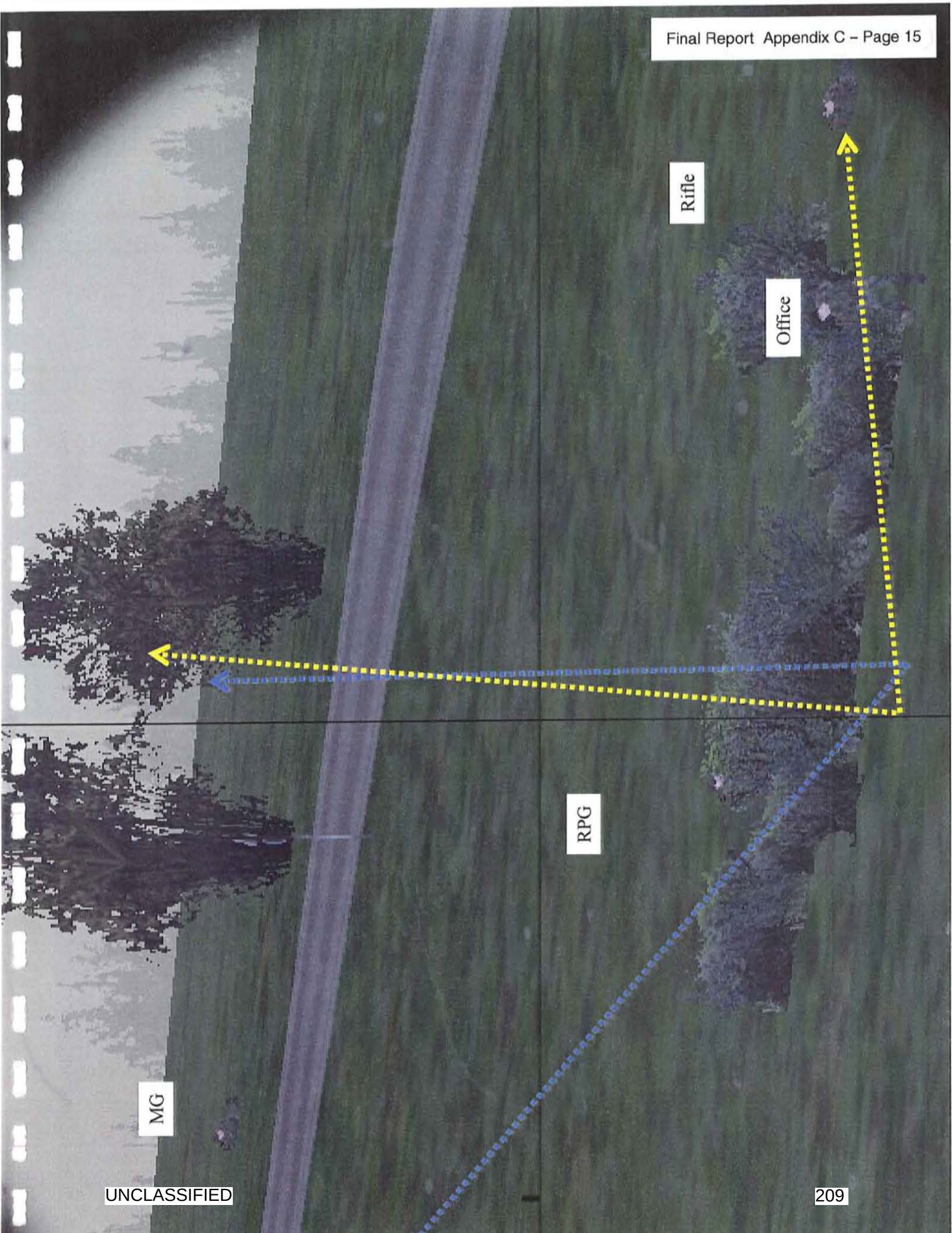


MG

Rifle

Officer

UNCLASSIFIED



Rifle – well pl

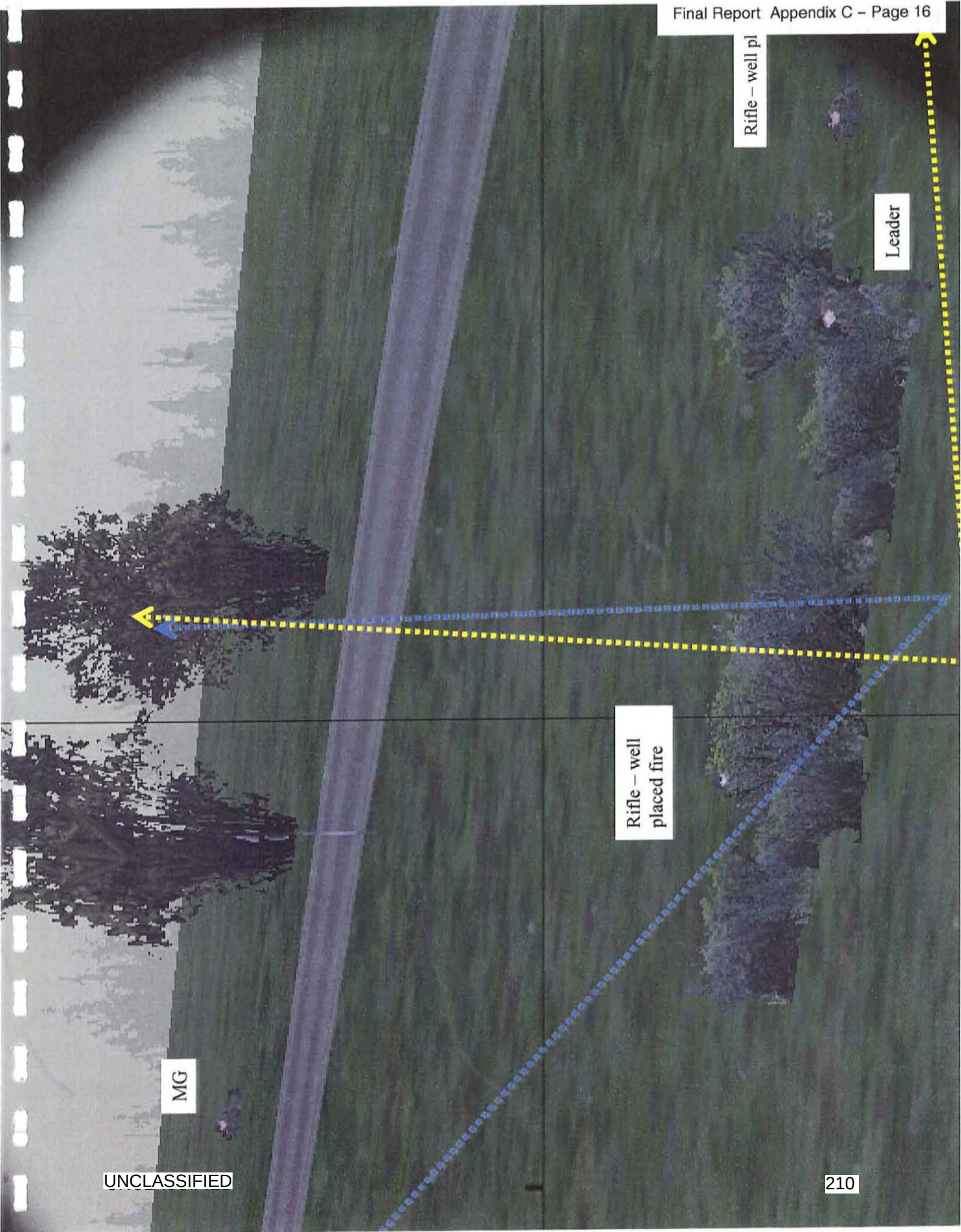
Leader

Rifle – well
placed fire

MG

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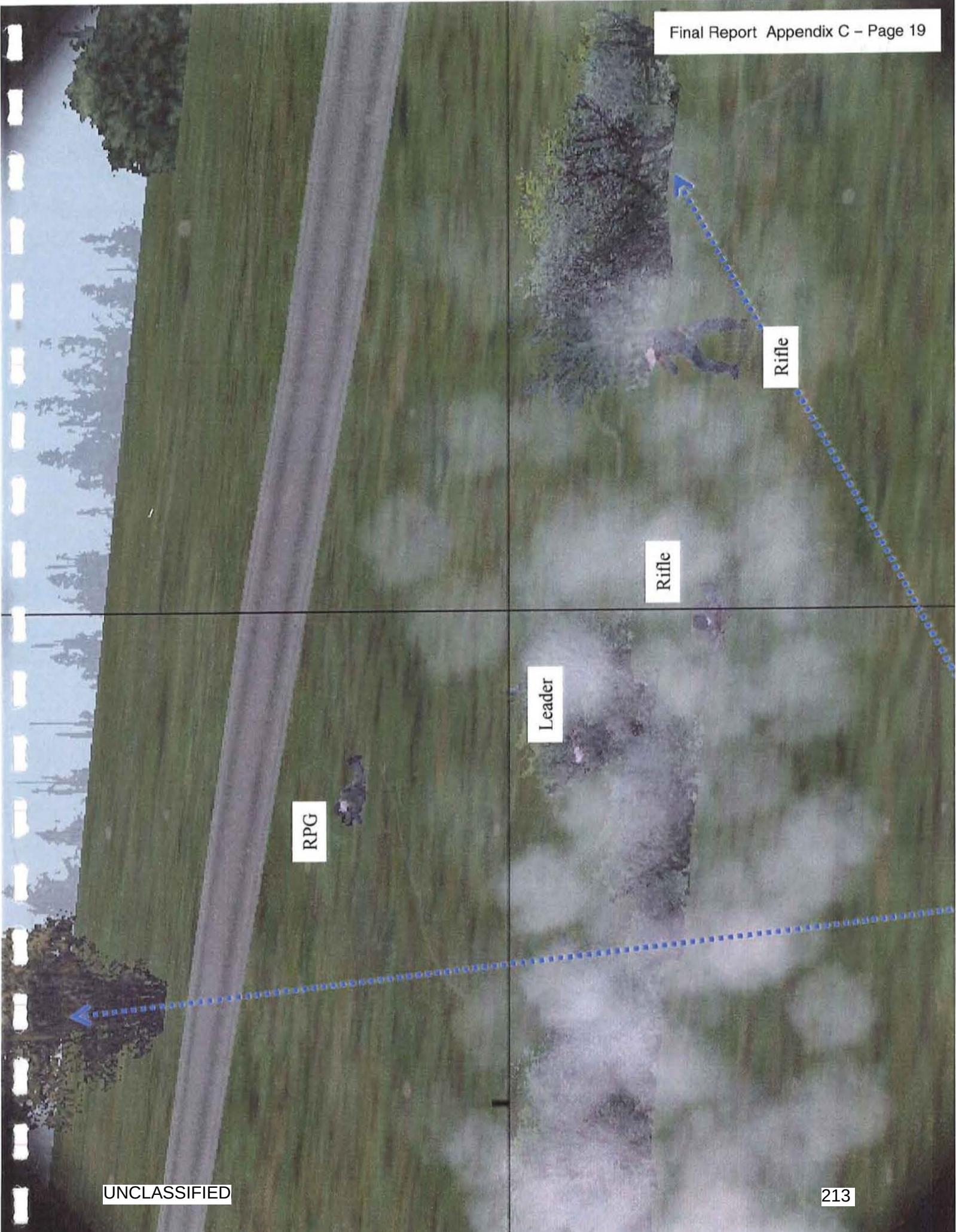
210







UNCLASSIFIED



Leader

Rifle

MG

UNCLASSIFIED

214



Rifle/Grenade RPG

MG

UNCLASSIFIED

216

150

50

Leader

Rifle/Grenade RPG

UNCLASSIFIED

217

150

50

Open Field Movie #7 Inserted Here

leader

rifle

leader

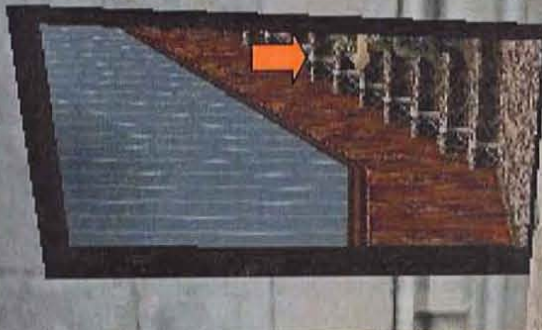
rifle

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APPENDIX D

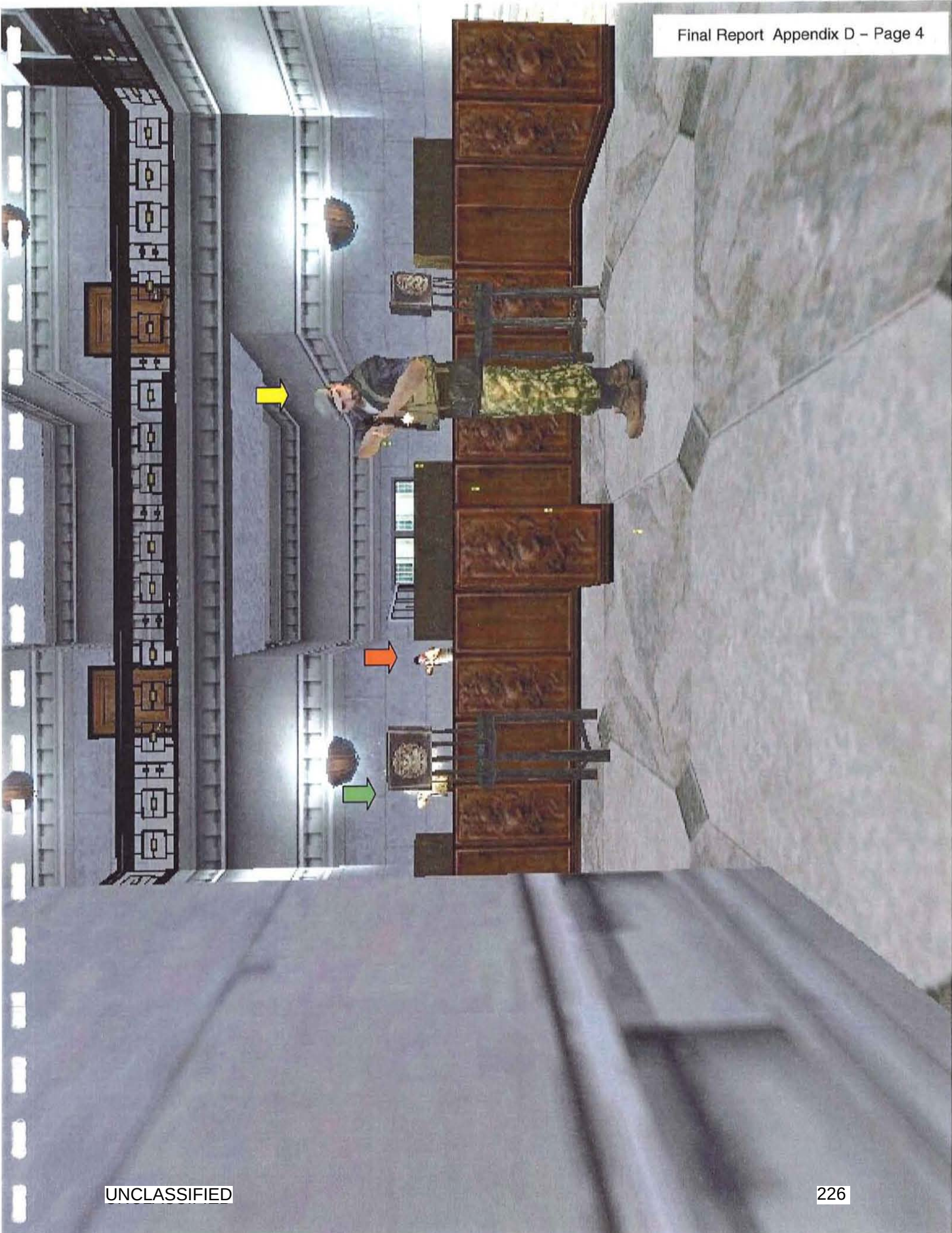
MOUT SLIDES

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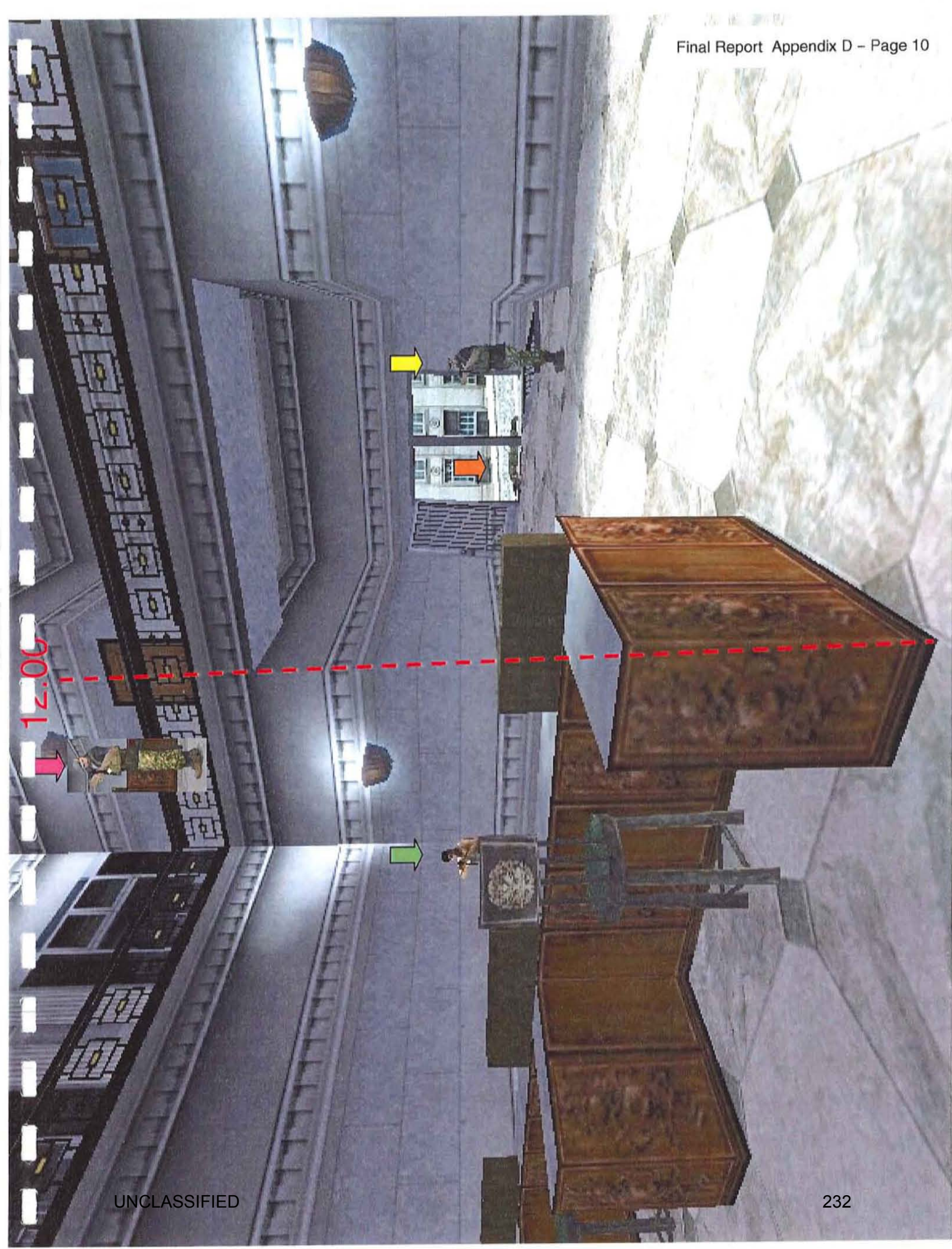


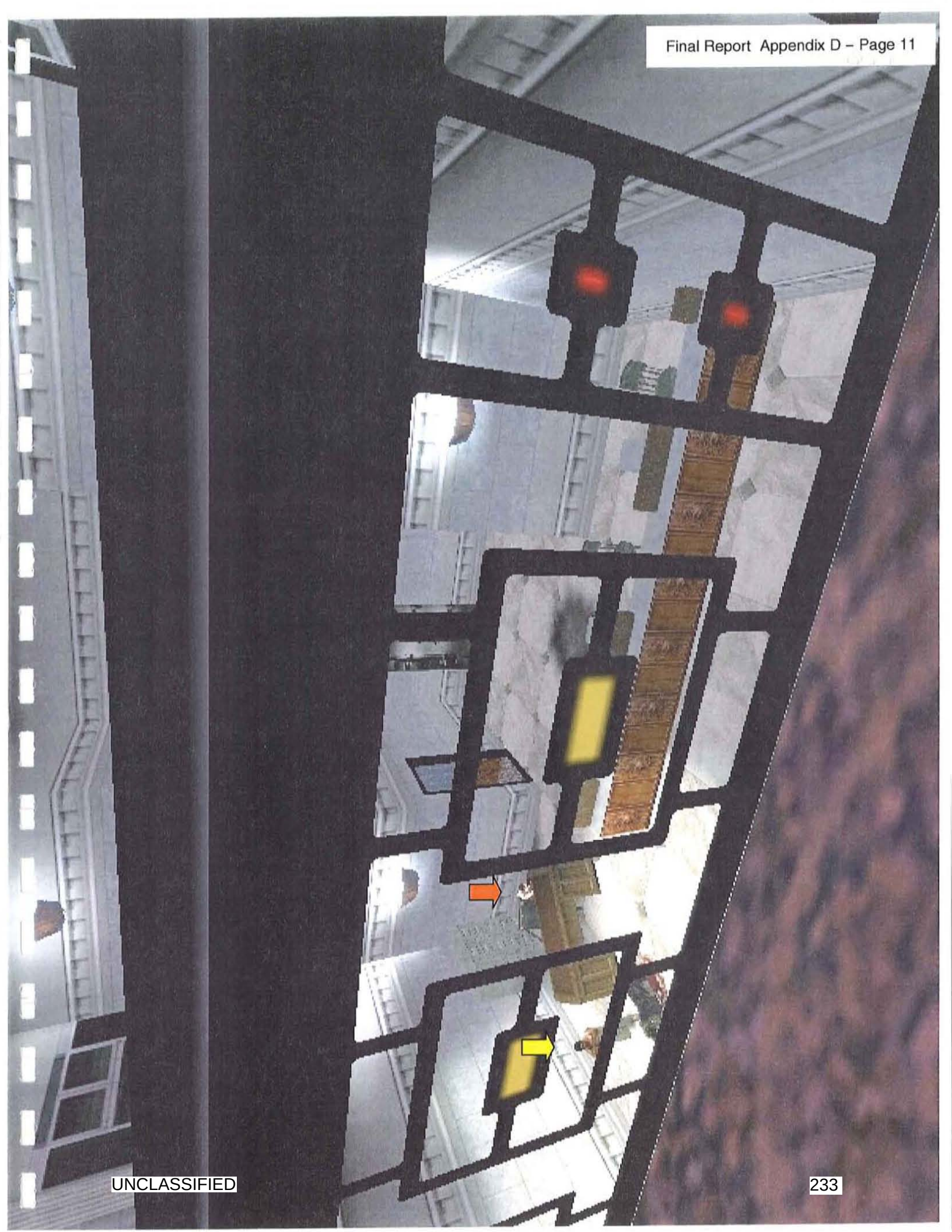


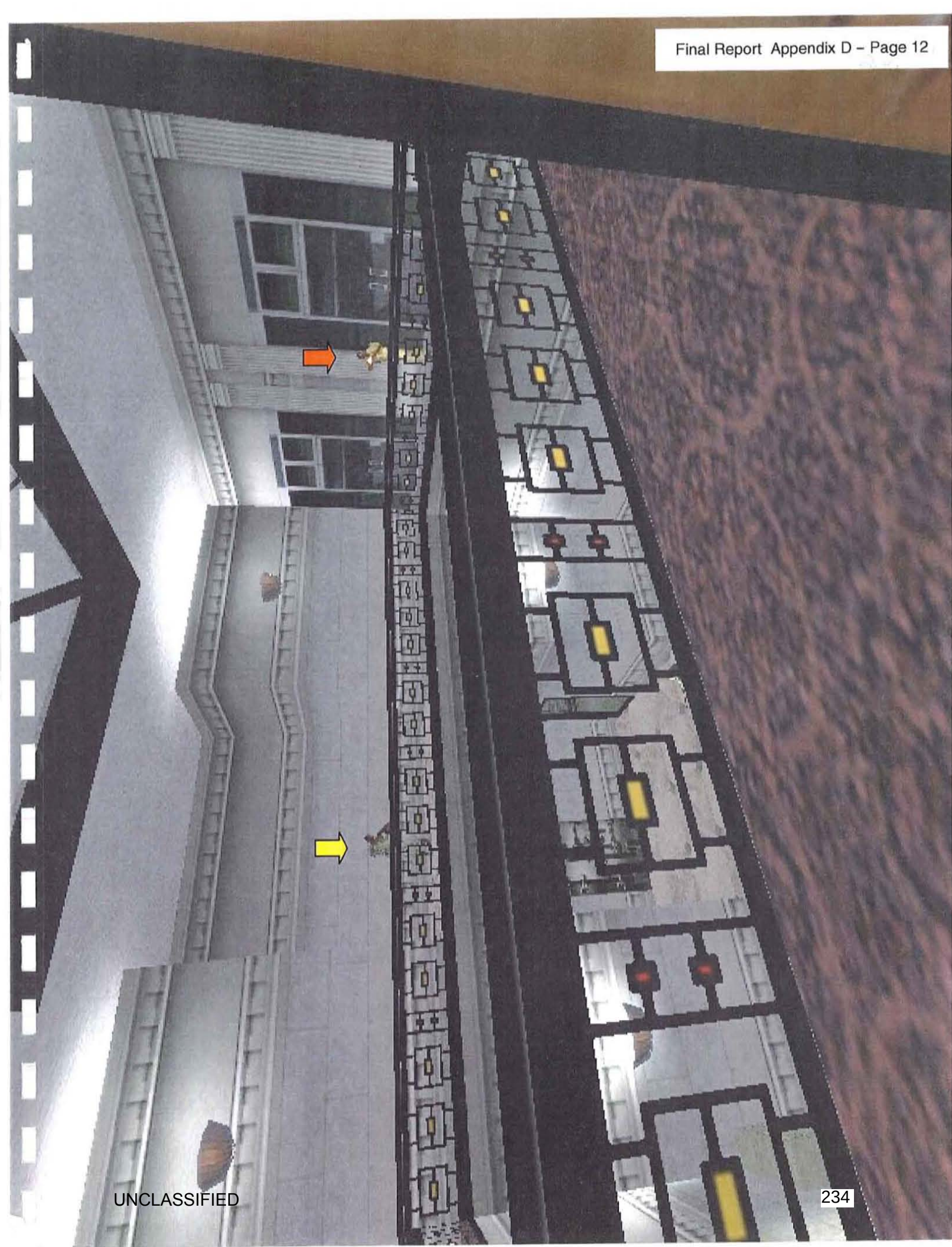
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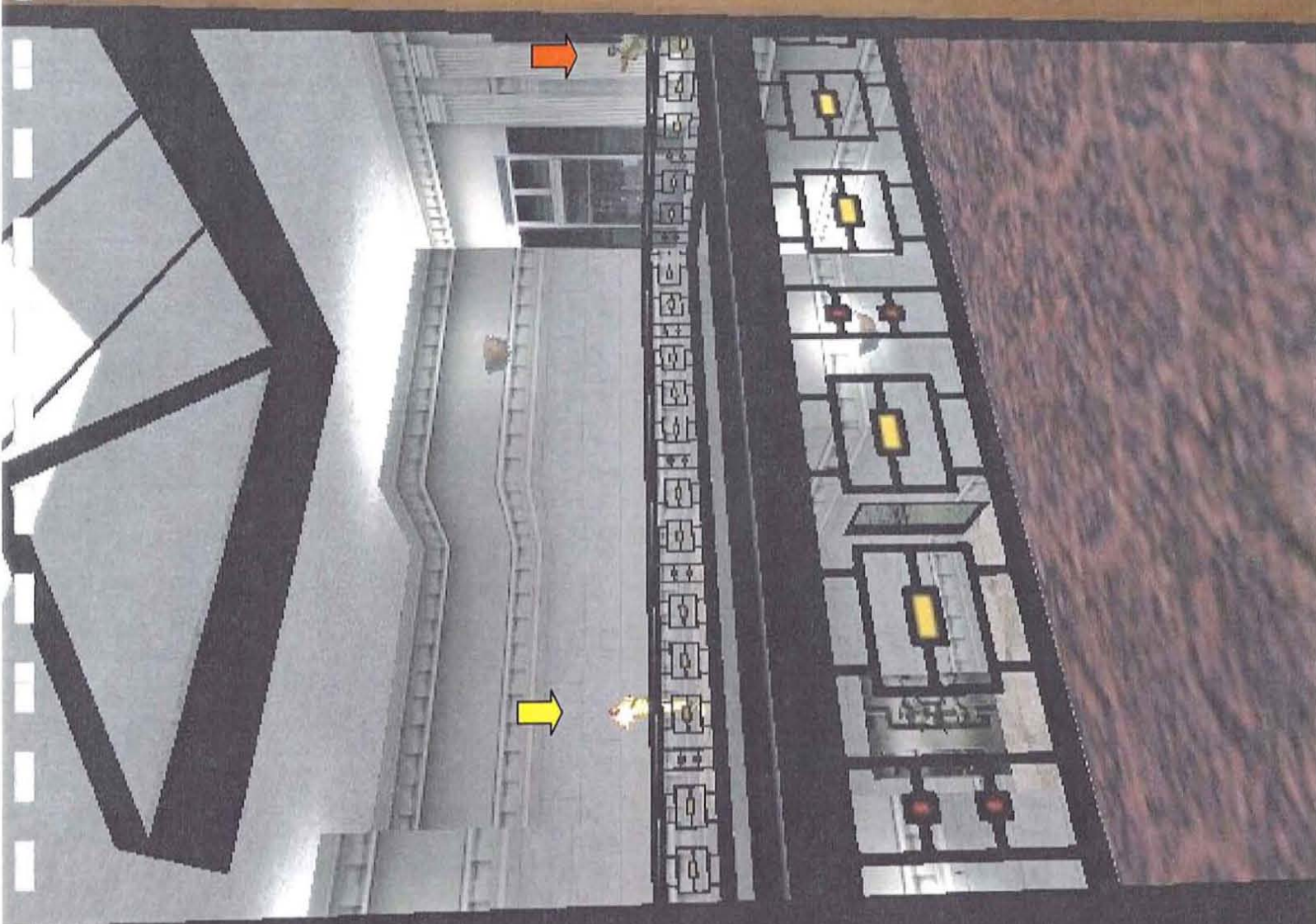


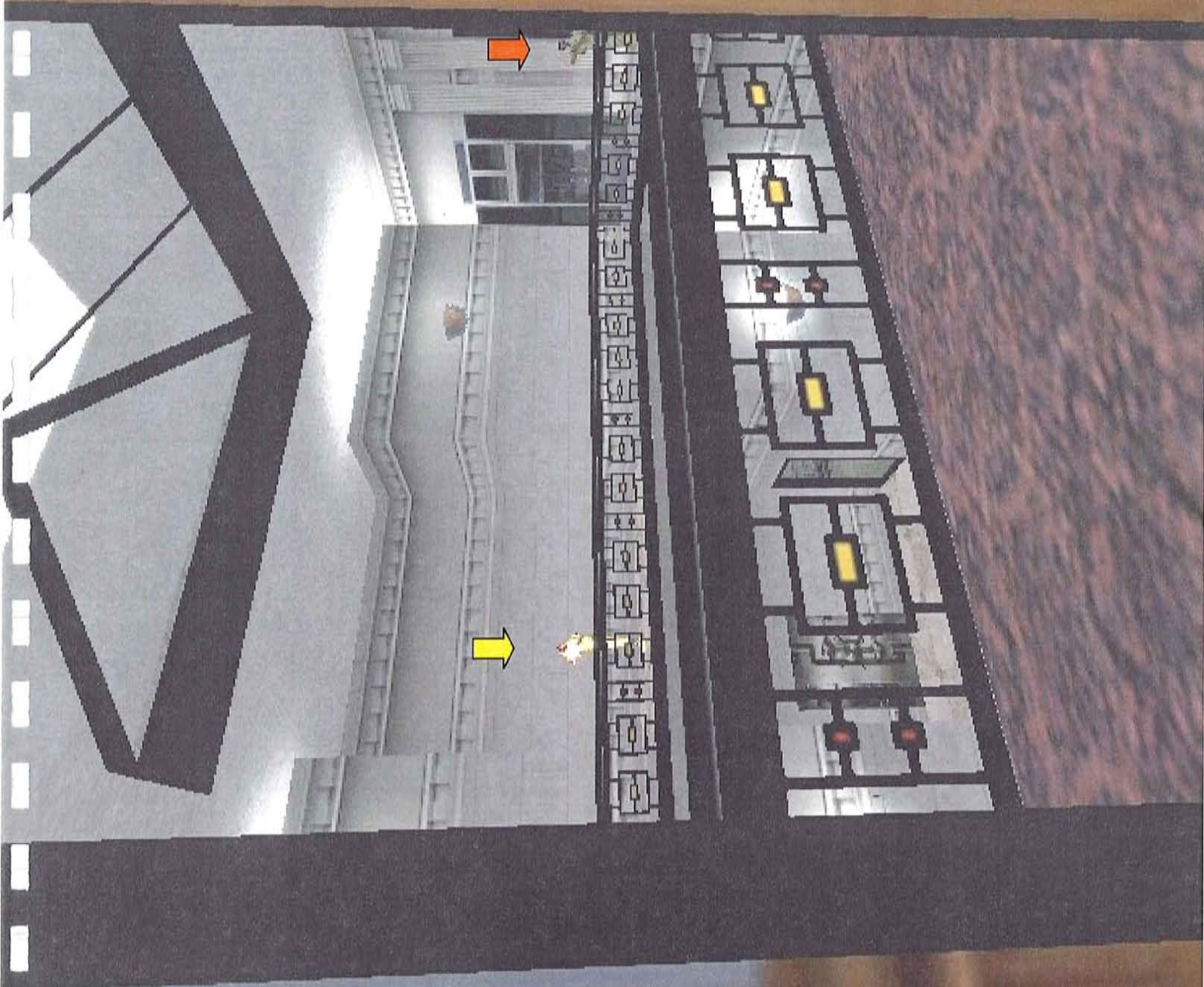






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MOUT Movie #1 Inserted Here



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Grenade launcher

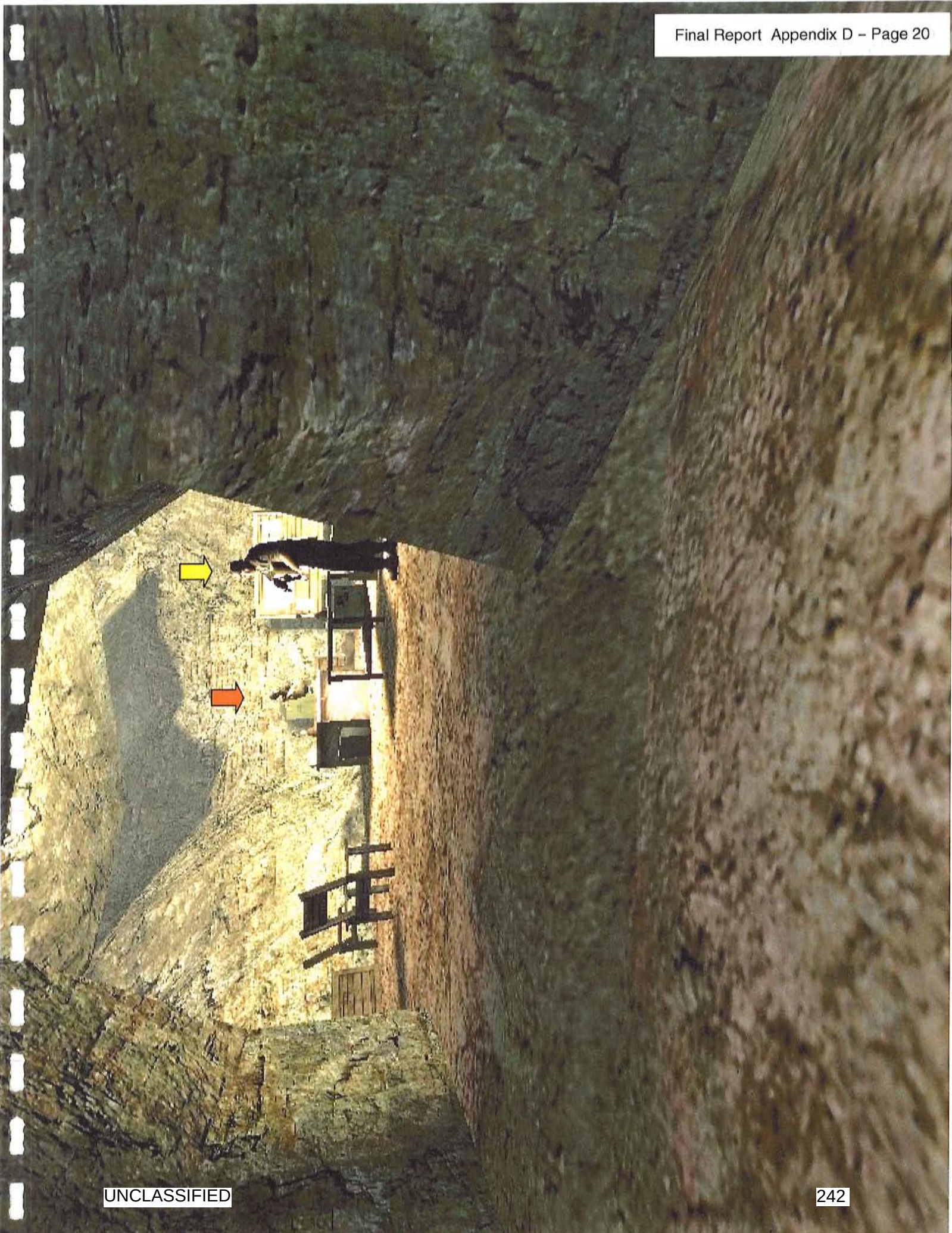


MG



Grenade launcher





Rifle
(single shot)



Rifle
(automatic)



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MOUT Movie #2 Inserted Here

MOUT Movie #3 Inserted Here









Firing at you

Firing at you





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MOUT Movie #4 Inserted Here



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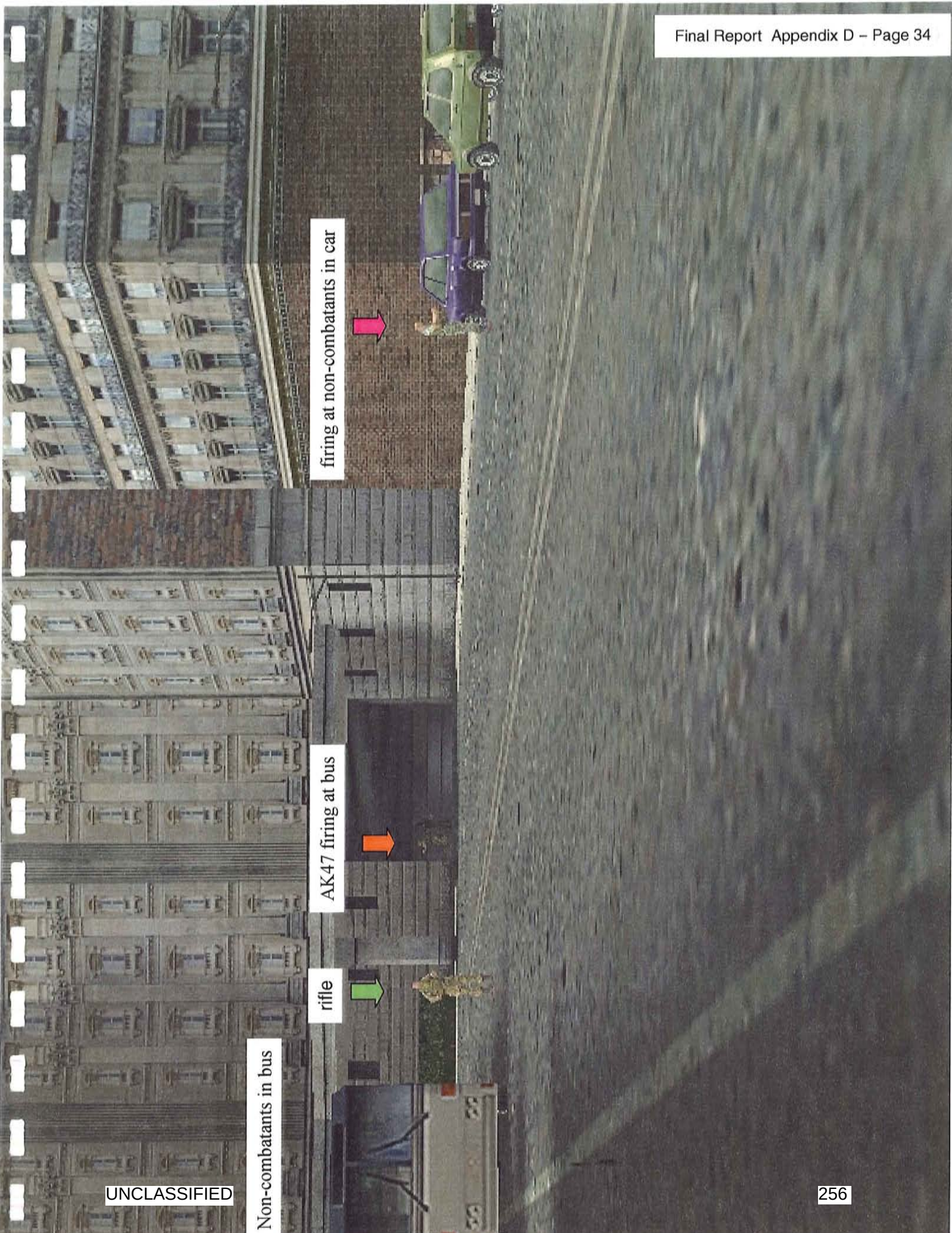
Non-combatants in bus

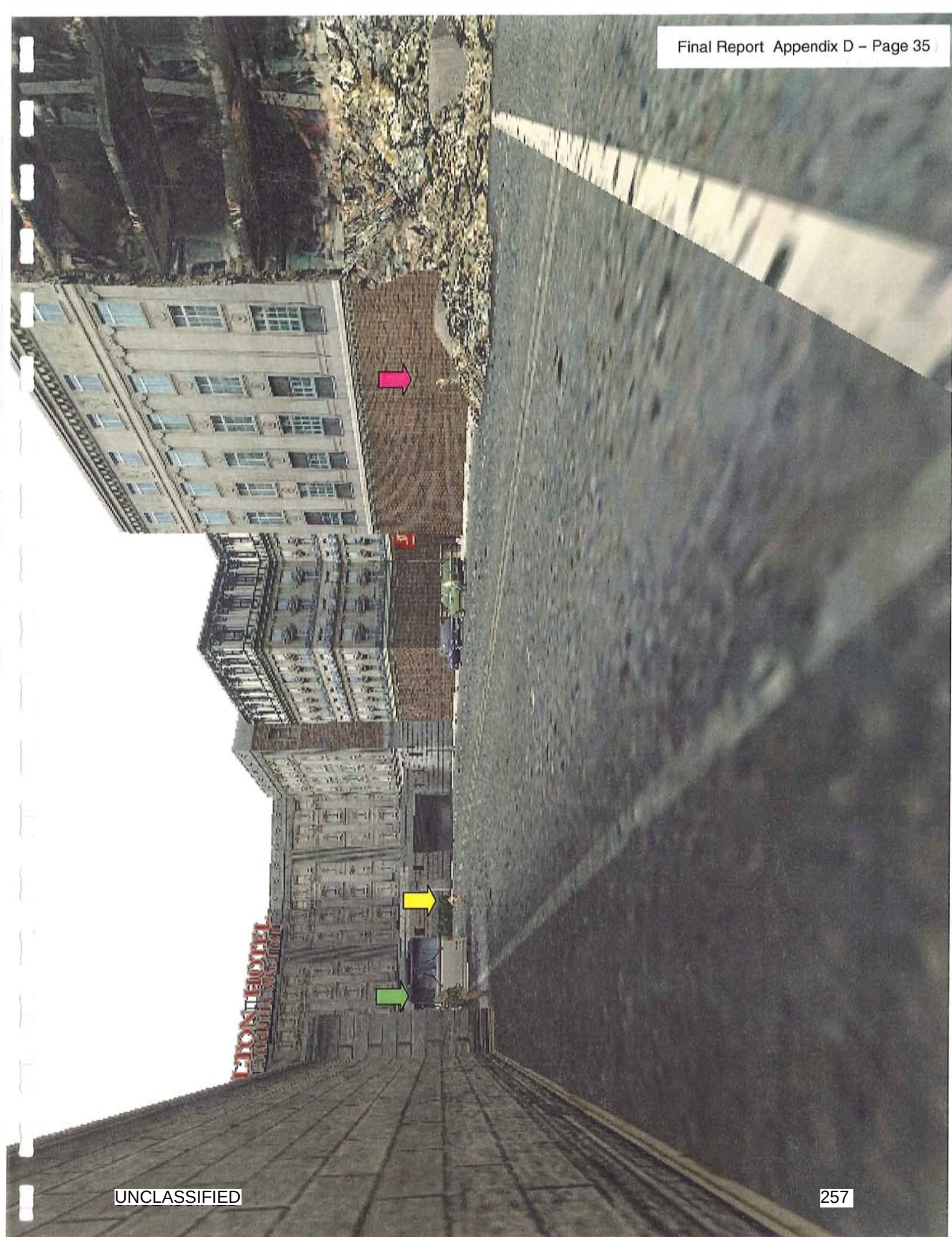
rifle

AK47 firing at bus

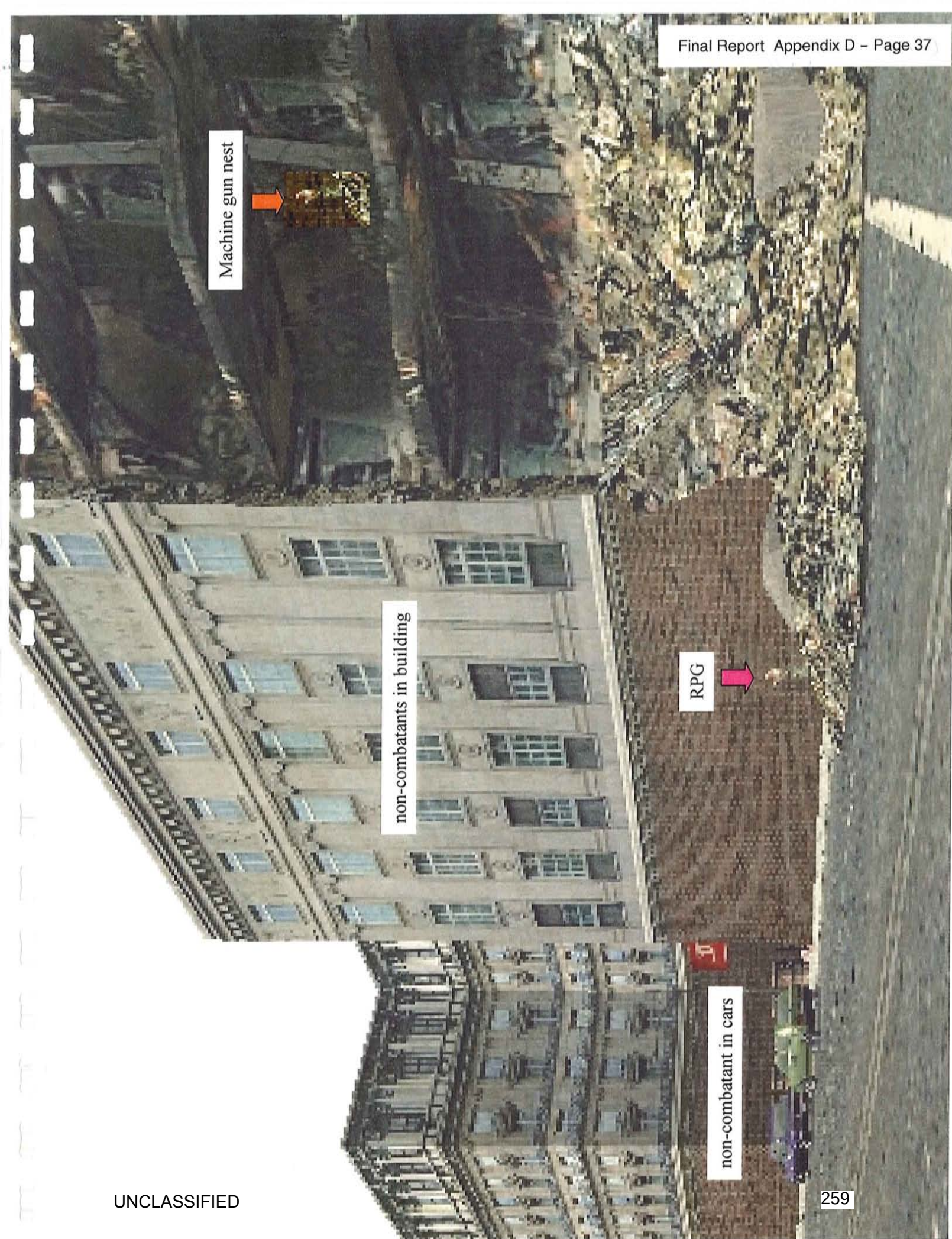
firing at non-combatants in car

256







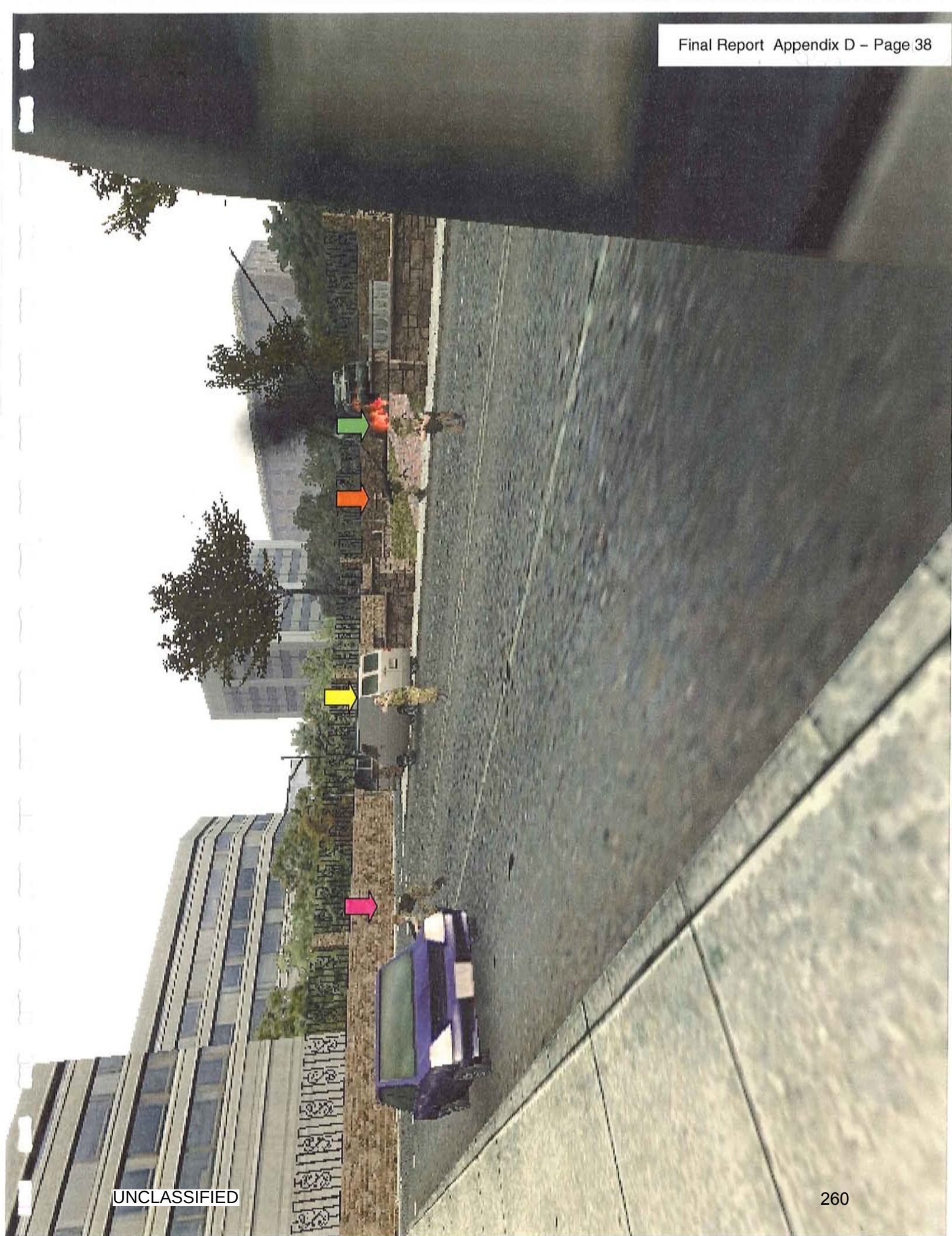


Machine gun nest

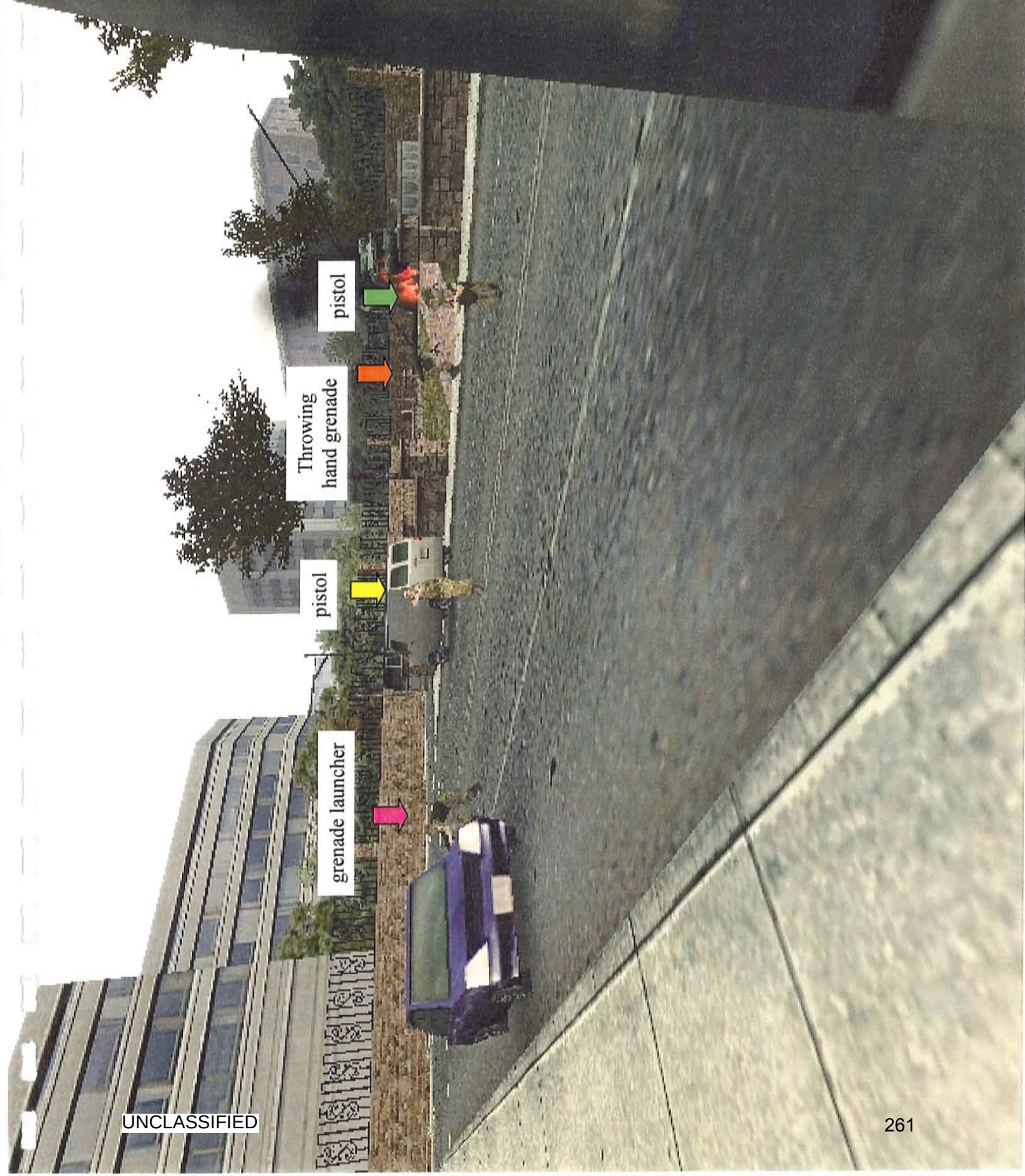
non-combatants in building

RPG

non-combatant in cars



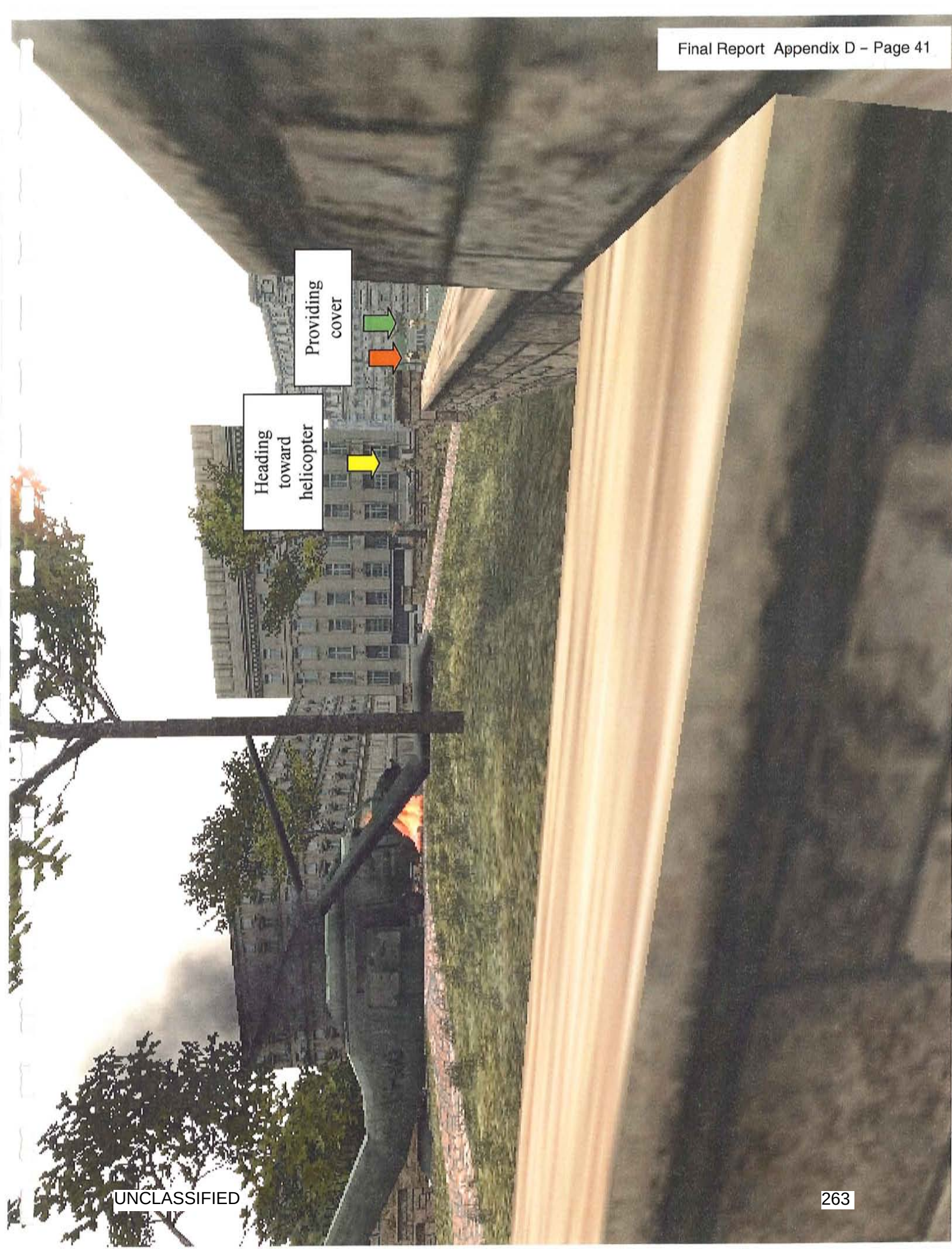
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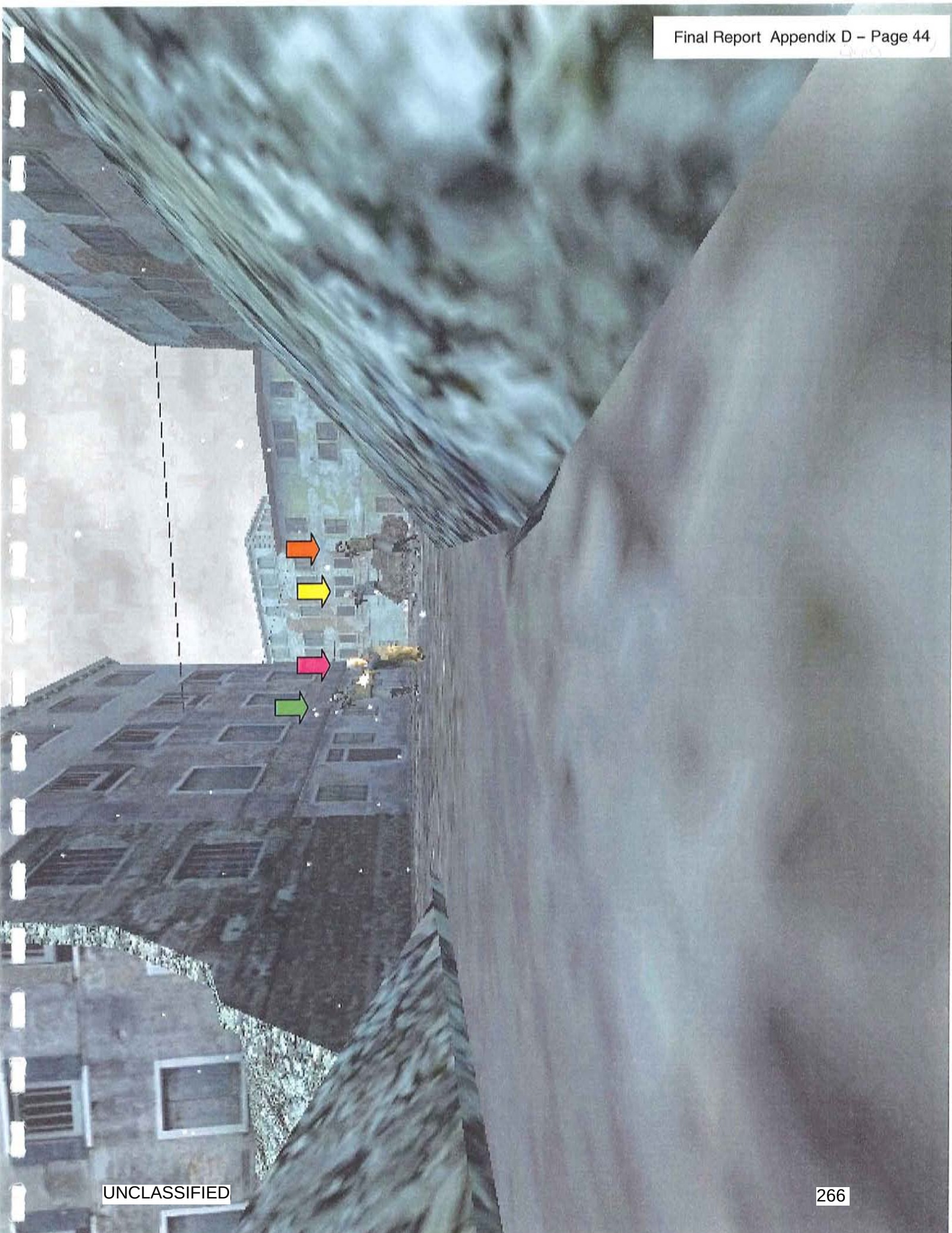
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MOUT Movie #6 Inserted Here



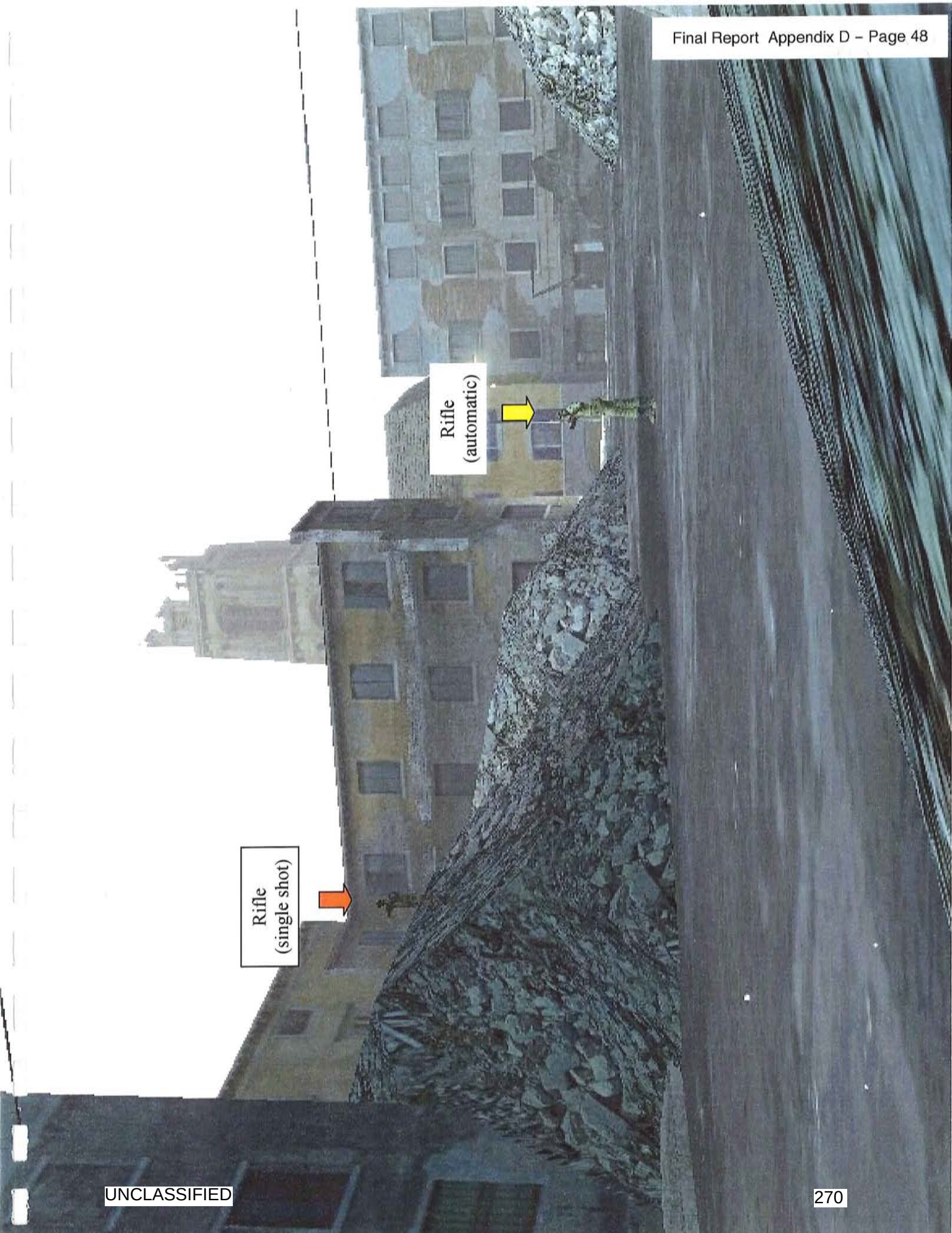
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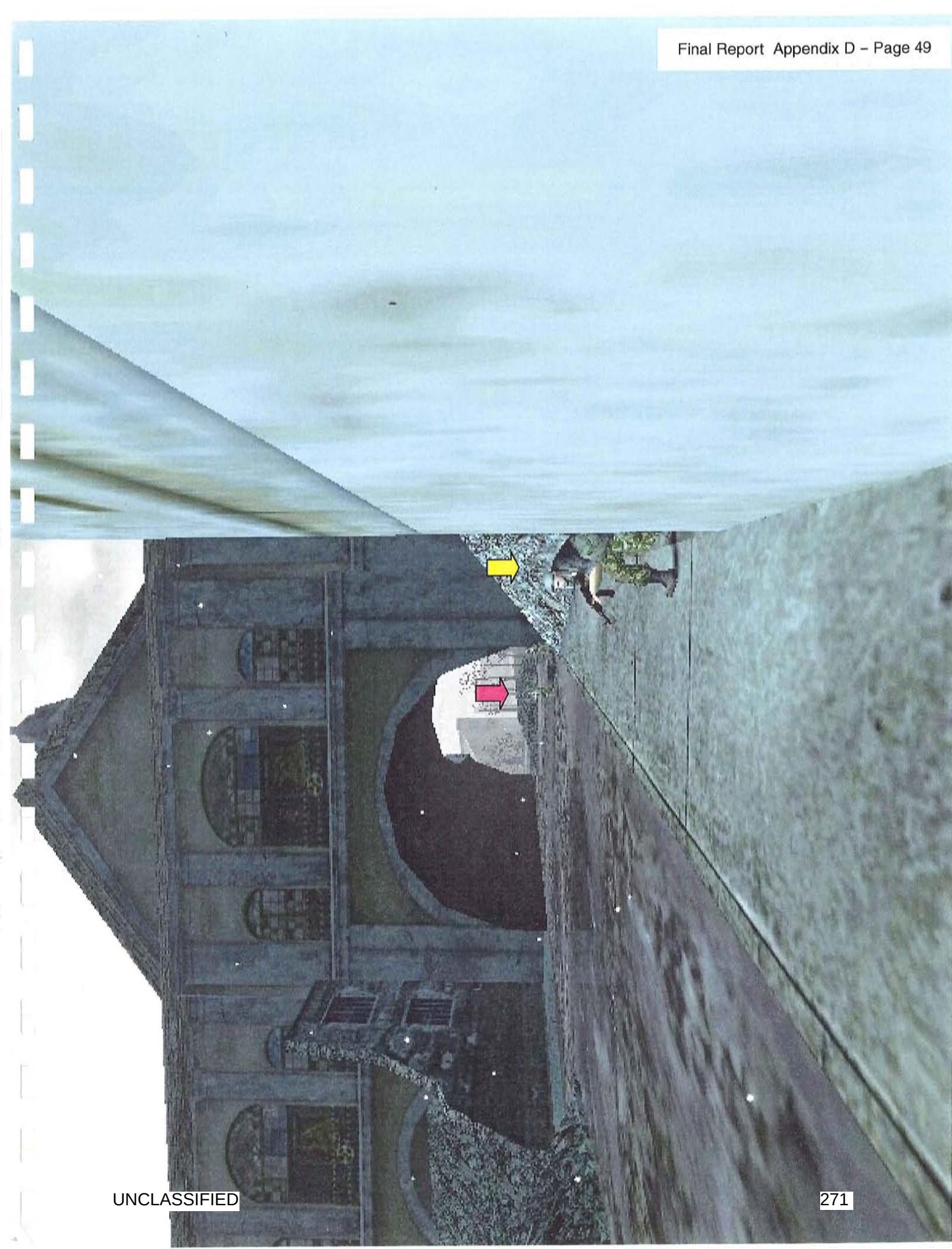
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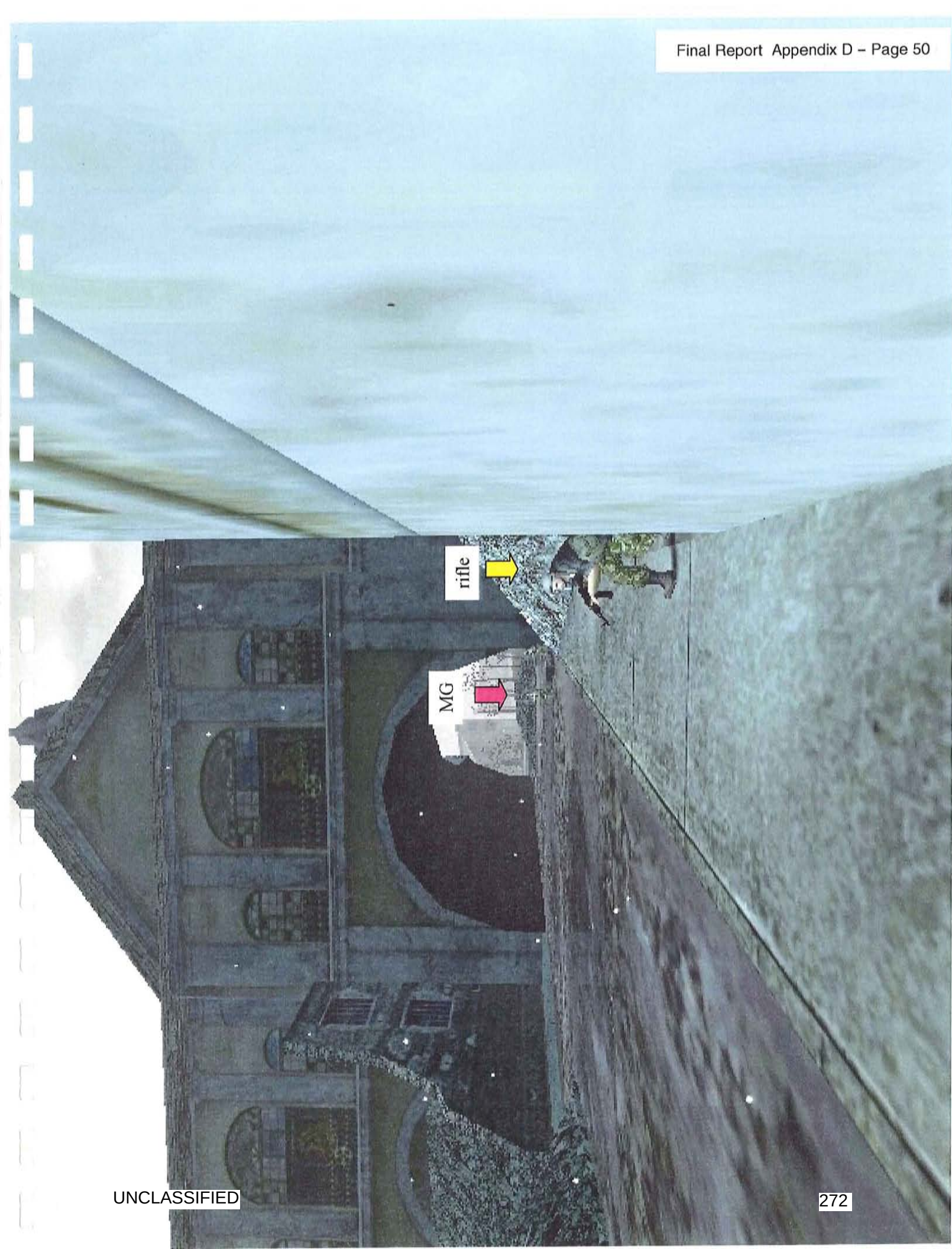
Rifle
(automatic)

Rifle
(single shot)

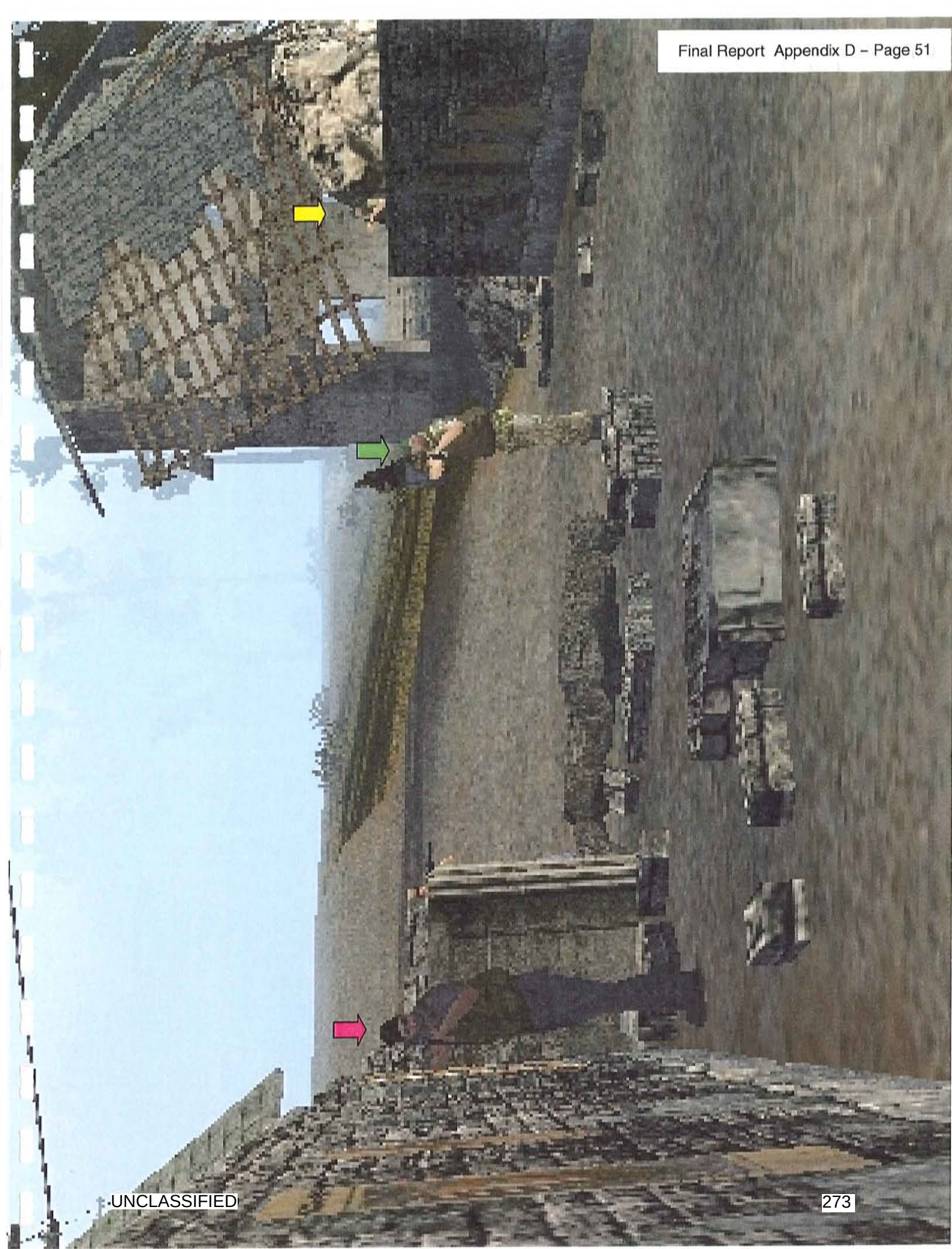


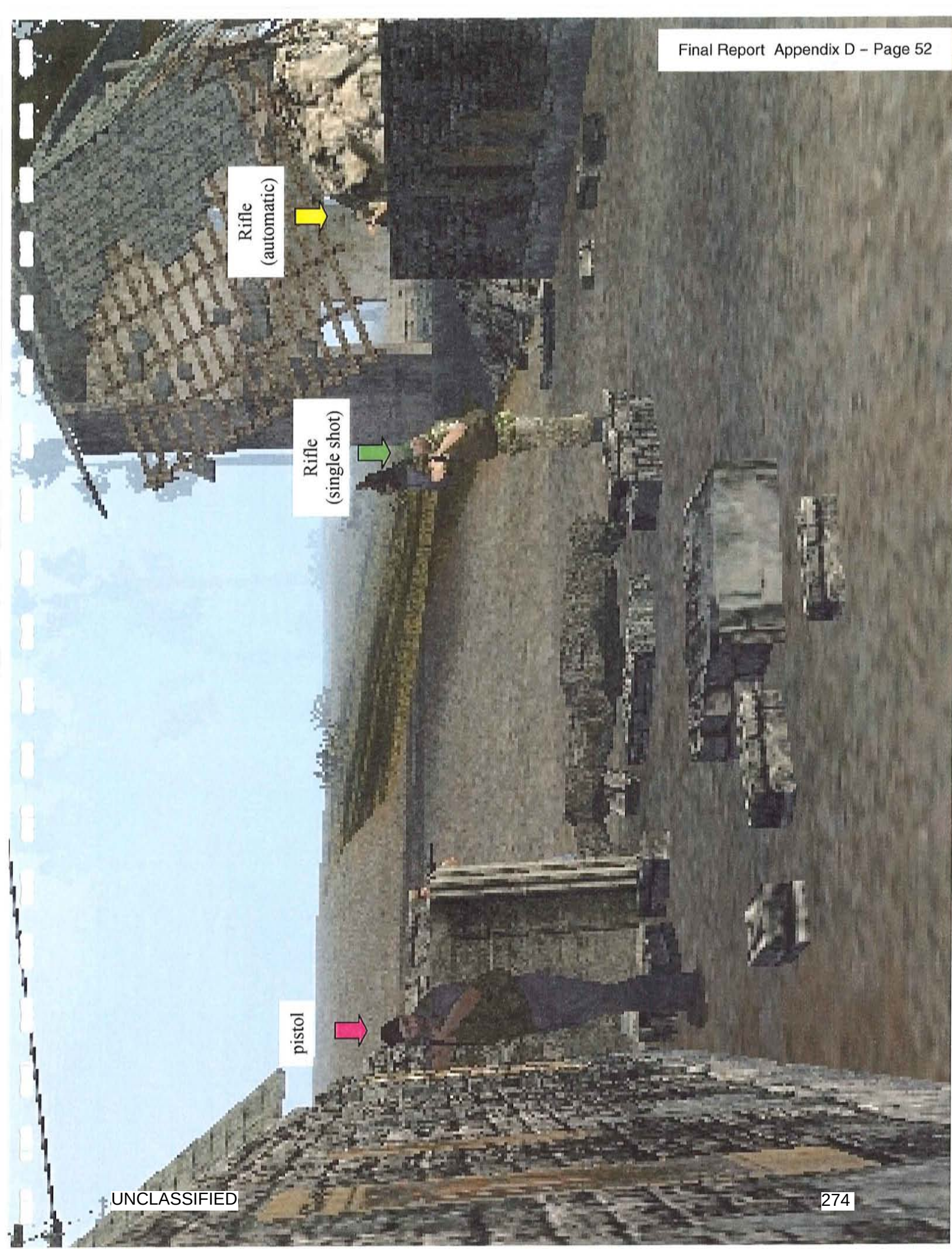
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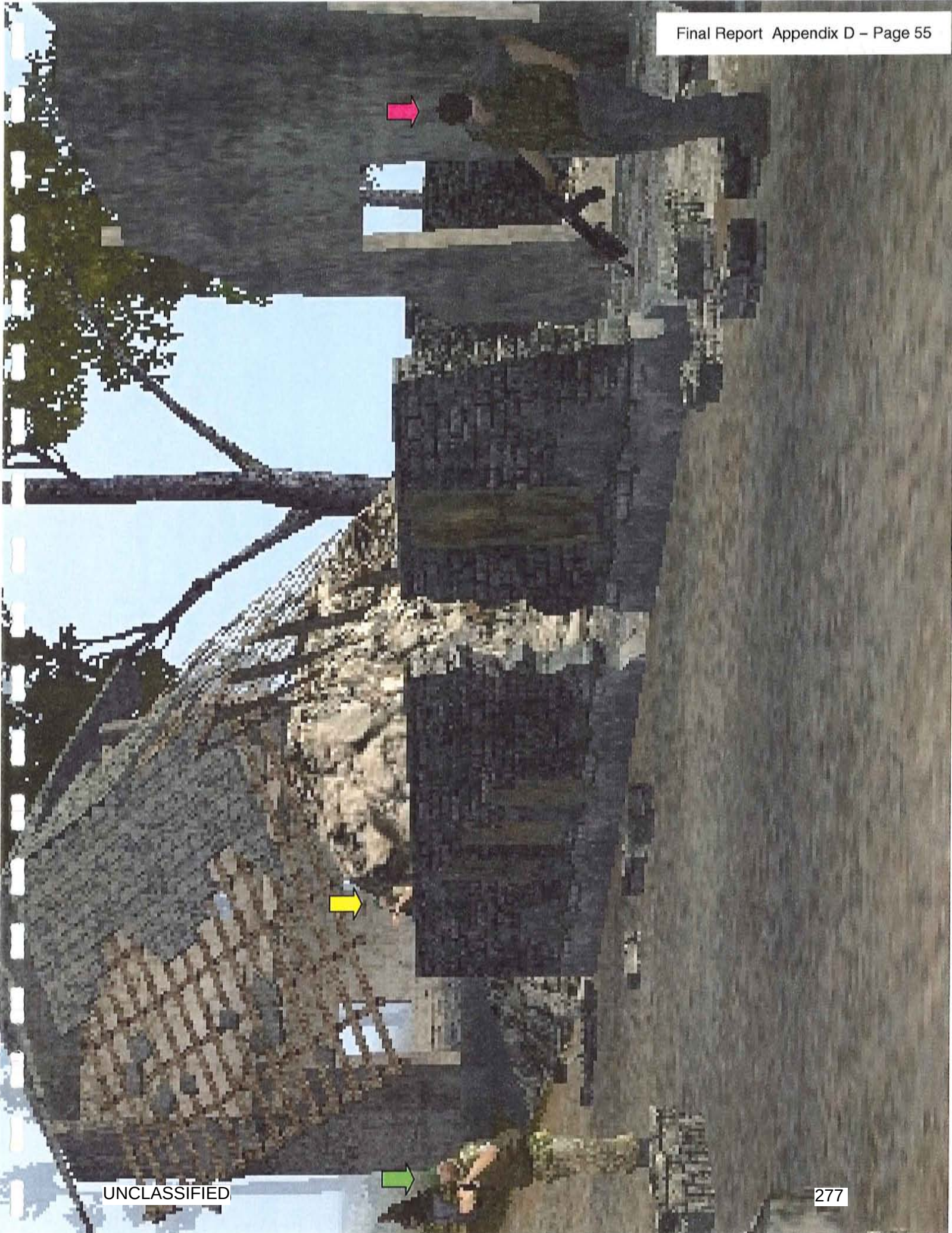


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275



UNCLASSIFIED



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Reaching for
hand grenade



rifle/grenade



rifle



UNCLASSIFIED



UNCLASSIFIED



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APPENDIX E
SUBJECT QUESTIONNAIRES

Weapons Firing Algorithm Subject Questionnaire

Name: _____

Rank: _____

1. How old are you?

☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

☐ Platoon Leader
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle						
Pistol						
M249 (SAW)						
M203						
MG (M240)						
Hand grenade						

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?
- ☐ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago
6. How many real fire fights have you been in?
- ☐ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more
7. Of those fights, what percentage was successful?
8. Rank what would you consider the most important aspect of executing infantry Battle Drills?
- ☐ Quick Response
☐ Team Work
☐ Situational Awareness
☐ Other _____
9. How many years of combat training have you received?
- ☐ None
☐ Less than 2 years
☐ 2 – 5 years
☐ 6 or more
10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- ☐ Amount and/or duration of your exposure
- ☐ Distance to Target
- ☐ Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☐ Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☐ How well Target is placing fire? Who is Target firing at?
- ☐ Speed/direction Target is moving
- ☐ Number and proximity of Targets relative to one another
- ☐ Other: _____

12. In a **MOUT Urban Canyon** scenario (outside building)

- ☐ Amount and/or duration of your exposure
- ☐ Distance to Target
- ☐ Visibility/Exposure of Target (smoke, dark, cover & concealment)
- ☐ Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☐ How well Target is placing fire? Who is Target firing at?
- ☐ Speed/direction Target is moving
- ☐ Number and proximity of Targets relative to one another
- ☐ Other: _____

13. In a **CQB/CCB** scenario (inside building)

- ☐ Amount and/or duration of your exposure
- ☐ Distance to Target
- ☐ Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☐ Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☐ How well Target is placing fire? Who is Target firing at?
- ☐ Speed/direction Target is moving
- ☐ Number and proximity of Targets relative to one another
- ☐ Other: _____

Weapons Firing Algorithm Subject Questionnaire

Name: GORDON, ROSE E.G.

Rank: MSG/E-8

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☒ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☒ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☒ Squad Leader
☒ Fireteam Leader
☒ Platoon Sergeant
☒ Rifleman
☒ Sniper
☒ Machine Gunner
☒ SAW Gunner
☒ Grenadier
☐ Other Company 1SG

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	25m	7-25	75m	75m	300	500
Pistol	7-10	7-10	25	10	25-50	25
M249 (SAW)	300	300	100	100	800	800
M203	150	50	100	25-50	300	450
MG (M240)	300	300	600	300	1000	800
Hand grenade	5-10	10	10	10	25	25

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

- ☐ Never
☒ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

6. How many real fire fights have you been in?

- ☐ None
☐ Less than 3
☐ 3 - 9
☒ 10 or more

7. Of those fights, what percentage was successful? ~~100%~~

8. Rank what would you consider the most important aspect of executing infantry Battle Drills?

- 4 ☒ Quick Response
 2 ☐ Team Work
 1 ☐ Situational Awareness
 3 ☒ Other Communication

9. How many years of combat training have you received?

- ☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

- The differences in possible range encounters in an open environment ~~may~~ will preclude the use of pistol caliber type long ~~guns~~ guns
- In open encounters shooters have an ability/inclination to take time on sighted shooting
- Traditional rifle cartridge weapons are as effective in MOUT environments but soldiers prefer ~~short~~ shortened weapons in MOUT
- Targets in MOUT environments are not as easily seen therefore their engagement can be somewhat hurried
- Pistol cartridge weapons (Pistols/Rifles) are very effective in MOUT ~~scenarios~~ scenarios

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- ☐ 1 Amount and/or duration of your exposure
- ☐ 4 Distance to Target
- ☐ 2 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☐ 6 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☐ 3 How well Target is placing fire? Who is Target firing at?
- ☐ 5 Speed/direction Target is moving
- ☐ 7 Number and proximity of Targets relative to one another
- ☐ Other: _____

12. In a **MOU Urban Canyon** scenario (outside building)

- ☐ 2 Amount and/or duration of your exposure
- ☐ 1 Distance to Target
- ☐ 3 Visibility/Exposure of Target (smoke, dark, cover & concealment)
- ☐ 7 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☐ 6 How well Target is placing fire? Who is Target firing at?
- ☐ 4 Speed/direction Target is moving
- ☐ 5 Number and proximity of Targets relative to one another
- ☐ Other: _____

13. In a **CQB/CCB** scenario (inside building)

- ☐ 1 Amount and/or duration of your exposure
- ☐ 2 Distance to Target
- ☐ 3 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☐ 7 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☐ 6 How well Target is placing fire? Who is Target firing at?
- ☐ 5 Speed/direction Target is moving
- ☐ 4 Number and proximity of Targets relative to one another
- ☐ Other: _____

Weapons Firing Algorithm**Subject Questionnaire – Please check only one response per question**Name: ARTHUR W. GARRETTRank: LTC

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☐ 37 – 42
☒ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☐ 15 – 20
☒ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☒ Squad Leader
☒ Fireteam Leader
☒ Platoon Sergeant
☒ Rifleman
☐ Sniper
☒ Machine Gunner
☒ SAW Gunner BAR
☐ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	100	60-80	300	150	400+	150+
rifle w/ scope	500	300	600	300-400	600+	400+
M249 (SAW)	300	250	350	350	500	400
M203	150	100	250	200	250+	250
MG (M240)	400	350	500	400	600	500
Hand grenade	40	20-30	50	30-40	50+	50

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☒ Less than 2 years ago
☐ 2 - 5 years ago
☐ More than 6 years ago

6. When is the last time you participated in real-world execution of Infantry Battle Drills?

☐ Never
☐ Less than 2 years ago
☐ 2 - 5 years ago
☒ More than 6 years ago

7. How many real fire fights have you been in?

☐ None
☐ Less than 3
☐ 3 - 9
☒ 10 or more

8. Of those fights, what percentage was successful?

80%

9. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☐ Quick Response
☒ Team Work
☐ Situational Awareness
☐ Other: _____

10. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 - 5 years
☒ 6 or more

11. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

weapons and targets are the same for
 field combat and urban canyon. The
 difference is in available firing position
 for the offense. The defender posture
 i.e. target exposures are very similar.
 Inside the building is a totally different
 situation.

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

12. In an **Open Field** scenario

- ☒ 7 Amount and/or duration of your exposure
- ☒ 3 Distance to Target
- ☒ 5 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☒ 2 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 1 How well Target is placing fire? Who is Target firing at?
- ☒ 4 Speed/direction Target is moving
- ☒ 6 Number and proximity of Targets relative to one another
- ☐ Other: _____

13. In a **MOUT Urban Canyon** scenario (outside building)

- ☒ 7 Amount and/or duration of your exposure
- ☒ 3 Distance to Target
- ☒ 5 Visibility/Exposure of Target (smoke, dark, cover & concealment)
- ☒ 2 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 1 How well Target is placing fire? Who is Target firing at?
- ☒ 4 Speed/direction Target is moving
- ☒ 6 Number and proximity of Targets relative to one another
- ☐ Other: _____

14. In a **CQB/CCB** scenario (inside building)

- ☒ 7 Amount and/or duration of your exposure
- ☒ 2 Distance to Target
- ☒ 3 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☒ 5 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 1 How well Target is placing fire? Who is Target firing at?
- ☒ 6 Speed/direction Target is moving
- ☒ 4 Number and proximity of Targets relative to one another
- ☐ Other: _____

Weapons Firing Algorithm Subject Questionnaire

Name: TRYON, MICHAEL ARank: CIV

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☐ 37 – 42
☒ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☐ 15 – 20
☒ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☒ Other Company Cdr

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	150	50	200	100	250	150
rifle w/ scope	250	50	400	100	500	200
M249 (SAW)	150	100	300	150	600	250
M203	150	50	200	100	250	150
MG (M240)	300	100	400	200	600	300
Hand grenade	20	30	30	30	40	30

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☒ More than 6 years ago

6. When is the last time you participated in real-world execution of Infantry Battle Drills?

☐ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☒ More than 6 years ago

7. How many real fire fights have you been in?

☐ None
☐ Less than 3
☐ 3 - 9
☒ 10 or more

8. Of those fights, what percentage was successful?

100%

9. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☒ Quick Response
☒ Team Work
☒ Situational Awareness
☐ Other _____

10. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

11. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other? *In MOUT I would engage elevated targets first due to their field of fire advantages of ability to see more.*

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

12. In an **Open Field** scenario

- | | |
|---|--|
| 7 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 6 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 1 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **MOUT Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 7 | Amount and/or duration of your exposure |
| 3 | Distance to Target |
| 6 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 1 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 4 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| 2 | Other: <i>location of target in vertical plane</i> |

14. In a **COB/CCB** scenario (inside building)

- | | |
|---|--|
| 2 | Amount and/or duration of your exposure |
| 5 | Distance to Target |
| 6 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 1 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 4 | Speed/direction Target is moving |
| 5 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: Richard MatthewsRank: Retired

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☐ 37 – 42
☒ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☐ 15 – 20
☒ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	50-100	25	150-300	100	150-300	100+
rifle w/ scope						
M249 (SAW)	50-300	25-100	300-500	150	500-1000	300
M203	50-100	50-100	100-250	100+	250+	
MG (M240)	50-300	50-100	300-800	100-300	800-1000	300+
Hand grenade	0-10	10	10-25	15	30+	20

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☒ Less than 2 years ago
☐ 2 - 5 years ago
☐ More than 6 years ago

6. How many real fire fights have you been in?

☐ None
☒ Less than 3
☐ 3 - 9
☐ 10 or more

7. Of those fights, what percentage was successful? *I survived. No deaths to ^{injuries} friendlies*

8. Rank what you consider the most important aspect of executing Infantry Battle Drills?

☒ 2 Quick Response
☒ 3 Team Work
☒ 1 Situational Awareness
☒ 4 Other *Experience (Real or simulated)* (highest)

9. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 - 5 years
☒ 6 or more

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

OPEN Field

practice/
 * MORE Experience firing at distant targets
 * CLOSE AIR SUPPORT TRAINING
 * RANGE ESTIMATION TRAINING
 *

MOUT/URBAN

* MORE FORCES TO EXECUTE
 * CLOSE Battle Drill Coordination in Close Quarters Combat/Rooming
 * MORE FLASHBANG/GRENADES
 * MORE AMMUNITION

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- | | |
|---|---|
| 1 | Amount and/or duration of your exposure |
| 3 | 2 Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 7 | Target's <u>weapon</u> or role in unit (rifle, RPG, MG, leader, sniper) |
| 2 | 8 How well Target is placing fire? Who is Target firing at? |
| 4 | Speed/direction Target is moving |
| 6 | Number and proximity of Targets relative to one another |
| | Other: _____ |

12. In a **MOUT Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 1 | Amount and/or duration of your exposure |
| 3 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 2 | How well Target is placing fire? Who is Target firing at? |
| 4 | Speed/direction Target is moving |
| 6 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **CQB/CCB** scenario (inside building)

- | | |
|---|--|
| 1 | Amount and/or duration of your exposure |
| 4 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 2 | How well Target is placing fire? Who is Target firing at? |
| 3 | Speed/direction Target is moving |
| 6 | Number and proximity of Targets relative to one another |
| * | Other: <u>Sector of fire</u> |

1.05

Weapons Firing Algorithm Subject Questionnaire

Name: Chris HickeyRank: CPT

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☒ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☒ 5 to 9
☐ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	125	50	250	100	300	200
Pistol	10	5	15	10	20	15
M249 (SAW)	200	75	400	200	600	400
M203	200	100	250	200	300	250
MG (M240)	600	200	800	400	1000	600
Hand grenade	15	15	20	20	35	35

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☐ Less than 2 years ago
☒ 2 – 5 years ago
☐ More than 6 years ago

6. How many real fire fights have you been in?

☐ None
☒ Less than 3
☐ 3 – 9
☐ 10 or more

7. Of those fights, what percentage was successful?

All, did not return fire due to civilians the opponent was trying to get us to hit.

8. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☒ Quick Response
☐ Team Work
☒ Situational Awareness
☐ Other _____

9. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☒ 2 – 5 years
☐ 6 or more

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

In Mout I would scan for longer period of time before moving.

I would scan vertically as well as horizontally.

I would prefer more automatic weapons and shorter lighter weapons in MOUT with a few long range precision weapons like sniper rifles.

I would fire more automatic weapons rounds at "possible" enemy positions.

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- | | |
|---|--|
| 2 | Amount and/or duration of your exposure |
| 3 | Distance to Target |
| 4 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 5 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 1 | How well Target is placing fire? Who is Target firing at? |
| 7 | Speed/direction Target is moving |
| 6 | Number and proximity of Targets relative to one another |
| | Other: _____ |

12. In a **MOUT Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 3 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 4 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 2 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 7 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **CQB/CCB** scenario (inside building)

- | | |
|---|--|
| 3 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 4 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 2 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 5 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: Robert Boerjan

Rank: MAJ

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☒ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☒ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☐ Squad Leader
☒ Fireteam Leader
☐ Platoon Sergeant
☒ Rifleman
☐ Sniper
☒ Machine Gunner
☐ SAW Gunner
☒ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	150	50	200	100	250+	125+
rifle w/ scope	200	150	250	175	300+	200+
M249 (SAW)	250	150	300-400	250	600+	400+
M203	700	75	200	150	250	200 175
MG (M240)	400	300	600	400	600+	400+
Hand grenade	20	20	35	20	35+	20+

point
 area
 window
 door
 bunker

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☒ More than 6 years ago

6. How many ^{Actual combat.} real fire fights have you been in?

☒ None
☐ Less than 3
☐ 3 – 9
☐ 10 or more

7. Of those fights, what percentage was successful? ^{define}

8. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☒ Quick Response
☐ Team Work
☐ Situational Awareness
☒ Other REPETITIVE TRAINING SO IT BECOMES SECOND NATURE

9. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

— SCANNING TECHNIQUES — SCAN HIGHER IN MOUT
 — EXPOSURE TIME (ENEMY'S) IN MOUT BECAUSE
 HAVE BETTER COVER
 — WEAPON SELECTION — LOOSE TARGETS WITH
 GRENADE LAUNCHERS OR RPG TYPE
 BECAUSE THEY CAN DEFEND YOUR
 COVER.

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- | | |
|---|--|
| 6 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 3 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 1 | How well Target is placing fire? Who is Target firing at? |
| 7 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| | Other: _____ |

12. In a **MOUT Urban Canyon** scenario (*street fighting* ~~outside building~~)

- | | |
|---|--|
| 6 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 7 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **CQB/CCB** scenario (*building clearing* ~~inside building~~)

- | | |
|---|--|
| 6 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 2 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: MICHAEL B. Bennett Jr

Rank: SFC.

1. How old are you?

- ☐ 19 – 25
☒ 26 – 30
☐ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☒ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☐ Platoon Leader
☒ Squad Leader
☒ Fireteam Leader
☒ Platoon Sergeant
☒ Rifleman
☐ Sniper
☐ Machine Gunner
☒ SAW Gunner
☒ Grenadier
☐ Other Anti tank gunner - section 1d12

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	400m	300 400m	400m	300	500m	300
rifle w/ scope						
M249 (SAW)	500m	500m	500m	500m	800m	800m
M203	100m	100m	200	150	300	200
MG (M240)	500m	300m	800m	800m	1200	1200
Hand grenade	35m	35m	40m	40m	50m	50m

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☒ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

6. When is the last time you participated in real-world execution of Infantry Battle Drills?

☒ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

7. How many real fire fights have you been in?

☒ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more

8. Of those fights, what percentage was successful?

9. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☒ Quick Response
☐ Team Work
☐ Situational Awareness
☐ Other _____

10. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

11. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other? Mout 3 dimensional and more stressful.

Depending on numbers of Non Combatants in a mout environment would greatly effect the type of WPN + the rates of fire.

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

12. In an **Open Field** scenario

- | | |
|---|--|
| 6 | Amount and/or duration of your exposure |
| 3 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 1 | How well Target is placing fire? Who is Target firing at? |
| 4 | Speed/direction Target is moving |
| 7 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **MOUT Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 7 | Amount and/or duration of your exposure |
| 3 | Distance to Target |
| 4 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 1 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 5 | Number and proximity of Targets relative to one another |
| | Other: _____ |

14. In a **COB/CCB** scenario (inside building)

- | | |
|---|--|
| 1 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 4 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 7 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: Chad Campbell

Rank: SFC / E-7

1. How old are you?

☐ 19 – 25
☒ 26 – 30
☐ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

☐ 1 to 4
☒ 5 to 9
☐ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

☐ Platoon Leader
☒ Squad Leader
☒ Fireteam Leader
☒ Platoon Sergeant
☒ Rifleman
☒ Sniper
☒ Machine Gunner
☒ SAW Gunner
☒ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	100	50	150	100	300	150
rifle w/ scope	300	300	600	600	900	900
M249 (SAW)	150	100	250	200	300	250
M203	100	75	150	100	200	150
MG (M240)	200	150	600	500	800	600
Hand grenade						

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☒ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

6. When is the last time you participated in real-world execution of Infantry Battle Drills?

☒ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

7. How many real fire fights have you been in?

☒ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more

8. Of those fights, what percentage was successful? *NA*

9. Rank what would you consider the most important aspect of executing infantry Battle Drills?

3 ☐ Quick Response
 1 ☒ Team Work
 2 ☐ Situational Awareness
☐ Other _____

10. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

11. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

*1) Types of cover/protection available to soldier.
 2) Movement formations*

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

12. In an **Open Field** scenario

- | | |
|---|--|
| 4 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 1 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 3 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 5 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 7 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **MOU Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 4 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 1 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 5 | Number and proximity of Targets relative to one another |
| | Other: _____ |

14. In a **COB/CCB** scenario (inside building)

- | | |
|---|--|
| 1 | Amount and/or duration of your exposure |
| 6 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 4 | Speed/direction Target is moving |
| 2 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: KENNETH F. SWEATRank: MAJOR

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☒ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☒ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☒ Squad Leader
☒ Fireteam Leader
☐ Platoon Sergeant
☒ Rifleman
☐ Sniper
☒ Machine Gunner
☐ SAW Gunner
☒ Grenadier
☐ Other _____

X = READING ENVIRONMENT

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	50	50	250	150	400	300
rifle w/ scope	300	200	500	400	1000	800
M249 (SAW)	100	100	500	800	900	900
M203	200	200	400	400	600	500
MG (M240)	200	200	600	600	1100	1000
Hand grenade	20	20	30	30	40	40

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

- ☐ Never
☒ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

6. When is the last time you participated in real-world execution of Infantry Battle Drills?

- ☐ Never
☐ Less than 2 years ago
☐ 2 – 5 years ago
☒ More than 6 years ago

7. How many real fire fights have you been in?

- ☒ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more

8. Of those fights, what percentage was successful? *N/A*

9. Rank what would you consider the most important aspect of executing infantry Battle Drills?

- ☐ Quick Response
☒ Team Work
☐ Situational Awareness
☐ Other _____

10. How many years of combat training have you received?

- ☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

11. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

1. RANGES
 2. AVAILABLE COVER

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

1 ↑

12. In an **Open Field** scenario

- ☒ 4 Amount and/or duration of your exposure
- ☒ 1 Distance to Target
- ☒ 5 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☒ 3 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 2 How well Target is placing fire? Who is Target firing at?
- ☒ 7 Speed/direction Target is moving
- ☒ 6 Number and proximity of Targets relative to one another
- ☐ Other: _____

13. In a **MOUT Urban Canyon** scenario (outside building)

- ☒ 4 Amount and/or duration of your exposure
- ☒ 2 Distance to Target
- ☒ 5 Visibility/Exposure of Target (smoke, dark, cover & concealment)
- ☒ 3 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 1 How well Target is placing fire? Who is Target firing at?
- ☒ 7 Speed/direction Target is moving
- ☒ 6 Number and proximity of Targets relative to one another
- ☐ Other: _____

14. In a **CQB/CCB** scenario (inside building)

- ☒ 4 Amount and/or duration of your exposure
- ☒ 3 Distance to Target
- ☒ 5 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☒ 2 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 1 How well Target is placing fire? Who is Target firing at?
- ☒ 7 Speed/direction Target is moving
- ☒ 6 Number and proximity of Targets relative to one another
- ☐ Other: _____

Weapons Firing Algorithm Subject Questionnaire

Name: AL AHUJARank: LTC

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☐ 31 – 36
☒ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☐ 10 – 14
☒ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☐ Other Company Commander / BN + Bde Operation

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	100	50	200	100	300	200
Pistol	25	10	35	20	50	25
M249 (SAW)	300	200	400	300	800	400
M203	200	100	300	200	250	200
MG (M240)	500	500	700	600	1000	700
Hand grenade	80	25	40	35	50	50

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☒ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

6. How many real fire fights have you been in?

☒ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more

7. Of those fights, what percentage was successful?

8. Rank what you would consider the most important aspect of executing infantry Battle Drills?

☐ 1 Quick Response
☒ 3 Team Work
☒ 2 Situational Awareness
☐ Other _____

9. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 – 5 years
☐ 6 or more

Formal Schools 3 yr
 Unit TNG 15 yr

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

Ranges in mout significantly less than open field
 MOUT battlefield is three dimensional.

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- | | |
|---|--|
| 6 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 1 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 4 | How well Target is placing fire? Who is Target firing at? |
| 3 | Speed/direction Target is moving |
| 7 | Number and proximity of Targets relative to one another |
| | Other: _____ |

12. In a **MOUT Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 3 | Amount and/or duration of your exposure |
| 6 | Distance to Target |
| 4 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 1 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 7 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **CQB/CCB** scenario (inside building)

- | | |
|---|--|
| 3 | Amount and/or duration of your exposure |
| 2 | Distance to Target |
| 5 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 7 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 1 | How well Target is placing fire? Who is Target firing at? |
| 6 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: Rob Goodroe

Rank: CPT

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☒ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☒ 5 to 9
☐ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☐ Other _____

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	75	25	200	200 50	300	100
Pistol	5	5	20	15	25	20
M249 (SAW)	100	50	250	100	400	150
M203	75	50	125	100	150	125
MG (M240)	100	75	250	150	400	300
Hand grenade	15	10	25	20	35	30

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☒ Less than 2 years ago
☐ 2 – 5 years ago
☐ More than 6 years ago

6. How many real fire fights have you been in?

☒ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more

7. Of those fights, what percentage was successful?

8. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☒ Quick Response
☐ Team Work
☐ Situational Awareness
☐ Other _____

9. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☒ 2 – 5 years
☐ 6 or more

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

- 3 dimensional - must look up
 - open field combat is more about speed
 mout is more about getting to/or finding the
 proper angle to attack/shoot from

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- | | |
|---|--|
| 7 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 6 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 4 | Number and proximity of Targets relative to one another |
| | Other: _____ |

12. In a **MOUT Urban Canyon** scenario (outside building)

- | | |
|---|--|
| 4 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 7 | Visibility/Exposure of Target (smoke, dark, cover & concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 3 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 6 | Number and proximity of Targets relative to one another |
| | Other: _____ |

13. In a **CQB/CCB** scenario (inside building)

- | | |
|---|--|
| 3 | Amount and/or duration of your exposure |
| 1 | Distance to Target |
| 7 | Visibility/Exposure of Target (smoke, dark, cover and concealment) |
| 2 | Target's weapon or role in unit (rifle, RPG, MG, leader, sniper) |
| 4 | How well Target is placing fire? Who is Target firing at? |
| 5 | Speed/direction Target is moving |
| 6 | Number and proximity of Targets relative to one another |
| | Other: _____ |

Weapons Firing Algorithm Subject Questionnaire

Name: Michael L. LanhamRank: CPT

1. How old are you?

- ☐ 19 – 25
☐ 26 – 30
☒ 31 – 36
☐ 37 – 42
☐ 43 or higher

2. How many years have you served in the military?

- ☐ 1 to 4
☐ 5 to 9
☒ 10 – 14
☐ 15 – 20
☐ Over 20

3. What infantry positions/roles in unit have you held? (please mark all that apply)

- ☒ Platoon Leader (*Light + Mechanized*)
☐ Squad Leader
☐ Fireteam Leader
☐ Platoon Sergeant
☐ Rifleman
☐ Sniper
☐ Machine Gunner
☐ SAW Gunner
☐ Grenadier
☒ Other *company commander*

4. List ranges (in meters) you think best fit the descriptive terms below (Easy, Reasonable, Difficult) for firing at a point target with the corresponding weapon. Please list quantities for both on a firing range and under stress.

Weapon	Easy		Reasonable		Difficult	
	Range	Firefight	Range	Firefight	Range	Firefight
M4/M16 rifle	25	25	200	100	300	200
Pistol	10	5	15	10	25	710
M249 (SAW)	200	100	300	150-200	400-500	7250
M203	50	50	150	100-150	300	200
MG (M240)	200	100	400	250	600-800	7400
Hand grenade	10	10	15	15	720	715

5. When is the last time you participated in training or evaluation of Infantry Battle Drills?

☐ Never
☐ Less than 2 years ago
☒ 2 – 5 years ago
☐ More than 6 years ago

6. How many real fire fights have you been in?

☒ None
☐ Less than 3
☐ 3 - 9
☐ 10 or more

7. Of those fights, what percentage was successful?

8. Rank what would you consider the most important aspect of executing infantry Battle Drills?

☒ Quick Response
☐ Team Work
☐ Situational Awareness
☐ Other _____

9. How many years of combat training have you received?

☐ None
☐ Less than 2 years
☐ 2 – 5 years
☒ 6 or more

10. Can you list any differences between open field combat and MOUT urban canyon combat that significantly change the way you would select targets or weapons in one versus the other?

arming range for exploding munitions becomes critical in urban environment.

also, speed of tgt. recognition & engagement must be higher in urban environment vice non-urban

When selecting targets within a sector of fire, what factors most influence your decision? Prioritize the characteristics that you consider to be important in target selection, in decreasing order of importance (1 is most important factor).

11. In an **Open Field** scenario

- ☒ 8 Amount and/or duration of your exposure
- ☒ 4 Distance to Target
- ☒ 7 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☒ 2 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 3 How well Target is placing fire? Who is Target firing at?
- ☒ 6 Speed/direction Target is moving
- ☒ 5 Number and proximity of Targets relative to one another
- ☒ 1 Other: can I kill it w/my weapon

12. In a **MOUT Urban Canyon** scenario (outside building)

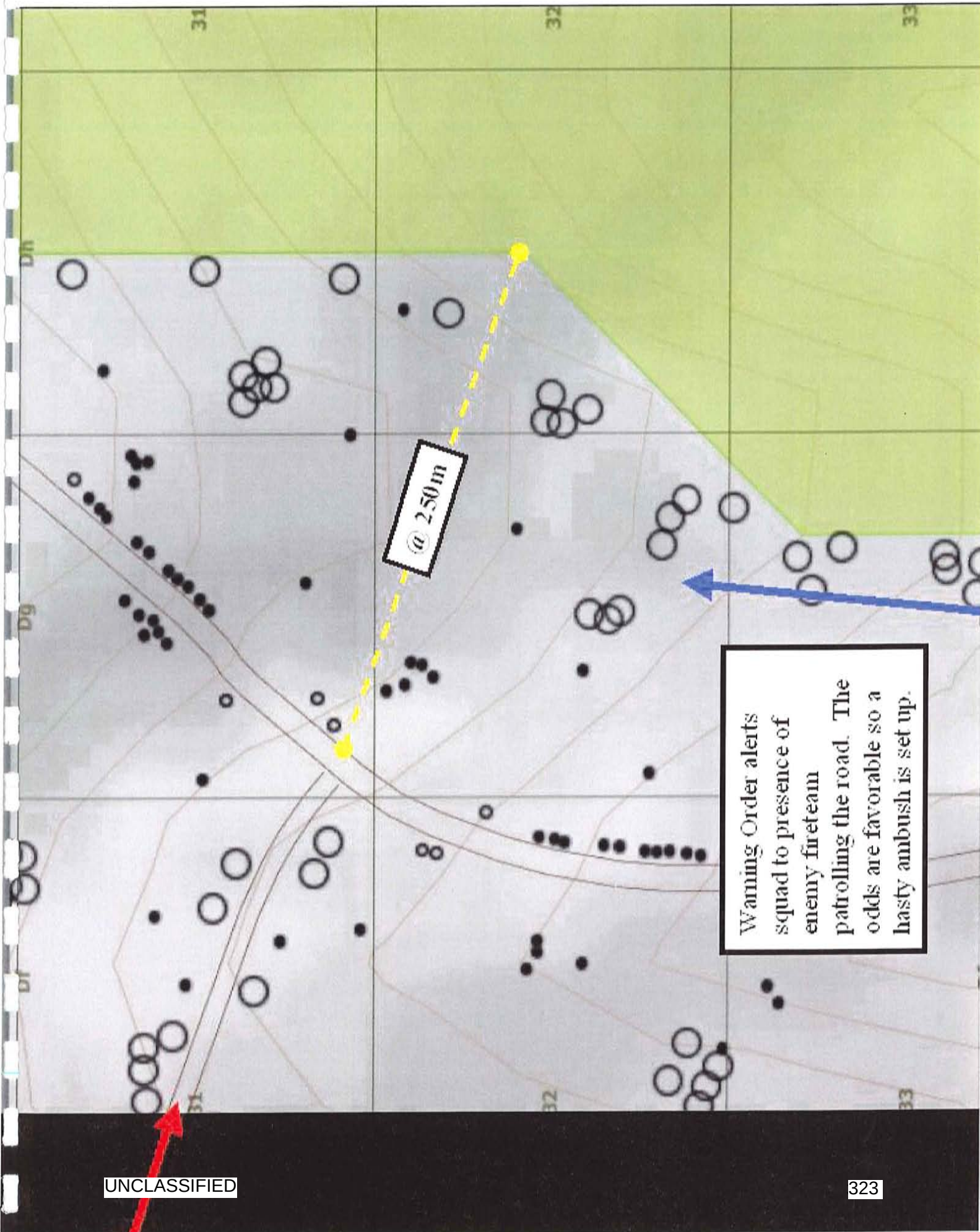
- ☒ 8 Amount and/or duration of your exposure
- ☒ 7 Distance to Target
- ☒ 3 Visibility/Exposure of Target (smoke, dark, cover & concealment)
- ☒ 2 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 4 How well Target is placing fire? Who is Target firing at?
- ☒ 6 Speed/direction Target is moving
- ☒ 5 Number and proximity of Targets relative to one another
- ☒ 1 Other: can I kill it w/my weapon

13. In a **CQB/CCB** scenario (inside building)

- ☒ 7 Amount and/or duration of your exposure
- ☒ 5 Distance to Target
- ☒ 4 Visibility/Exposure of Target (smoke, dark, cover and concealment)
- ☒ 6 Target's weapon or role in unit (rifle, RPG, MG, leader, sniper)
- ☒ 3 How well Target is placing fire? Who is Target firing at?
- ☒ 1 X Speed/direction Target is moving
- ☒ 2 Number and proximity of Targets relative to one another
- ☒ Other: can I kill it w/my weapon

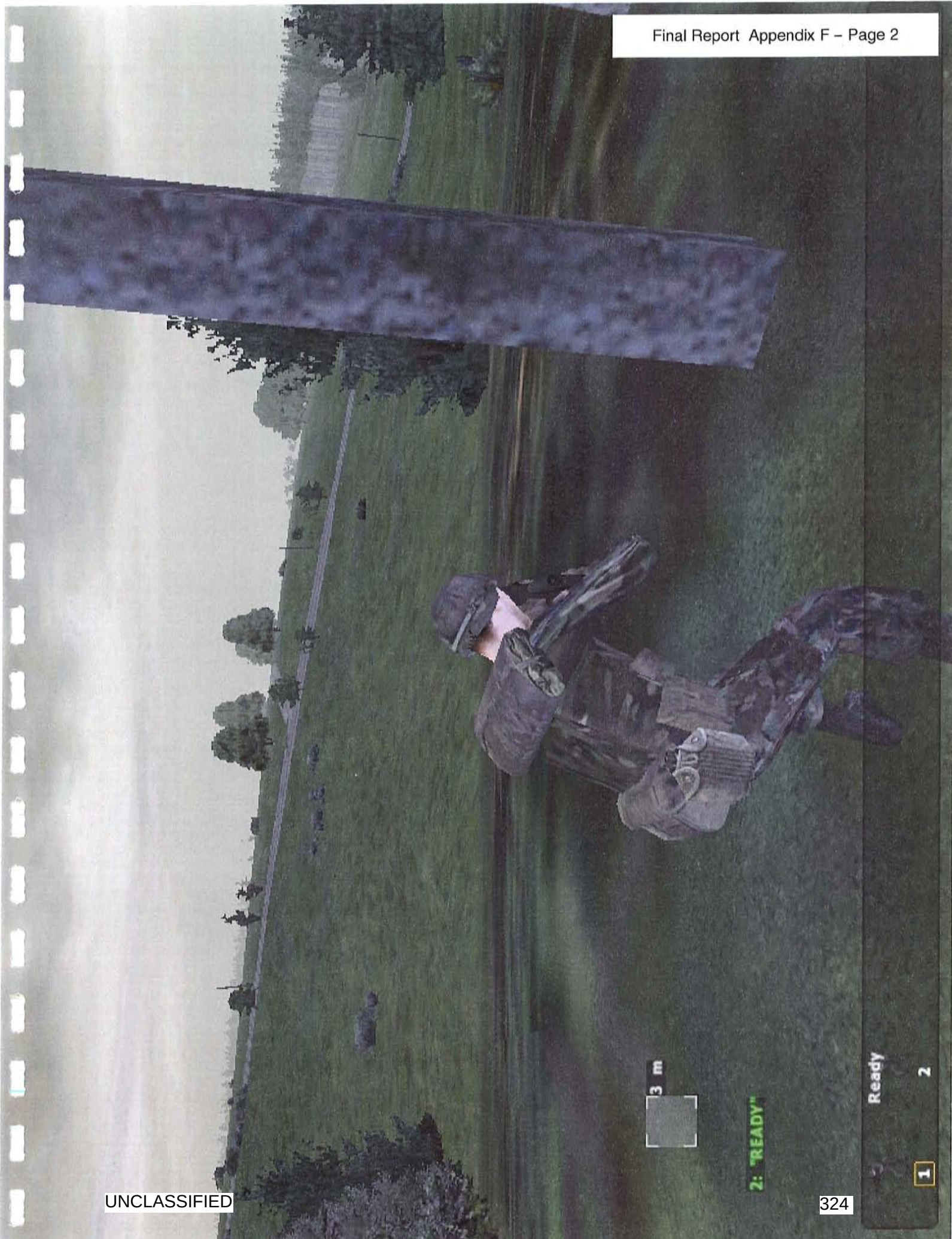
APPENDIX F

SAMPLE TERRAIN ANALYSIS



UNCLASSIFIED

324



UNCLASSIFIED

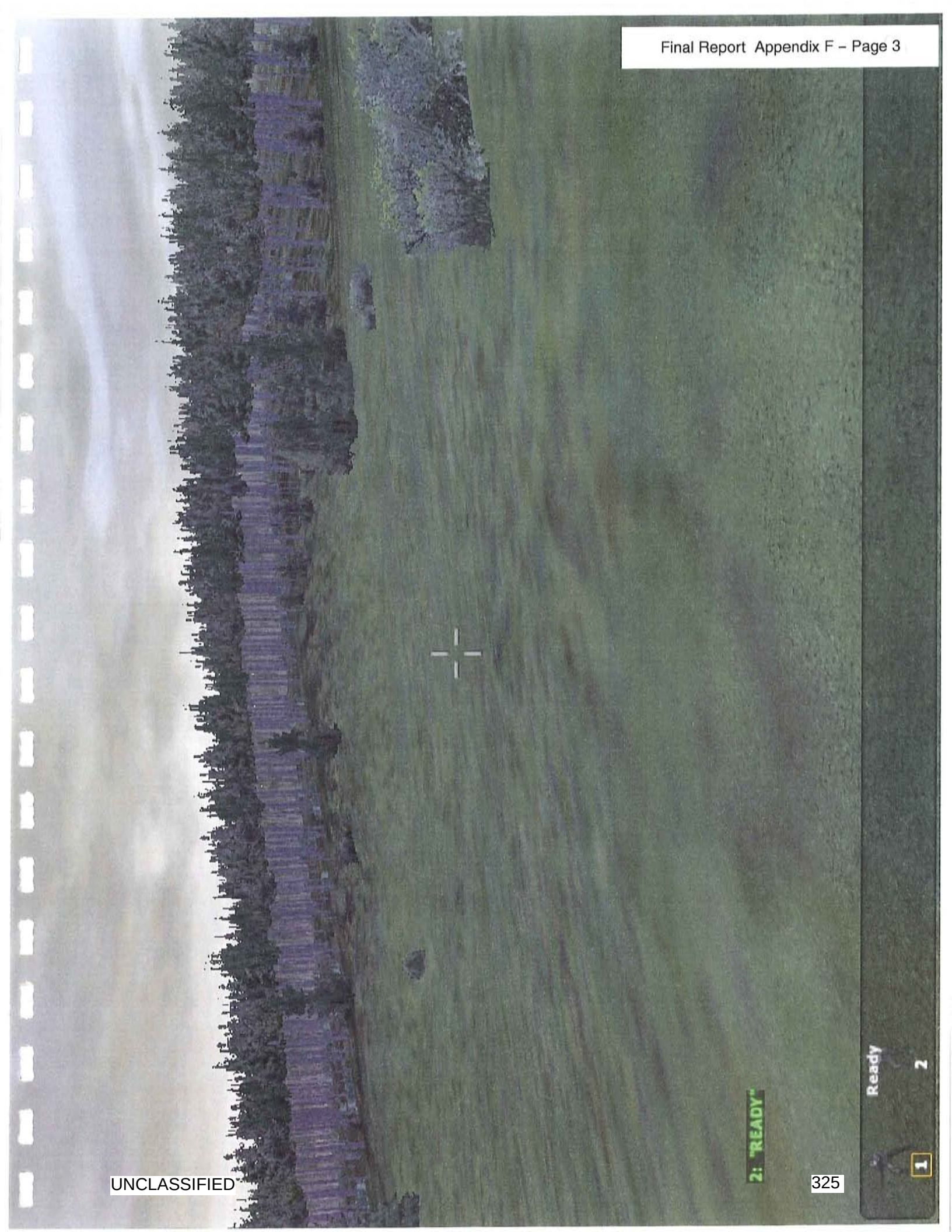
2: "READY"

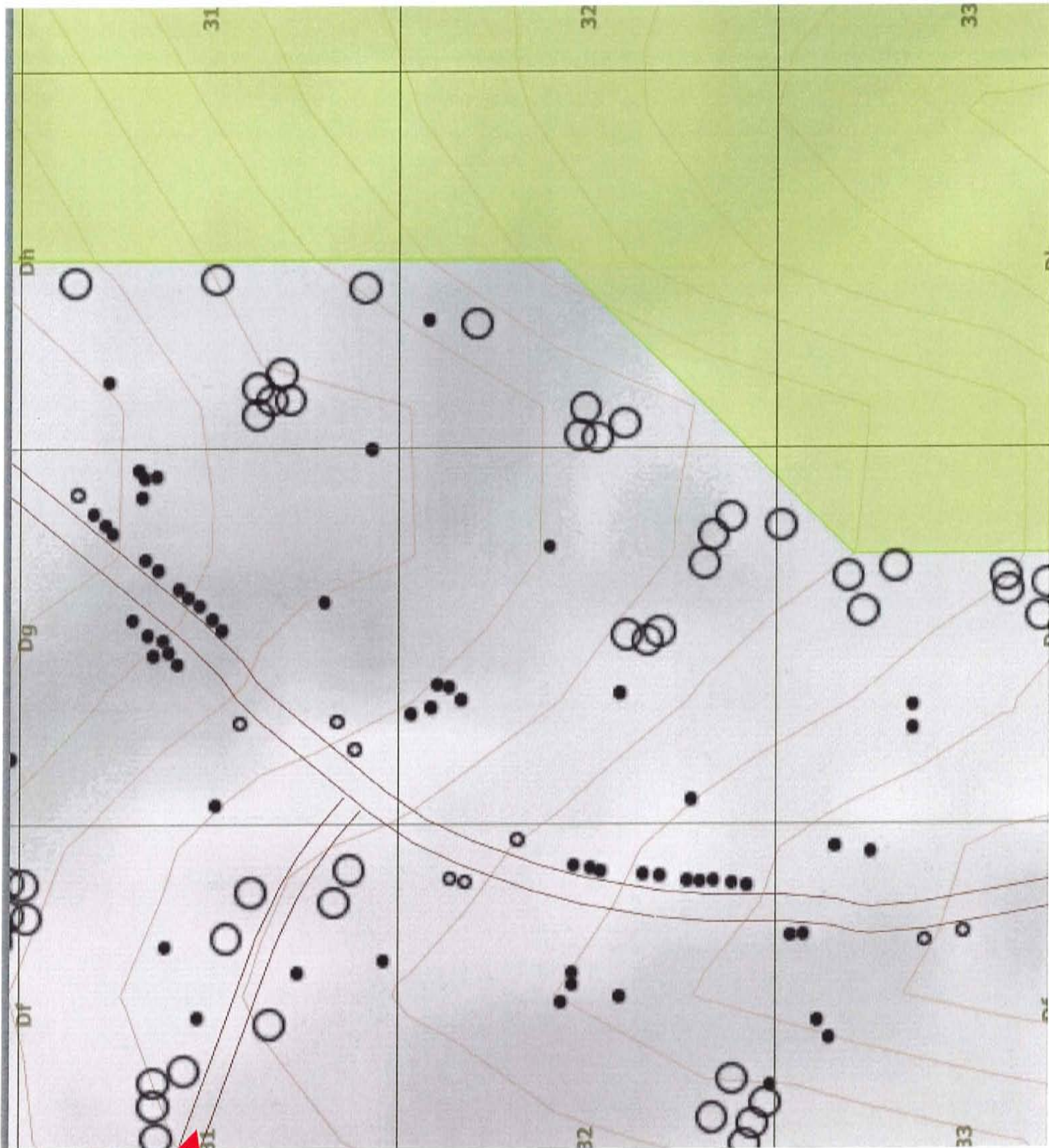
325

Ready

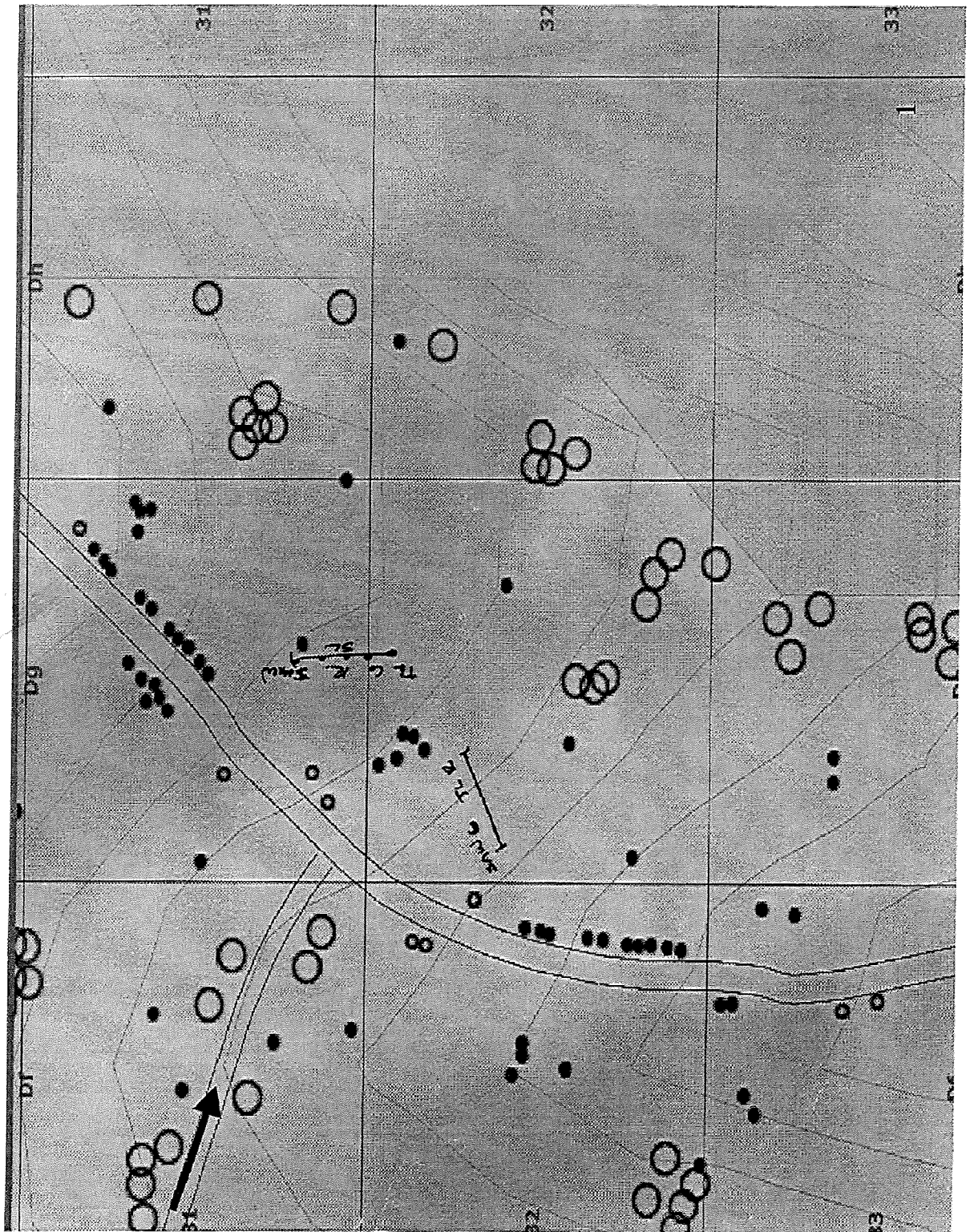
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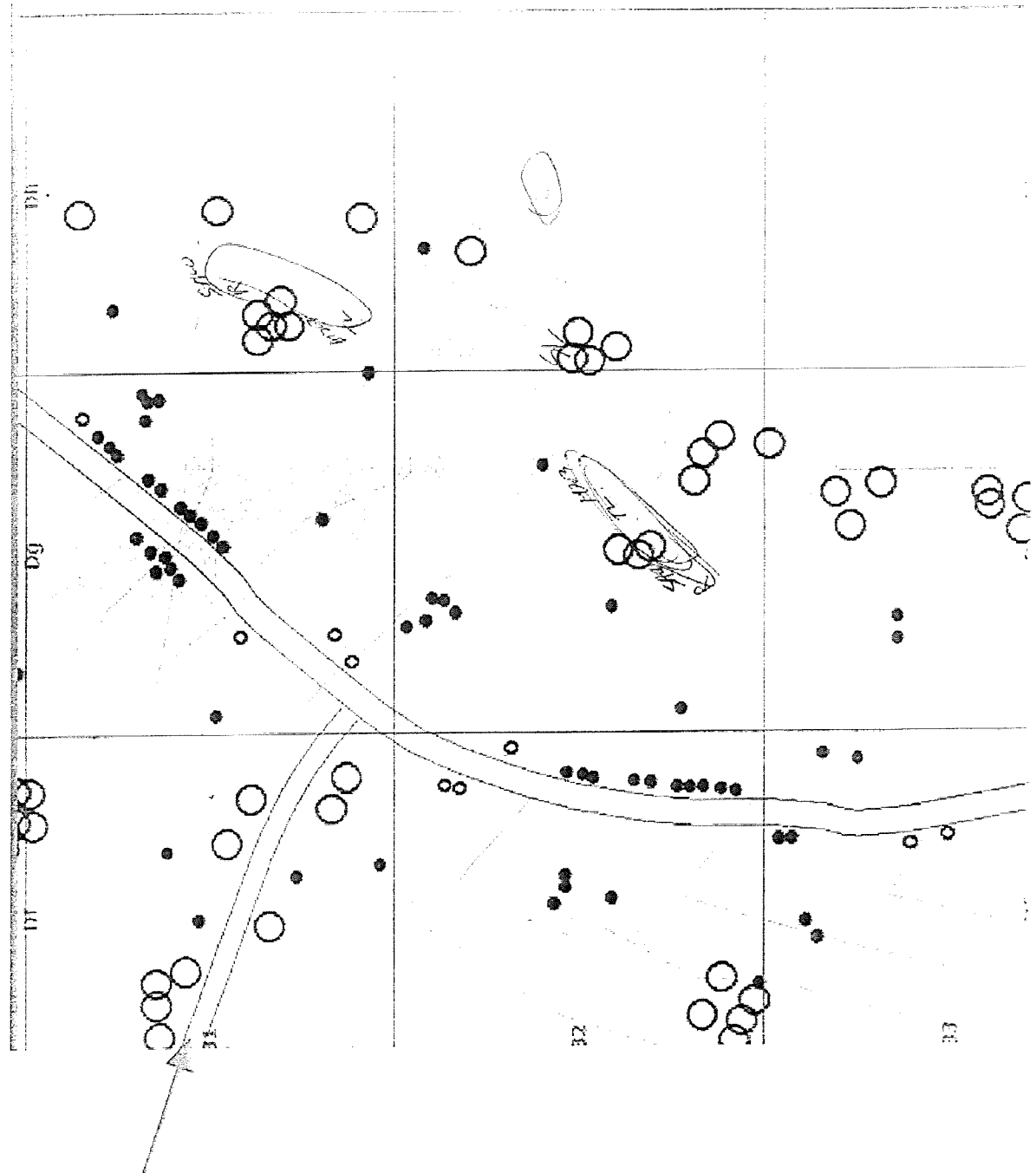
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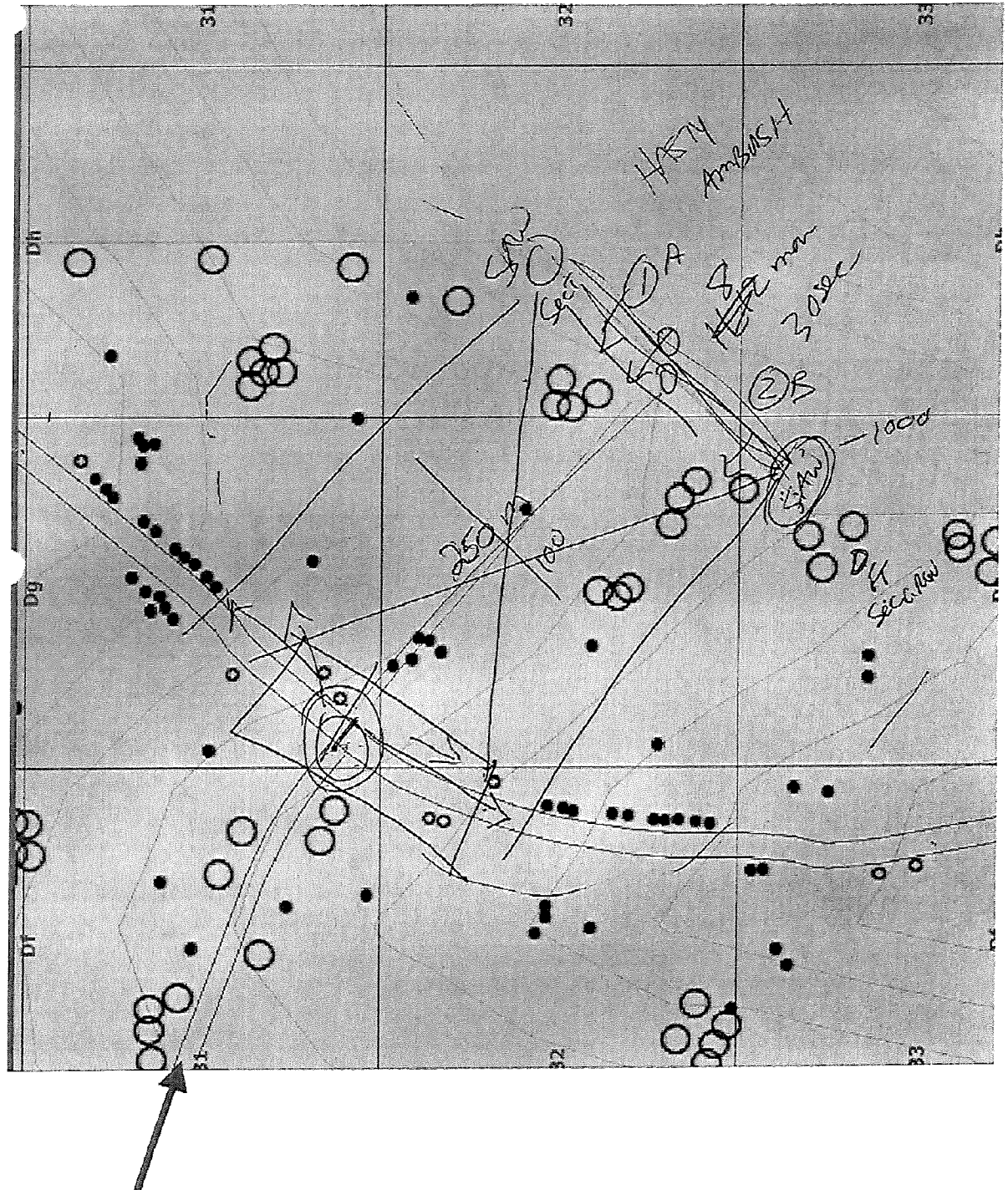


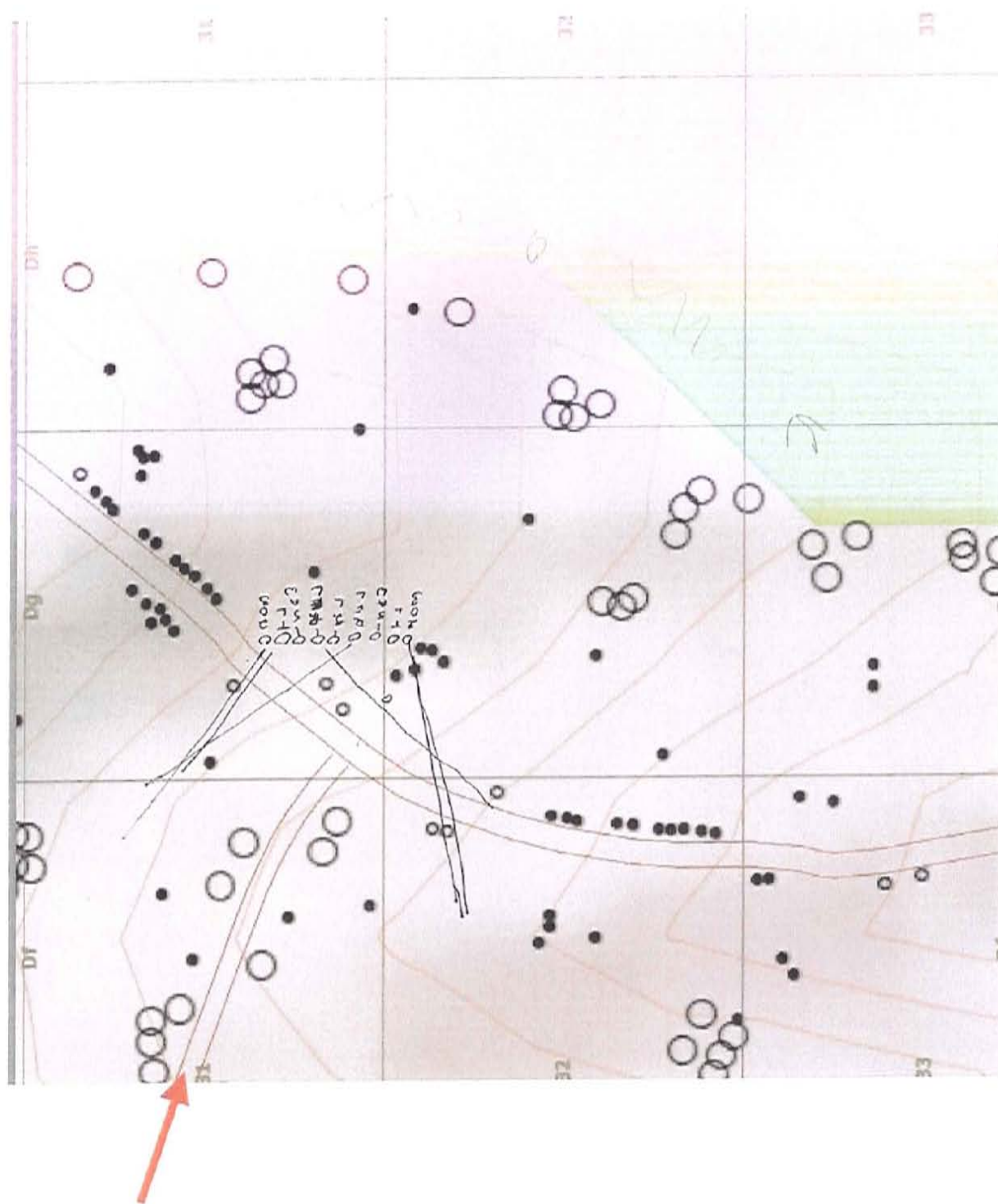


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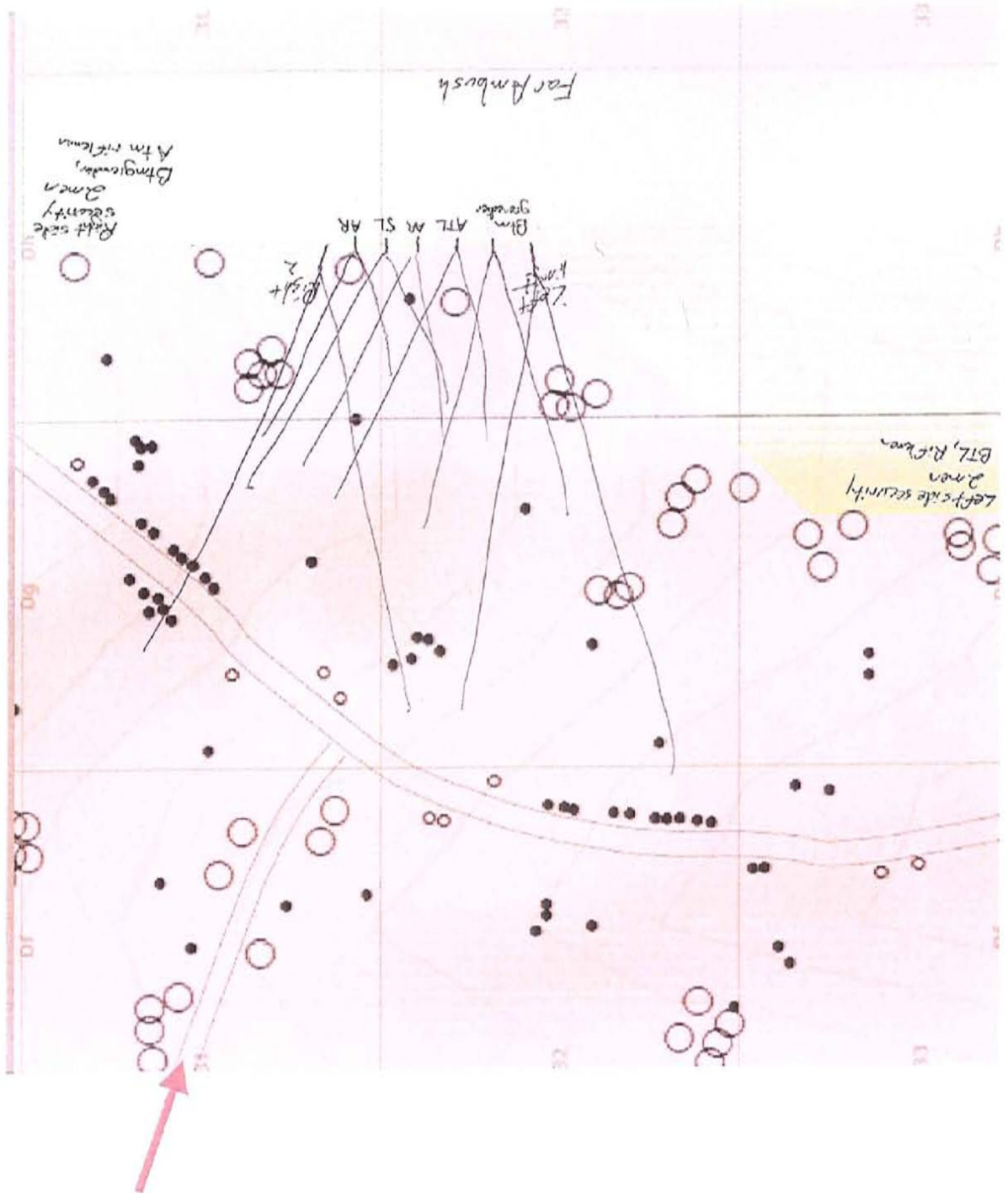


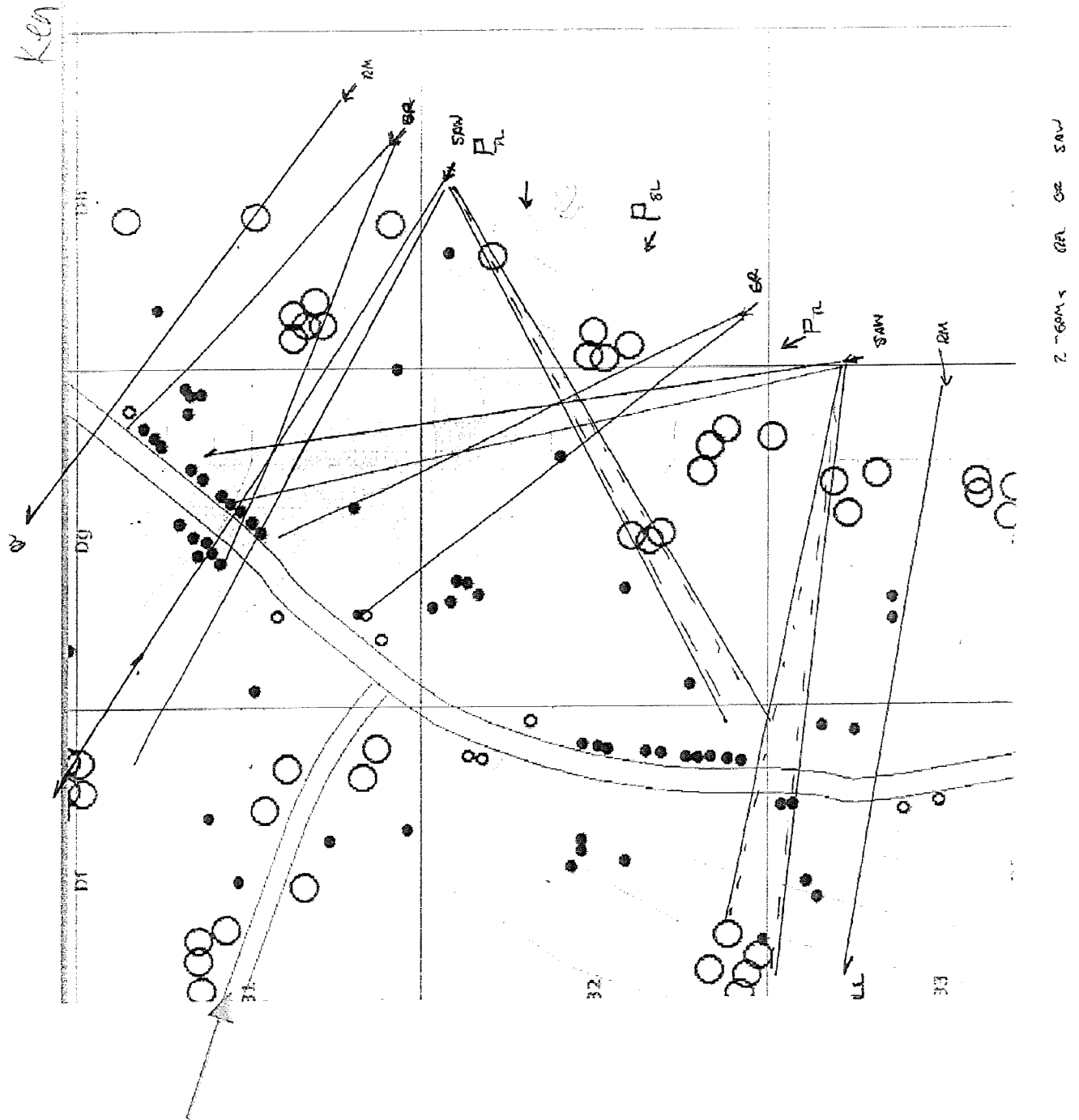






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APPENDIX G

OPEN FIELD RESPONSES

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Slide in Appendix C- Page 1: This slide presents an initial view of enemy targets. According to past intelligence reports, only 3-4 enemy are expected. SME is asked to talk about this slide from perspective of SQD LEADER and/or Shooter. As SQD LEADER, SME is asked how he assigns Targets to Teams or individual combatants. If SME had already made assignments in ambush setup, he is asked if these assignments will change and why. Also, SME is asked about prioritizing and assigning these targets according to whether he does or does not know their individual roles/weapons. SME is also asked about this slide from perspective of individual. That is, if SME was Rifleman, SAW, or Grenadier, who would he shoot at first and why. Again, this is usually done assuming he does know the individual roles/weapons and then again, assuming he does not know individual roles/weapons.	SME 2: If know roles (because of labels) Officer, MG, Rifle-right, Rifle-left Else (if don't know roles or have labels) Officer, Rifle-right, MG, Rifle-left (Rifle-left is moving out of sector) Realistically wouldn't know roles of targets unless there had been some firing that helped you to discern weapons. SME 3: Rifle-left, OFF (heading to cover), Rifle-right SME 7: if know roles MG is first else Rifle-left is first SME 8: Officer, Rifle-left SME 9: Work on targets that can get away first (far to near, left to right). Have TMLDR assign SAW gunners crossing fire. May just have one team engage and wait to see if other enemy show up. Would have Rifle, Grenadier, and Leader using 3 rnd burst initially.
Slide in Appendix C- Page 2: SME is asked to prioritize targets according to perspective of IC assigned to Blue-sector and IC assigned to Yellow-sector. As Blue-sector IC, factors influencing decision include role (i.e., MG vs Rifle), positioning (i.e., front,left,back,right), proximity to cover and/or concealment (CC) (i.e., back target, MG, is nearer to tree), and proximity to sector (i.e., front target, Rifle, is expected to move out of sector sooner). Yellow-sector IC must make decision on same same factors. However, role in this case tests Officer and Rifle.	SME 2: Blue: MG, R SME 3: Blue: Rifle, Yellow: Officer SME 7: if know roles, Blue: MG, Rif (closest) Yellow: Closer, then officer SME 8: Blue: Rifle, MG on left Yellow: Officer, Rifle(closest) SME 9: If know roles, Blue: MG, Rifle Yellow: Rifle, Officer Else Blue: MG, Rifle Yellow: Officer, Rifle
Slide in Appendix C- Page 3: Open Field Movie #1 may be viewed in enclosed CD-ROM.	SME 2: N/A

	SME 3: try to take out MG with grenade launcher
	SME 7: N/A
	SME 8: far right and MG laying down support fire
	SME 9: guys in back are controlled and more lethal. Guys in front are moving and less threat.
Slide in Appendix C- Page 4: Open Field Movie #2 may be viewed in enclosed CD-ROM.	SME 2: N/A
	SME 3: still concerned with automatic weapon (put team on MG), put other team on other 2 guys Rifleman - take out Officer, Grenadier - fire grenade in between SAW - guy on road
	SME 7: 203 target guys on left, SAW gunner firing to suppress
	SME 8: As SQDLDR, would assign Left, Officer, Right
	SME 9: TMLDRs have engagement criterion. ATM takes out MG with 203 round.
Slide in Appendix C- Page 5: Open Field Movie #3 may be viewed in enclosed CD-ROM.	SME 2: N/A
	SME 3: As SQDLDR, TMB - go after MG, TMA - what's with smoke in bush? Can you see full sector? If somebody in bush, use grenadier
	SME 7: concentrate on right flank
	SME 8: Right, Center, Left assign MG to take out MG; fire smoky bushes with SAW; pick up rate of fire on bush; could move grenadier over to make a shot
	SME 9: TMLDRs have engagement criterion. ATM takes out MG with 203 round.
Slide in Appendix C- Page 6: Open Field Movie #4 may be viewed in enclosed CD-ROM.	SME 2: N/A

	SME 3: N/A
	SME 7: make assignments to 203 and/or SAW; RPG is stationary and firing at us
	SME 8: Still hit bushes with SAW; shoot Officer; other saw will go after back guy
	SME 9: MG and Rifle type engagement since targets are moving (single shot for rifles)
Slide in Appendix C- Page 7: Open Field Movie #5 may be viewed in enclosed CD-ROM.	SME 2: N/A
	SME 3: N/A
	SME 7: N/A
	SME 8: RPG (because of ATGM capability); assign good shooter to RPG
	SME 9: now I can see that target is carrying an RPG. SAW/203 should concentrate on RPG (target assignments are modified within constraints of plan)
Slide in Appendix C- Page 8: Open Field Movie #6 may be viewed in enclosed CD-ROM.	SME 2: N/A
	SME 3: Rifleman and SAW aimed single shot. Since running, might use 3-rnd burst. Rifle would pick RPG. As TMLDR, would assign left 2 guys to left target and right 2 guys to right target.
	SME 7: N/A
	SME 8: N/A
	SME 9: 3-round shots on RPG, since haven't gotten to him yet. MG on officer (could let guy keep running and target him when he stops)

Slide in Appendix C- Page 9: This slide weighs a number of factors including role/weapon (i.e., Officer vs MG vs Rifle), firing/aiming status (aiming vs firing vs firing well placed fire), position in sector (left, middle, right), and proximity to concealment (i.e., Rifleman near bush). All Targets are in prone firing positions, so posture or movement or intent recognition are not discriminating factors. Also, all targets are approximately the same distance away, so ability to make shot according to distance to Target is not a discriminating factor. However, weapon system lethality as a function of distance to Target may be discriminating factor.	SME 2: MG, Rifle, Officer (officer not as important once firefight has begun because everything is in turmoil)
	SME 3: MG, closer target - rifle
	SME 7: Rifleman, MG – well placed fire on me is threat. MG is next threat - small adjustment.
	SME 8: MG (in front), Rifle (at end), then Officer
Slide in Appendix C- Page 10: SME is asked to prioritize targets according to perspective of Blue-sector IC and Yellow-sector IC. In Blue-sector, factors influencing decision include role (i.e., MG vs Rifle/Grenade), positioning (i.e., front,left,back,right). Yellow-sector factors influencing decision include role (i.e., MG vs RPG vs Rifle), positioning (i.e., front,left,back,right), Target's existence in overlapping sector (i.e., MG is also in blue-sector), Target's proximity to sector boundaries (i.e., MG is on edge, Rifleman is clearly in center, RPG is on edge), Target's stance (prone, standing). Firing status is not significant, as both Targets are aiming. Also, all targets are approximately the same distance away, so ability to make shot according to distance to Target is not a discriminating factor. However, Target's threat according to weapon system lethality as a function of distance to Target may be discriminating factor.	SME 9: tossup? As TMLDR, assign 2 guys on each As IC, priority is: MG, Rifle, then Officer.
	SME 2: Blue: MG, Rifle and Yellow: MG, RPG, Rifle MG is the more effective weapon, still must point the RPG (not poised to fire)
	SME 3: If know roles, Blue: Rifle/Grenade Yellow: Rifle (up and easier target), then MG Else (if don't know roles) Blue: same as before, but Yellow: MG, then Rifle
	SME 7: if know roles Blue: MG, Rifle/Grenade Yellow: RPG; Else (if don't know roles) Blue: Rifle/Grenade then MG Yellow is still RPG
	SME 8: Blue: whichever catches your attention first Yellow: RPG (about to fire and is exposed)
	SME 9: Blue: MG, Rifle/Grenade Yellow: if RPG stops, he's very important, then Rifle. "Grenade range is where priorities start to change"

Slide in Appendix C- Page 11: SME is asked to prioritize targets according to perspective of Blue-sector and Yellow-sector. In Yellow-sector, factors influencing decision include role (i.e., MG vs Rifle), Target's exposure as function of concealment (i.e., Rifle open, MG partially concealed), movement dynamics (running, stationary), firing status (none, aiming), orientation (facing left, facing IC), Target's proximity to sector boundaries (i.e., Rifle is almost out of sector and moving in that direction), and predicted intent of Target (Rifle may be heading for concealment AND/OR may be trying to flank on left). Blue-sector factors influencing decision include role (i.e., LEADER vs Rifle/Grenade/RPG), positioning (i.e., front, left, back, right), Target's proximity to sector boundaries (i.e., LEADER is almost out of sector), Target's stance (prone, standing), Target's exposure as function of concealment (LEADER partially concealed, R/G/RPG in open), predicted intent of Target (LEADER and R/G/RPG appear to be heading for concealment and looks like LEADER will achieve concealment first). Firing status is not significant, as neither Target is aiming.	SME 2: If know roles Blue: RPG, Officer (RPG is easier target and catches attention) Yellow: MG Else Blue is still the same and Yellow: Rifle
	SME 3: Blue: closer target that's visible
	SME 7: N/A
	SME 8: Blue: RPG (exposed), then Leader Yellow: Rifle, MG (but would assign SAW or grenadier to bushes)
SME 9: Blue: RPG; 203 gunners can engage bush.	

Slide in Appendix C- Page 12: SME is asked to prioritize targets according to perspective of Blue-sector and Yellow-sector. In Yellow-sector, factors influencing decision include role (i.e., MG vs Officer), Target's visibility as function of smoke (i.e., MG highly visible, Officer less visible), firing status (firing (not at you), aiming (at you)), orientation (facing left, facing IC), Target's distance (Officer closer, MG further), proximity of Target to Cover and Concealment (i.e., Officer is closer to concealment than MG is), and Target's existence in overlapping sector (i.e., Officer is also in blue-sector). Blue-sector factors influencing decision include role (i.e., Officer vs Rifle/Grenade), positioning (i.e., front, left, back, right), and Target's existence in overlapping sector (i.e., Officer is also in blue-sector). Visibility to both targets is approximately equally obscured and both targets are approximately equally near edges of blue-sector boundary.	SME 2: If know roles Blue: RPG, Officer Yellow: MG, Officer Else Blue is same but Yellow: Officer, MG SME 3: Yellow: auto weapon is priority target Blue: Officer ways to detect Leader include commands, signals, directing, radio, sometimes not firing. SME 7: If know roles Blue: Officer (closest threat) then Rifle/Grenade Yellow: MG, Officer Else (if don't know roles) Blue: same but Yellow: Officer then MG SME 8: Blue: whoever you see first Yellow: MG (in open), Leader SME 9: Blue: equally dangerous, but Officer is a little closer; Yellow: MG
Slide in Appendix C- Page 13: SME is asked to prioritize targets according to perspective of Blue-sector. Blue-sector factors influencing decision include role (i.e., Rifle vs MG vs RPG), distance (RPG is closest, Rifle-R is furthest), proximity to sector boundaries (RPG near right boundary, Rifle-L near left boundary), IC duties on security (pulling security for left or right), Target's proximity to cover (RPG is near shrubs), stance (prone, standing), movement (running, stationary), orientation (front, left), relative positioning of Targets (r-to-l, l-to-r, Rifles close to one another).	SME 2: MG, RPG, Rifle, Rifle SME 3: MG, then RPG. IF RPG just fired, would direct attention to RPG (sanding up and is easier target between riflemen) SME 7: RPG, MG, Rifle SME 8: MG - straight in front, RPG (could handoff), Rifle at end SME 9: RPG is down (more lethal) and easier to hit. As TMLDR, since target is down w/ RPG he's more stable and more lethal. Since MG is on run, he's less lethal. Running with MG is OK for suppression, but not for controlled/effective fire.

Slide in Appendix C- Page 14: SME is asked to prioritize targets according to perspective of Blue-sector. Blue-sector factors influencing decision include role (i.e., Officer vs Rifle vs MG), proximity to sector boundaries (MG near right boundary, Officer crossing left boundary), Target's proximity to cover (MG is near shrubs), stance (prone, standing), orientation (front, left), and firing status of Targets (i.e., MG is firing, Officer is firing, Rifle is aiming).	SME 2: If know roles MG, Officer, Rifle else MG, R, Officer SME 3: MG, if I can see him (he's sort of behind bushes), easier target Rifleman is next SME 7: If know roles MG, Officer, Rifle Else MG, Rifle, Officer SME 8: Rifle (easy target), then make attempt at MG, Officer SME 9: MG down, Officer, Rifle (based on position)
Slide in Appendix C- Page 15: SME is asked to prioritize targets according to perspective of Blue-sector and Yellow-sector. In Yellow-sector, factors influencing decision include role (i.e., Rifle vs Officer), Target's exposure as a function of stance (i.e., Officer standing, Rifle prone), firing status of Target (running not firing, prone and aiming), orientation (facing left, facing IC), Target's distance (Officer closer, Rifle further), proximity of Target to CC (i.e., Officer is in front of and heading away from shrubs and Rifle is behind and heading toward shrubs), predicted intent of Target (Officer seems to be making run to get closer to us, Rifle is providing cover/suppression for Officer to move). Blue-sector factors influencing decision include role/weapon type (i.e., MG vs RPG), distance (RPG nearer, MG farther), visibility as a function of cover and concealment AND distance (MG clearly visible but further away, RPG closer but less visible).	SME 2: Blue: RPG, MG (due to proximity) SME 3: Blue: RPG is closest, if MG is engaging use SAW on him; Yellow: closer and easiest is Officer target (maybe use 203) SME 7: If know roles Blue: MG, RPG Yellow: Officer, Rifle else Blue: RPG, MG and Yellow: same SME 8: Blue: RPG, M; Yellow - Officer (easy target), Rifle SME 9: Blue: RPG(in 203 range), MG(SAW to suppress him) Yellow: getting close - Off is closest, go for him.

Slide in Appendix C- Page 16: SME is asked to prioritize targets according to perspective of Blue-sector and Yellow-sector. As Yellow-sector, factors influencing decision include role (i.e., Rifle vs Leader), Target's exposure as a function of stance (i.e., Leader standing, Rifle prone), firing status of Target (running not firing, prone and aiming) AND effectiveness of target's fire (Rifle is placing fire well, Leader isn't firing), orientation (facing left, facing IC), Target's distance (Leader closer, Rifle further), proximity of Target to CC (i.e., Leader is in front of and heading away from shrubs and Rifle is behind and heading toward shrubs), predicted intent of Target (Leader seems to be making run to get closer to us, Rifle is providing cover/suppression for Officer to move). Blue-sector factors influencing decision include role/weapon type (i.e., MG vs Rifle) AND effectiveness of that target's fire (i.e., Rifle is placing fire well VS MG with no comment indicating fire effectiveness), distance (Rifle nearer, MG farther), visibility as a function of cover and concealment AND distance (MG clearly visible but further away, Rifle closer but less visible).	SME 2: N/A
	SME 3: MAYBE USE GRENADE
	SME 7: Blue: Rifle-well-placed-fire, MG Yellow: Rifle-well-placed-fire, Leader
	SME 8: Same as 22; assign somebody to MG
Slide in Appendix C- Page 17: SME is asked to prioritize targets according to perspective of IC covering entire sector. Factors influencing decision include role (i.e., Rifle vs Leader vs RPG), Target's exposure as a function of cover and smoke (i.e., Rifle-Left in open but slightly obscured by smoke, Rifle-Right in concealment and highly obscured by smoke, Leader in open but slightly obscured by smoke, and RPG in open and not obscured by smoke), firing status of Target (RPG firing at Tnow but at someone else, Leader aiming at IC and placing fire well, Rifle-Left aiming, Rifle-Right firing status can't be ascertained), orientation (RPG facing/firing left, Leader facing IC, Rifle-Left facing IC), Target's distance (Rifle-Right closest, Leader-next closest, Rifle-Left next closest, and RPG furthest), proximity of Target to CC (i.e., Leader and Rifle-Right are behind and heading toward shrubs).	SME 9: N/A
	SME 2: N/A

	SME 3: Would engage closest guy first. As SQD/TMLDR, have SAW engage RPG and grenade work on Leader-well-placed-fire in bush
	SME 7: If know roles Leader, Rifle, RPG, last Rifle Else Rifle (closest), Leader, RPG, Rifle
	SME 8 RPG, Leader (next easiest), Rifle(out), Rifle(in bush)
	SME 9: As SQDLDR, TM-A assigned LEFT TM-B assigned RIGHT; Rifle in bush(203), other Rifle(SAW), RPG(SAW),Leader(203)
Slide in Appendix C- Page 18: SME is asked to prioritize targets according to perspective of IC covering entire blue sector. Factors influencing decision include sector (only fire at targets in assigned sector VS nuisance targets in adjacent sectors), role (i.e., Rifle vs Leader vs RPG), Target's exposure as a function of cover and smoke (i.e., Rifle-Left in open but slightly obscured by smoke and out of sector, Rifle-Right in open but slightly obscured by smoke, Leader in concealment and highly obscured by smoke, and RPG in open and not obscured by smoke), firing status of Target (RPG getting in position to fire, Rifle-Left firing, Rifle-Right in position to fire at IC, and Leader's firing status not known), orientation (RPG facing/firing left, Leader orientation unknown, Rifle-Left facing IC, Rifle-Right facing IC), Target's distance (Rifle-Right closest, Leader-next closest, Rifle-Left next closest, and RPG furthest).	SME 2: N/A
	SME 3: Rifle closer target first
	SME 7: Regardless of roles, Rifle, Leader, RPG
	SME 8: RPG (in open), Rifle
	SME 9: Rifle aiming at you, RPG, Leader (make sure somebody sees shooting Rifleman)

Slide in Appendix C- Page 19: SME is asked to prioritize targets according to perspective of IC covering entire blue sector. Factors influencing decision include role (i.e., Rifle vs Leader vs RPG), Target's exposure as a function of cover and smoke (i.e., Rifle-Left in open but slightly obscured by smoke and prone, Rifle-Right in open but slightly obscured by smoke and standing, Leader in concealment and partially obscured by smoke and crouched, and RPG in open and not obscured by smoke and prone), firing status of Target (RPG getting in position to fire, Rifle-Left in position to fire, Rifle-Right in position to fire but running, and Leader's in position to fire), orientation (RPG facing/firing left, Leader orientation unknown, Rifle-Left facing IC, Rifle-Right facing IC), Target's distance (Rifle-Right and Rifle-Left closest, Leader-next closest, RPG furthest).	SME 2: N/A
	SME 3: As TmLDR would assign: SAW gunner engage Rifle- right, 203 go after RPG, Rifleman fire on bushes
	SME 7: If know roles, Rifle-left, Leader, Rifle-right, RPG If don't know roles, Rifle-left, Rifle-right, Leader,
	SME 8: Rifle (right up and exposed), RPG (open), conserving ammo - take well aimed shots
	SME 9: Rifle(down), RPG, Rifle(Run),Leader; the guy running is not a threat if SME was pulling security would go for Rifle on run to protect flank.
Slide in Appendix C- Page 20: SME is asked to prioritize targets according to perspective of IC covering entire blue sector. Factors influencing decision include role (i.e., Rifle vs Leader), Target's exposure/visibility as a function of cover and smoke and stance (i.e., Rifle in concealment and partly obscured by smoke and crouched, Leader in open and partially obscured by smoke and standing), firing status of Target (Rifle in position to fire, Leader in position to fire but running), and Target's distance (Leader closest, Rifle furthest).	SME 2: N/A
	SME 3: Leader is close - go w/ Rifleman. SAW go after MG. Might go for MG if well placed fire.
	SME 7: If know roles, Leader, MG, Rifle Else (If don't know role Leader, Rifle, MG
	SME 8: Leader, MG
	SME 9: MG (if putting good fire) with Rifle or SAW. Leader (if he knows this), then get him early, then Rifleman

Slide in Appendix C- Page 21: SME is asked to prioritize targets according to perspective of IC given entire sector. This slide is first in series of close-in engagements allowing us to determine changes in priorities as a function of engagement ranges. Factors influencing decision include role (i.e., Rifle vs Rifle/Grenade-RPG), Target's exposure as a function of stance (i.e., Rifle standing, Rifle/Grenade-RPG prone), firing status of Target (Rifle holding weapon in position to fire, Rifle-Grenade-RPG in position to fire Rifle), orientation (Rifle/Grenade-RPG facing/firing right, Rifle facing IC), Target's distance (Rifle closer than Rifle/Grenade-RPG furthest), and predicted intent of Target (Rifle seems to be making run to get closer to us, Rifle/Grenade-RPG is providing cover/suppression for Rifle to move).	SME 2: N/A
	SME 3: Rifle is closer and approaching, then RPG
	SME 7: Regardless of roles, Rifle is first target
	SME 8: Rifle (standing up), then RPG (since the RPG is on his back)
	SME 9: Since RPG on back, go for Rifleman (who's getting close). If had RPG out, would go for him first.
Slide in Appendix C- Page 22: SME is asked to prioritize targets according to perspective of IC covering entire sector. This slide helps us to determine weapon threat priorities at engagement ranges far within bounds of weapons systems' effective ranges. Factors influencing decision include role/weapon system (i.e., MG vs Rifle/Grenade-RPG), firing status of Target (MG holding weapon in position to fire, Rifle-Grenade-RPG not in position to fire), orientation (Rifle/Grenade-RPG facing front, MG facing/firing left), and predicted intent of Target (MG seems to be making run to flank, Rifle/Grenade-RPG is making run towards front or other flank).	SME 2: N/A
	SME 3: MG is greater threat
	SME 7: If know roles, Rifle/Grenade/RPG first and then MG second else (if don't know roles) MG; then Rifle/Grenade/RPG
	SME 8: MG (bigger target) and about same distance
	SME 9: MG, RPG

Slide in Appendix C- Page 23: SME is asked to prioritize targets according to perspective of IC covering entire sector. Factors influencing decision include role (i.e., Leader vs Rifle/Grenade-RPG), firing status of Target (Rifle/Grenade-RPG holding RPG in position to fire, Leader in position to fire Rifle but running), orientation (Rifle/Grenade-RPG facing/firing a little to left, Leader facing IC), Target's distance (Leader a little further than Rifle/Grenade-RPG), and predicted intent of Target (Rifle/Grenade seems to be making run to left flank and Leader appears to be providing cover/suppression for Rifle/Grenade-RPG to move).	SME 2: N/A
	SME 3: RPG is closer target, then Leader
	SME 7: RPG (because it's closer), then Leader
	SME 8: RPG (positioned ready to fire), then Leader
	SME 9: RPG, Leader (clearly, since RPG is heading to cover and getting ready to fire)
Slide in Appendix C- Page 24: Open Field Movie #7 may be viewed in enclosed CD-ROM.	SME 2: N/A
	SME 3: N/A
	SME 7: N/A
	SME 8: N/A
	SME 9: N/A
Slide in Appendix C- Page 25: SME is asked to prioritize targets according to perspective of IC covering entire sector. This slide illustrates a very close engagement, allowing us to determine changes in priorities as a function of engagement ranges. Factors influencing decision include role (i.e., Rifle vs Leader), Target's exposure as a function of stance and cover (i.e., Rifle prone but only partially concealed and Leader standing and partially covered), Target's proximity to cover (Rifle must move more to get to fully protective cover, Leader need only take one step to his right), firing status of Target (Rifle holding weapon in position to fire, Leader not as ready to fire).	SME 2: Regardless of roles, Rifle-left due to threatening posture
	SME 3: Rifleman (looks closer), then Leader Fire rifle with single shots or short burst with MG)
	SME 7: Regardless of roles, Rifle, Leader
	SME 8: If know roles, Would at least shoot at Leader (to sort of suppress him) Else (if don't know roles) Rifle, because we see more of him
	SME 9: Rifle, then Leader

Slide in Appendix C- Page 26: SME is asked to prioritize targets according to perspective of IC covering entire sector. Factors influencing decision include role (i.e., Rifle vs Leader), Target's exposure as a function of stance (i.e., Leader prone and Rifle standing), Target's proximity to cover (Leader must roll to get to fully protective cover, Rifle need only take one step to his left), firing status of Target (Rifle holding weapon in position to fire but doesn't have stable stance, Leader ready to fire and stable).	SME 2: Officer due to proximity
	SME 3: Rifleman (bigger target), then Leader second. Work on same guy until get him or he's out of sector. If I don't get him, might switch to 3-rnd burst if not getting soon enough.
	SME 7: Regardless of whether roles are known, Leader, then Rifle
	SME 8: Regardless of whether roles are known, Rifle (because he's standing up and can move more easily into cover)
	SME 9: Leader (surer hit because it's harder for him to move out of the way), then Rifle

APPENDIX H

MOUT RESPONSES

Slide in Appendix D- Page 1: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's exposure as a function of cover/concealment (i.e., Yellow behind counter, Green fully exposed, Orange behind door way), visibility of the Target due to lighting and camouflage (Yellow and Orange in low light and blend into background, Green in brighter light and more contrasted to background environment), orientation, and Target's distance (Orange slightly closer, Green/Yellow equally close but further than Orange).	SME 1: Drill: ORANGE AAR: Orange 1st "exposure" that he'd see and he would take a kill shot into shoulder. Then he'd engage green or yellow. Using an M4 (his weapon of choice in this situation), SME-1 would shoot up to 3 controlled pairs at Orange until he sees Target go down. SME 4: Drill: GREEN AAR: visibility SME 5: Drill: GREEN AAR: target more visible. Use M4 to sweep up with a double tap on center of mass. Shoot until Target goes down, but might switch to Yellow, if Green doesn't drop. SME 10: Drill: GREEN AAR: most exposed. Use M4 or 9-mil, single shot SME 11: Drill: GREEN AAR: most visible, fully exposed, probably wouldn't have seen Orange SME 12: Drill: GREEN AAR: in open and moving. Would use single shots with M4. If saw Orange, that would be second target.
Slide in Appendix D – Page 2: SME is asked to prioritize targets according to perspective of Team entering room for clearing. Factors influencing decision include Sector (Green at 12o'clock, Orange in Right Sector, Yellow more in Left Sector), Target's exposure as a function of cover/concealment (i.e., Yellow behind counter, Green fully exposed, Orange behind door way), visibility of the Target due to lighting and camouflage (Yellow and Orange in low light and blend into background, Green in brighter light and more contrasted to background environment), orientation, and Target's distance (Orange slightly closer, Green/Yellow equally close but further than Orange).	SME 1: AAR: As first in room, SME1 would take path of least resistance (to right) and engage Orange. Second IC in room would then head to left and hence engage yellow and green. SME 4: AAR: 1st person going in would move to right, take Green (at about 12o'clock) and then Orange. SME 5: AAR: N/A SME 10: AAR: N/A SME 11: AAR: 1st guy in room goes left, so Green is first target, then Orange. 2nd guy goes right, so Yellow is his first target. Would fire M4-A2 with 3rd burst. SME 12: AAR: 1st guy in to right would engage Orange. 2nd guy in to left would engage Green. Both use M4s with single shots.

Slide in Appendix D – Page 3: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's exposure as a function of cover/concealment (i.e., Yellow behind door, Green fully exposed), visibility of the Target due to camouflage/contrast with surroundings (Yellow blended into background, Green contrasted to background environment), orientation, and Target's action (Green not poised to fire, Yellow poised to fire).	SME 1: Drill: GREEN AAR: Is immediate threat, exposed, and coming into sector. Would shoot M4 controlled pairs and aim for a body shot.
	SME 4: Drill: GREEN AAR: even though he's reloading, Green is easier target for equally non-immediate threat
	SME 5: Drill: GREEN AAR: obvious and helpless. Probably wouldn't see Yellow. Would use double tap.
	SME 10: Drill: GREEN AAR: distance to target, easy to shoot
	SME 11: Drill: GREEN AAR: neither appears to be immediate threat, but Green is easier shot and fully exposed
	SME 12: Drill: GREEN AAR: in open and close. Fire with single shots.
Slide in Appendix D – Page 4: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's exposure as a function of cover/concealment (i.e., Green behind counter and chair, Yellow fully exposed, Orange behind counter and more exposed than Green), Target's distance (Yellow slightly closer, Green/Orange equally close but further than Yellow).	SME 1: Drill: YELLOW AAR: After shot at Yellow, would shoot for Orange and then move to position and take Green
	SME 4: Drill: YELLOW AAR: aiming at me and closer and uncovered
	SME 5: Drill: YELLOW AAR: pointblank with any automatic weapon, then Orange, then Green
	SME 10: DRILL: YELLOW AAR: next targets would be Orange then Green
	SME 11: Drill: YELLOW AAR: biggest threat and most exposed
	SME 12: Drill: YELLOW AAR: in open and close.

Slide in Appendix D – Page 7: SME is asked to prioritize targets according to perspective of Team entering room for clearing. Factors influencing decision include Sector of Target (All Targets are Left Sector, but now Yellow is placed in vertical dimension), Target's exposure as a function of cover/concealment (i.e., Green behind counter and chair, Yellow behind railing, Orange behind counter and more exposed than Green).	SME 1: AAR: 1st IC probably wouldn't see vertical Yellow target until after he's seen Orange or unless Yellow started to engage. He would have seen Orange, since he was directly in line with the bore line of weapon and IC's sight axis. Second IC in room would most likely see Green first. SME-1's impression was that this would be a fatal scenario for room clearing team.
	SME 4: AAR: N/A
	SME 5: AAR: 1st guy in should shoot Yellow. This would be good use of SAW to suppress targets.
	SME 10: AAR: N/A
	SME 11: AAR: 1st guy would shoot Orange. 2nd guy in would (hopefully) pick out Yellow. Yellow may go unnoticed until he actually fires.
Slide in Appendix D – Page 8: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's exposure as a function of cover/concealment (i.e., Yellow behind counter, Green fully exposed, Orange almost fully exposed), Target's distance (Yellow slightly closer, Green next closest, Orange furthest), Targets' actions/firing status (Yellow prepared to fire, Green not poised to fire, Orange not poised to fire).	SME 12: AAR: 1st guy in Orange. 2nd guy in Yellow. If there's a 3rd guy into room, he would take high (Yellow). Use well-placed single shots.
	SME 1: Drill: YELLOW
	AAR: IMMEDIATE THREAT SINCE HE'S POINTING WEAPON. SME-1 WOULD TAKE KILL SHOT
	SME 4: Drill: GREEN
	AAR: Should have picked Yellow. Green was more visible, but Yellow is more threatening target.
	SME 5: Drill: YELLOW
	AAR: about to engage. Would shoot for center of mass with a double tap.
	SME 10: Drill: YELLOW
	AAR: Green is reloading
	SME 11: Drill: YELLOW
	AAR: weapon is ready and Green is not a threat. Use M4 on 3 rnd burst or pistol with single shots.
	SME 12: Drill: YELLOW
	AAR: weapon is aimed at me

Slide in Appendix D – Page 11: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's exposure as a function of cover/concealment (i.e., Yellow almost fully exposed, Orange partly covered by desk), Target's distance (Yellow closer than Orange), Targets' actions/firing status (Yellow prepared to fire, Orange intent not discernible).	SME 1: Drill: YELLOW AAR: would probably see YELLOW first. ORANGE not well exposed. Would shoot M4 with slow, controlled pairs. SME 4: Drill: YELLOW AAR: stood out most and seems to be pointing a gun. SME 5: Drill: YELLOW AAR: could discern what Orange was doing. Would use double tap on mid/upper shot. SME 10: Drill: YELLOW AAR: more exposed, coming away from cover SME 11: Drill: YELLOW AAR: hard to tell who was threat, Yellow most exposed and easier shot. SME 12: Drill: YELLOW AAR: saw Yellow first
Slide in Appendix D – Page 12: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's visibility as a function of lighting and camouflage (i.e., Yellow blends into background better, Orange contrasts with background more), Target's distance (Yellow slightly closer, Orange further), Targets' actions/firing status (Orange clearly prepared to fire, Yellow actions less easily discerned), and proximity/orientation to IC's cover position (Yellow is in front of doorway, Orange is to side).	SME 1: Drill: ORANGE AAR: Path of least resistance entering room would lead SME-1 to right and he would engage ORANGE first. Also, since ORANGE is engaged, ORANGE is higher threat. SME 4: Drill: ORANGE AAR: clearly pointing a gun at me SME 5: Drill: ORANGE AAR: engaging, obvious target, difficult to discern what Yellow is doing. SME 10: Drill: ORANGE AAR: more exposed, close to door so it would be easier to get away faster SME 11: Drill: ORANGE AAR: appears to be aiming or looking at me. Couldn't discern what Yellow was doing, and both are equally exposed. SME 12: Drill: ORANGE AAR: target acquisition, pointing weapon at me

Slide in Appendix D – Page 13: Drill where SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's visibility as a function of lighting and camouflage (i.e., Orange blends into background better, Yellow contrasts with background more because of muzzle flash), Target's distance (Yellow slightly closer, Orange further), Targets' actions/firing status (Yellow firing, Orange preparing to fire), and proximity/orientation to IC's cover position (Yellow is in front of doorway, Orange is to side).	SME 1: Drill: ORANGE AAR: same reason as slide #7. SME 4: Drill: YELLOW AAR: Pointing/firing a weapon and in front SME 5: Drill: YELLOW AAR: shooting, can use door as cover from Red. SME 10: Drill: ORANGE AAR: same reasons as previous slide SME 11: Drill: YELLOW AAR: easier shot and can still have cover with Yellow than if I target Orange (tactical priority). SME 12: Drill: ORANGE AAR: it's a wash. They're both shooting. Maybe go with Yellow, since it's easier to see and you have partial cover from Orange in your current position.
Slide in Appendix D – Page 14: SME is asked to prioritize targets according to perspective of Team entering room for clearing. Factors influencing decision include Targets' sectors (Yellow close to 12o'clock, Orange in Right Sector), visibility as a function of lighting and camouflage (i.e., Orange blends into background better, Yellow contrasts with background more because of muzzle flash), Target's distance (Yellow slightly closer, Orange further), Targets' actions/firing status (Yellow firing, Orange preparing to fire), and proximity/orientation to IC's cover position (Yellow is in front of doorway, Orange is to side).	SME 1: AAR: First in room would engage ORANGE (since going right with path of least resistance), second in room would engage YELLOW. SME 4: AAR: 1st guy in room would target YELLOW (the immediate threat), take double tap at Yellow and then double tap at Orange. SME 5: AAR: N/A SME 10: AAR: N/A SME 11: AAR: N/A SME 12: AAR: N/A

Slide in Appendix D – Page 15: MOUT Movie #1 may be viewed in enclosed CD-ROM. SME is asked to describe priority of targets, mode of fire, and response as a function of weapons system available.	SME 1: Drill: LEFT AAR: Closest threat and exposed. Would use even cadence shots, acquiring red dot every time before shooting. SME 4: Drill: Guy on Left AAR: Double tap guy on Left and then double tap guy on Right. SME 5: Drill: Right the Left AAR: picked up muzzle flash of right and thought he was more dangerous SME 10: Drill: Guy on Left AAR: most exposed, first to see SME 11: Drill: Guy on Left AAR: similar threats, guy on left is completely exposed SME 12: Drill: Right AAR: saw muzzle flash first. Especially in low light situations, eye is attracted to movement.
Slide in Appendix D – Page 16: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include Target's distance (Orange closest, Green next closest, Yellow furthest), Targets' actions/firing status (Yellow prepared to fire, Green not poised to fire, Orange not poised to fire).	SME 1: Drill: ORANGE AAR: nearest threat; would shoot near to far (Orange, Green, Yellow). Weapon of choice would be a pistol caliber type long gun (e.g., M5) or rifle cartridge short gun (e.g., FP90 or M-16). SME 4: Drill: YELLOW AAR: is firing and Orange and Green are reloading SME 5: Drill: YELLOW AAR: Yellow is about to engage, then target Orange, then Green. Would prefer to have SAW, but if had rifle, would use double tap mode. Would re-engage target until he goes down. SME 10: Drill: YELLOW AAR: looking at me, prepared to fire SME 11: Drill: ORANGE AAR: closest and can't see that Yellow is a threat. SME 12: Drill: GREEN AAR: saw Green first. Probably should have picked Yellow, as weapon is up and engaged.

Slide in Appendix D – Page 17: SME is asked to prioritize targets according to perspective of given sector. This time scenario is altered to measure effects of weapons in this type of environment. Factors influencing decision include Target's distance (Orange closest, Green next closest, Yellow furthest), Targets' actions/firing status (Yellow prepared to fire, Green not poised to fire, Orange not poised to fire), and weapon type (Yellow has grenade launcher).	SME 1: AAR: Wouldn't change anything from earlier response on slide in Page 16. Also suggests that IC would NOT be able to recognize that Yellow has grenade launcher. SME 4: AAR: would still pick Yellow, but weapon change did not affect his decision. SME 5: AAR: Would change target selection order to Orange, Green, Yellow, because grenade won't "hit" me. SME 10: AAR: N/A SME 11: AAR: Wouldn't change anything from earlier response on slide in Page 16. Grenade launcher doesn't create enough alarm to change behavior. But, Yellow had MG or AK, then might prioritize Yellow, as SMEs are more geared to fear automatic weapons. SME 12: AAR: would still pick Yellow, but weapon change did not affect his decision.
Slide in Appendix D – Page 18: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include Target's distance (Green closer, Orange further), and visibility as a function of lighting and contrast to background (Orange in better lit area, but glare strains visibility and Orange blends into background, Green is in more dimly lit area, but is more readily visible).	SME 1: Drill: GREEN AAR: saw Green first SME 4: Drill: GREEN AAR: stood out more clearly and is pointing something SME 5: Drill: GREEN AAR: only target he saw. SME 10: Drill: GREEN AAR: nearest target, best chance of getting a hit SME 11: Drill: GREEN AAR: looking at me, harder to see Orange, closer and fully exposed. SME 12: Drill: GREEN AAR: closer and both equally threatening postures.

Slide in Appendix D – Page 19: SME is asked to prioritize targets according to perspective of Shooter given entire sector. Factors influencing decision include Target's distance (Green closer, Orange further), and visibility as a function of lighting and contrast to background (Orange in better lit area, but glare strains visibility and Orange blends into background, Green is in more dimly lit area, but is more readily visible).	SME 1: AAR: Nothing changes from previous slide's selection rationale. In a cave, everything is very loud and close. Thus, everything seems the same, and it would be difficult to differentiate which Target had which weapon. SME 4: AAR: Still Green (nothing changes from previous slide) SME 5: AAR: Still Green then Orange (nothing changes from previous slide) SME 10: AAR: AAR: If knew weapons systems, would shoot from grenade launcher (Orange) SME 11: AAR: Weapons used by Targets is NOT as big of a factor in MOUT as it is in Open Field combat. Maybe pistol vs. MG is enough to get one's attention. SME 12: AAR: Still Green (nothing changes from previous slide)
Slide in Appendix D – Page 20: Drill where SME is asked to prioritize targets according to perspective of given sector. This time scenario is altered to measure effects of weapons in this type of environment. Factors influencing decision include Targets' weapons (Orange firing automatic rifle, Yellow firing single shot), Targets' distance (Yellow closer, Orange further), exposure as a function of cover/concealment (Orange behind desk and equipment and Yellow fully exposed), firing status of Targets (Orange appears to be poised to fire and Yellow is not in firing posture), and visibility as a function of lighting and contrast to background (Orange in better lit area, but glare strains visibility and Orange blends into background and Yellow is in more dimly lit area, but is more readily visible).	SME 1: Drill: YELLOW AAR: Would shoot near to far. Also, Yellow is most exposed and largest target. SME 4: Drill: YELLOW AAR: closest and stood out more. Not covered by anything SME 5: Drill: YELLOW AAR: only target he saw SME 10: Drill: ORANGE AAR: prepared to fire more than Yellow SME 11: Drill: YELLOW AAR: hard to see what orange is doing, Yellow's posture is close to aiming and he's fully exposed. After shooting Yellow, move to right side of wall and try to get better shot at Orange. Would be firing M4 on 3rd burst with aimed shots. SME 12: Drill: ORANGE AAR: Orange is in more threatening fire posture.

Slide in Appendix D – Page 21: SME is asked to prioritize targets according to perspective of given sector. This time scenario is altered to measure effects of weapons in this type of environment. Factors influencing decision include Targets' weapons (Orange firing automatic rifle, Yellow firing single shot), Targets' distance (Yellow closer, Orange further), exposure as a function of cover/concealment (Orange behind desk and equipment and Yellow fully exposed), firing status of Targets (Orange appears to be poised to fire and Yellow is not in firing posture), and visibility as a function of lighting and contrast to background (Orange in better lit area, but glare strains visibility and Orange blends into background and Yellow is in more dimly lit area, but is more readily visible).	SME 1: AAR: Nothing would change from selection rationale on previous slide. I.e., knowing weapon type (in this environment) does not change SME's selection of Target. SME 4: AAR: N/A SME 5: AAR: If firing, would target Orange because of weapon. SME 10: AAR: definitely still pick Orange (additional information strengthens his initial reaction) SME 11: AAR: probably wouldn't change anything because probably wouldn't know (i.e., US soldier would recognize an uzi) by sight. If they were firing on you, then you would know (by the muzzle flashes) and you would prioritize the automatic weapon. SME 12: AAR: definitely still pick Orange (additional information strengthens his initial reaction)
Slide in Appendix D – Page 22: MOUT Movie #2 may be viewed in enclosed CD-ROM. SME is asked to describe priority of targets, mode of fire, and response as a function of weapons system available.	SME 1: Drill: PRONE AAR: Man prone is the most exposed threat. SME 4: Drill: Guy on Ground AAR: was moving and caught SME's attention SME 5: Drill: Guy on Right AAR: only target he saw SME 10: Drill: N/A AAR: SME 11: Drill: Guy left of street AAR: non-combatant who looked like he was getting ready to pull something out of his jacket. SME 12: Drill: missed targets AAR:

Slide in Appendix D – Page 23: MOUT Movie #3 may be viewed in enclosed CD-ROM. SME is asked to describe priority of targets, mode of fire, and response as a function of weapons system available.	SME 1: Drill: PRONE AAR: Man prone is the most exposed threat. Would shoot with M4 controlled pairs. SME 4: Drill: Guy Prone AAR: pointing gun at me SME 5: Drill: front AK AAR: guy running away wasn't as much of a threat as the AK. SME 10: Drill: Left guy running AAR: movement caught SME's attention first SME 11: Drill: Guy Prone in BDUs AAR: hard to figure out threat, hadn't been briefed on ROEs. Try to shoot uniforms. SME 12: Drill: Prone AAR: close in and saw first
Slide in Appendix D – Page 24: Drill where SME is asked to prioritize targets according to perspective of given sector. This series of slides was used to determine changes in IC firing preferences due to presence of non-combatants. Factors influencing decision include Target's distance (Yellow closest, Pink next closest, Green furthest), exposure as a function of cover/concealment (Yellow behind non-combatant, Pink exposed, Green exposed), Targets' stance (Yellow and Pink standing, Green crouched), Targets' position in vertical plane (Yellow and Pink on horizontal, Green has vertical advantage), visibility as a function of lighting and contrast to immediate environment (Pink and Green camouflaged well, Yellow hidden less well), and proximity of non-combatants to Targets (Yellow directly behind non-combatant, Pink mingled in non-combatants though not using one as cover, Green safely away from non-combatants).	SME 1: Drill: PINK AAR: because Pink has a gun. Probably wouldn't ever see Green and Yellow is not exposed enough. Shot a Pink would require extra time to set up for a "good cranial shot". SME 4: Drill: PINK AAR: since Yellow is behind hostage SME 5 Drill: PINK AAR: Pink and Yellow seem equally dangerous, but can hit Pink faster because he's more exposed and there are no civilians near him. Would use M4 double tap on Pink center of mass. In Haiti, for crowd scenarios like there, we used grenade launchers with stinger balls to separate civilians from combatants and would designate a marksman to shoot combatants. Because of ROEs in Haiti, we carried M4s in lieu of SAWs and were not allowed to have sniper rifles. SME 10: Drill: PINK AAR: most exposed, less chance of hurting civilian. SME 11: Drill: YELLOW AAR: pink would probably be equally easy. Use rifle in single shot for precision. If sniper capability, this would be better. SME 12: Drill: missed targets AAR:

Slide in Appendix D – Page 25: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include Target's distance (Yellow closest, Green next closest, Pink furthest), exposure as a function of cover (Yellow behind civilian, Pink exposed, Green exposed), Targets' exposure as a function of stance (Yellow and Green standing, Pink crouched) and orientation (Yellow facing IC, Green facing opposite IC, Pink facing IC), Targets' position in vertical plane (Yellow and Green on horizontal, Pink has vertical advantage), visibility as a function of smoke (Yellow and Green not covered by smoke, Pink camouflaged by smoke), and proximity of non-combatants to Targets (Yellow directly behind civilian, Pink mingled in non-combatants though not using one as cover, Green safely away from non-combatants).	SME 1: Drill: YELLOW AAR: See enough of his head to take a good controlled pair. Would engage Green next. SME 4: Drill: YELLOW AAR: pointed toward me and because Green is turned around and not a threat. SME 5: Drill: GREEN AAR: is easiest target and equally threatening. Would use M4 and fire as fast as I can in front of him, so he runs "into" the rounds. SME 10: Drill: GREEN AAR: away from crowd. Less chance of hurting civilian. SME 11: Drill: YELLOW AAR: same reason as previous slide but in hindsight Green is just as viable an option. Would use single shots because of civilians. If targeting Yellow, would aim as far to left as possible. SME 12: Drill: YELLOW AAR: use single shot to kill
Slide in Appendix D – Page 26: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include Target's distance (Green closest, Yellow next closest, Orange furthest), exposure as a function of cover/concealment (Yellow behind fellow-combatant, Orange partly obscured by non-combatant, Green exposed), Targets' exposure as a function of stance (Orange and Green standing, Yellow is prone) and orientation (Yellow and Green are facing IC, Orange facing opposite IC), Targets' action/firing status (Green is firing, Yellow could be in position to fire, Orange seems to be running), visibility as a function of camouflage with environment (Green clearly visible, Yellow mostly visible, Orange least visible), and proximity of non-combatants to Targets (Orange, Green, mingled in non-combatants though not using one as cover).	SME 1: Drill: GREEN AAR: Nearest threat.

	SME 4: Drill: GREEN AAR: shooting and easiest target
	SME 5: Drill: GREEN AAR: Green is directly in front of me and firing. Would target Yellow next. Use center of mass double tap on green.
	SME 10: Drill: GREEN AAR: firing, use rifle in single-shot mode
	SME 11: Drill: GREEN AAR: firing in my direction, threat to civilians, Orange is blocked by civilian, Yellow is blocked by Green. Use M4 in single shot.
	SME 12: Drill: GREEN AAR: in process of shooting. Use single shot to chest or center of mass.
Slide in Appendix D – Page 27: Drill where SME is asked to prioritize targets according to perspective of given sector. This slide specifically, was used to determine priorities in street MOUT non-combatant scenarios. Factors influencing decision include Target's distance (Yellow closest, Green furthest), exposure as a function of cover/concealment (Yellow in open, Green partly obscured by rooftop), Targets' exposure as a function of stance (Green crouched, Yellow is prone), visibility as a function of camouflage with environment (Green less clearly visible than Yellow), proximity of non-combatants to Targets (Yellow behind non-combatant, Green not near non-combatant), and Targets' vertical advantage (Yellow at IC-level, Green has vertical advantage over IC).	SME 1: Drill: YELLOW AAR: Nearest threat. Would engage with controlled pairs.
	SME 4: Drill: YELLOW AAR: firing at me, closer, more immediate threat
	SME 5: Drill: YELLOW AAR: closer, easier to hit, more of a threat. Would use double tap to chest/head.
	SME 10: Drill: YELLOW AAR:
	SME 11: Drill: YELLOW AAR: closer and both are firing, use single shots.
	SME 12: Drill: YELLOW AAR: closest and firing. Shoot for head/chest.

Slide in Appendix D – Page 28: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include Target's distance (Orange closest, Green furthest), proximity of non-combatants to Targets (Orange closer to non-combatants than Green), and Targets' weapons systems (Green has sniper rifle VS Orange with rifle), and firing status of Targets (Orange is firing, Green may be preparing to fire).	SME 1: AAR: Would take some time, but eventually would see Orange first and engage. Would use well-aimed single shots, where sight is acquired every time. SME 4: AAR: whoever is firing at you. "If all things equal, go for closer" SME 5: AAR: If knew there was a sniper, would target him. Would identify/detect sniper through signature fire (i.e., single shot sounded at distance and only 1 shot) SME 10: AAR: N/A SME 11: AAR: Tough targets to pick up. Assuming that SME has detected targets, shoot at Orange first (easier shot). Could use 3-rnd burst. If have option of finding cover and placing a well-aimed shot, accuracy >> speed. If no civilians, could use M203 for sniper or rifle. SME 12: AAR: Just depends on which one he'd detect first. If knew both targets existed, target firing would take precedence. If both firing, the closest takes precedence.
Slide in Appendix D – Page 29: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure tradeoff between effective range of Targets' weapons versus distance to target. Factors influencing decision include Target's distance (Green closer than Orange), proximity of non-combatants to Targets (Green closer to non-combatants than Orange), and Targets' weapons systems (Green has rifle VS Orange with sniper rifle).	SME 1: AAR: Would shoot for Green Rifle first. SME 4: AAR: Sniper is more effective at that distance with a scope than other guy (Green) with a rifle, so would shoot for Sniper. But, realistically detect sniper unless there had been a single shot. Would probably require an entire team to suppress him. SME 5: AAR: If knew there was a sniper, would target him first. Would probably need a 240 or SAW at that distance. SME 10: AAR: N/A SME 11: AAR: if you KNOW he was a sniper, would shoot Orange first. Sniper rifle has bigger round, makes more noise, and has bigger flash. O.W. it's a toss-up. SME 12: AAR: muzzle flash and movement dependent.

Slide in Appendix D – Page 30: MOUT Movie #4 may be viewed in enclosed CD-ROM. SME is asked to describe priority of targets, mode of fire, and response as a function of weapons system available.	SME 1: Drill: Combatant on Street AAR: take well-aimed shots as quick as he could get sight back up. After he sees Target on street fall, would move back and engage Target in window. SME 4: Drill: Missed Target AAR: SME 5: Drill: Guy on Street. AAR: Could use a M230 in window. 240 or SAW for guy on street would be best. Due to stress of battle, M4 might not really be an effective weapon at distance to target in street. SME 10: Drill: Middle Guy down road AAR: fire on burst or 249 to suppress him SME 11: Drill: Far left down road AAR: Because scenario is more “spread apart” have time to assign targets to a team. Would duck behind corner of building and assign targets. As TmLdr would assign SAW to suppress far left on street, and Rifle at nearer left on street, and 203 in window across street. SME 12: Drill: Guy in center of Street AAR: Using rifle, fire rapid single shots (4-5 rounds) where he saw light (at minimum to suppress the area), would engage target in window next.
Slide in Appendix D – Page 31: Drill where SME is asked to prioritize targets according to perspective of given sector.	SME 1: Drill: ORANGE AAR: Would engage right to left out of habit

	SME 4: Drill: ORANGE AAR: stands out more and other guy (Green) doesn't seem to be pointing gun
	SME 5: Drill: ORANGE AAR: most visible and green is focused in another direction. Would prefer to have a SAW here. If using M4 would fire with double tap on both targets.
	SME 10: Drill: ORANGE AAR: pointing at me
	SME 11 Drill: ORANGE AAR: Green is looking to right and Orange is looking at me. Orange is in better lighting. Use 3-rnd burst mode. Would use 3 rnd burst mode because in Blackhawk Down incident, M4s weren't effective in generating kills.
	SME 12: Drill: ORANGE AAR: pointing at me
Slide in Appendix D – Page 32: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include, Targets' weapons (Green has RPG and Orange has a pistol), proximity of non-combatants to Targets (Green closer to possible non-combatants in bus than Orange), and visibility of Targets as a function of lighting and camouflage with environment (Orange slightly more visible than Green), and firing status/action of Targets (Orange prepared to fire at IC, Green's actions less discernible due to visibility).	SME 1: AAR: Same as previous slide. Would shoot ORANGE first. If SME-1 was in building (or similar type cover that could be affected by RPG), he would shoot RPG first.
	SME 4: AAR: still Orange since distance is close enough for pistol to be effective
	SME 5: AAR: Would still pick Orange as first target and then Green. Would definitely use M4 instead of SAW because of non-combatants on bus. Would shoot double taps with M4.
	SME 10: AAR: RPG becomes priority. Use rifle single shot (since non-combatants nearby).
	SME 11: AAR: Since non-combatants in busses, would use single, well-aimed shots. RPG (Green) is higher priority because at this range Orange (with pistol) is not as much of a threat. If there were no civilians in busses, could assign 203 gunner to both targets.
	SME 12: AAR: If he's pointing at me with RPG, Green is priority. If not, shoot Orange (pistol). If I'm in cover, shoot Green (RPG) first, even if not pointing weapon at me.

Slide in Appendix D – Page 33: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, distance to IC (Green closest, Pink next closest, Orange furthest), perceived weapons (Pink looks to have pistol, Green rifle, Orange unknown), proximity of non-combatants to Targets (Pink threatening non-combatants, Green close to possible non-combatants in bus, Orange not near non-combatants), visibility of Targets as a function of lighting and camouflage with environment (Orange less visible than Green or Pink), and firing status/action of Targets (Green facing IC, Pink firing in car, Orange's actions less discernible due to visibility).	SME 1: Drill: PINK AAR: Right to left engagement sweep SME 4: Drill: GREEN AAR: stood out more, clean target, and firing at me. SME 5: Drill: GREEN AAR: obvious target, detecting me. Preferred weapon would be SAW. SME 10: Drill: GREEN AAR: fairly clear shot SME 11: Drill: GREEN AAR: Green and Pink are obvious choices, neither is aiming at me, Green is more exposed. As TmLdr would assign SAW to Orange, 203 to Pink, and Rifles to Green. SME 12: Drill: GREEN AAR: nearest target
Slide in Appendix D – Page 34: SME is asked to prioritize targets according to perspective of a FireTeam Leader given an organic team and additional information. Factors influencing Target assignment decisions include, Targets' weapons (Green has rifle, Pink has pistol, and Orange has AK47), distance to IC (Green closest, Pink next closest, Orange furthest), perceived weapons (Pink looks to have pistol, Green rifle, Orange unknown), proximity of non-combatants to Targets (Pink threatening non-combatants, Green close to possible non-combatants in bus, Orange not near non-combatants), visibility of Targets as a function of lighting and camouflage with environment (Orange less visible than Green or Pink), and firing status/action of Targets (Green facing IC, Pink firing in car, Orange firing at non-combatants in bus).	SME 1: AAR: TmLdr would take Pink. Verbally order rest of team to take Green and Orange. Using concise communications is KEY. Would use Rifle or SAW or 203 for the AK47 (Orange) and a Rifle for Green (because it's near bus).

	SME 4: AAR: As TmLdr, would assign Rifle to Green, TmLdr would engage Orange, whoever is on right (SAW or 203) would engage Pink. Target assignment to team is correlated to team-members' positioning relative to Targets' positioning.
	SME 5: AAR: Priority of targets: Pink, Orange, Green. As TmLdr, would assign SAW/203 to AK47 (Orange), TmLdr would target Pink, and Rifleman assigned to Green.
	SME 10: AAR: Priority of targets becomes Pink, Orange (at least to suppress Orange), and then Green. As TmLdr would assign Rifle to Pink (for precision because of civilians in car), 203 on Orange, and 249/Rifle on Green (rifle)
	SME 11: AAR: With additional scenario information, would assign SAW to Orange, Rifle (single shot) to Pink, and Rifle (single shot or burst) to Green. Most likely would shoot in whatever mode weapon was already set to.
	SME 12: AAR: As TmLdr would engage Green, assign MG to Orange (AK-47), and Rifleman to Pink. If MG doesn't get AK, then use 203.
Slide in Appendix D – Page 35: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, distance to IC (Green closest, Pink next closest, Yellow furthest), visibility of Targets as a function of lighting and camouflage with environment (Green and Pink more visible than Yellow), and orientation of Targets (Green and Yellow facing IC, Pink facing 90 degrees off).	SME 1: Drill: GREEN AAR: nearest threat. Because SME-1 is moving down wall, bore sight is already pointed along that axis. After Green, would shoot Yellow, then Pink (unless Pink shoots first). Would take controlled, well-aimed body shots for all Targets.
	SME 4: Drill: GREEN AAR: pointed at me and closest
	SME 5: Drill: PINK AAR: Only target SME would see unless targets had started shooting. Site Pink center of mass and pull until he goes down. Would be good SAW target too.
	SME 10: Drill: GREEN AAR: closest
	SME 11: Drill: PINK AAR: Pink and Green seem similar, but looks like Pink is looking at me. Pink would be first thing you see as you're coming around corner. Green would be next choice for targets. Use a M4. "People seem to shoot what they see first"
	SME 12: Drill: GREEN AAR: saw it first

Slide in Appendix D – Page 36: SME is asked to prioritize targets according to perspective of a FireTeam Leader given an organic team and additional information. Factors influencing decision include, distance to IC (Green closest, Pink next closest, Yellow furthest), visibility of Targets as a function of lighting and camouflage with environment (Green and Pink more visible than Yellow), and orientation of Targets (Green and Yellow facing IC, Pink facing 90 degrees off).	SME 1: AAR: As TmLdr would shoot for Green and assign rest of Team to other 2 Targets.
	SME 4: AAR: As TmLdr, would assign person(s) on Left to take Yellow, person(s) on Right to take Pink, and TmLdr in Center would take Green. Initial reaction should be to seek cover.
	SME 5: AAR: Pink could be a good SAW target.
	SME 10: AAR: N/A
	SME 11: AAR: As TmLdr would assign front guy to Green and Yellow and 2nd guy to Pink. If had time to set up would assign A/R to Green and Yellow and 203 (or SAW) on Pink.
	SME 12: AAR: As TmLdr, would assign targets according to geometry of team. That is, whoever is right, shoot Pink, TmLdr shoots Green (then would shoot Yellow). Use M4 in single shot. Burst modes better used on area targets and low light conditions.
Slide in Appendix D – Page 37: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, Targets' weapons (Pink RPG, Orange MG), Targets' exposure as a function of cover/concealment (Orange has access to more cover than Pink), and position of Targets in the vertical plane (Pink at IC-ground-level, Orange has vertical advantage).	SME 1: AAR: RPG first then MG. RPG in line with bore line/sight axis.
	SME 4: AAR: If receiving rounds from MG, would take MG. Else, at least try to suppress/disrupt Pink prior to targeting MG. Use 203 on Orange to suppress him.
	SME 5: AAR: Would shoot everything he's got at MG. If shooting from building, might pay more attention to RPG's actions.
	SME 10: AAR: Pink (RPG), but if he's not threatening then MG. As TmLdr would assign Rifle on MG (Orange) and 249 on RPG (Pink)
	SME 11: AAR: 1st target is Orange (MG), 2nd is Pink (RPG). If inside cover (across the street), the MG is still biggest threat (i.e., being in cover does not make RPG more threatening); but if in cover and RPG is aiming, then RPG (Pink) takes priority over MG (Orange).
	SME 12: AAR: Pink (RPG) is first target and Orange (MG) is second because I would look at street level before I look up vertically.

Slide in Appendix D – Page 38: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, distance to IC (Pink and Green closest, Yellow next closest, Orange furthest), visibility of Targets as a function of lighting and camouflage with environment (Yellow is most visible, followed by Green, Pink, and then Orange), orientation of Targets (Green, Yellow and Orange facing IC, Pink facing 90 degrees off), firing status/actions of Targets (Yellow and Green stationary and prepared to fire, Orange's actions not easily discerned, Pink running to car), posture/stance of Target (Yellow standing, Green crouching, Orange not easily determined, Pink crouching but moving).	SME 1: Drill: GREEN AAR: Well exposed and using sweeping pattern of Right-to-Left SME 4: Drill: YELLOW AAR: center of picture and most visible SME 5: Drill: ORANGE AAR: looks like he's crouching, YELLOW probably the better target. Yellow is aiming at me, easy 1-2 shot kill. Would shoot double tap with M4 then sweep right. SAW would be good weapon to use here too. As TmLdr, would assign SAW to sweep right-to-left, Rifleman sweep left-to-right, and 203 to shoot in center of group. SME 10: Drill: GREEN AAR: appears closest to me, good exposure. Maybe should have gone to Pink??? SME 11: Drill: YELLOW AAR: Yellow and Green aiming at me, Yellow seems to be larger target because Green is kneeling. SME 12: Drill: YELLOW AAR: in open and center at 12 o'clock
Slide in Appendix D – Page 39: SME is asked to prioritize targets according to perspective of given sector with information that may prompt him to change prior response. Factors influencing decision include, weapon type of Targets (Pink has grenade launcher, Yellow has pistol, Orange has hand grenade, Green has pistol), distance to IC (Pink and Green closest, Yellow next closest, Orange furthest), visibility of Targets as a function of lighting and camouflage with environment (Yellow is most visible, followed by Green, Pink, and then Orange), orientation of Targets (Green, Yellow and Orange facing IC, Pink facing 90 degrees off), firing status/actions of Targets (Yellow and Green stationary and prepared to fire, Orange's actions not easily discerned, Pink running to car), posture/stance of Target (Yellow standing, Green crouching, Orange not easily determined, Pink crouching but moving).	SME 1: AAR: Wouldn't change selection criteria from previous slide.

	SME 4: AAR: Wouldn't change selection criteria from previous slide
	SME 5: AAR: Priority of targets would be Orange (throwing hand grenade) since SME is behind bus, Pink (grenade launcher) for same reason, and then pistols (Yellow/Green). Orange is higher priority than Pink, because Orange is closer to being able to engage.
	SME 10: AAR: Biggest threats are Pink (grenade launcher) and Orange (hand grenade)
	SME 11: AAR: Would now shoot Orange first, as Orange is throwing hand grenade and SME/IC is behind bus that could take damage. Pink (grenade launcher) is also a concern, but distracted at immediate moment, so will require more time to engage SME than Orange will.
	SME 12: AAR: Wouldn't change selection criteria from previous slide, because probably wouldn't know what they had
Slide in Appendix D – Page 40: SME is asked to prioritize targets according to perspective of given sector with additional information. Factors influencing decision include, weapon type of Targets (Pink has RPG, Yellow has pistol), distance to IC (Yellow closer than Pink), visibility of Targets as a function of lighting, camouflage, and distance (Yellow is most visible, Pink is less visible), orientation of Targets (Yellow facing IC, Pink facing 90 degrees off), firing status/actions of Targets (Yellow stationary and prepared to fire, Pink moving and not aimed at IC), and responsibilities to protect friendly forces and non-combatants.	SME 1: AAR: Would target Pistol (Yellow), as he's exposed, more visible, and closer. Would then move somewhere left behind the tank and then engage Pink.
	SME 4: AAR: Would target Pistol (Yellow) As a TmLdr, would assign Green to Left, Pink to 203, and Yellow to another Rifleman or self.
	SME 5: AAR: Yellow (pistol) and shoot with M4 using double tap.
	SME 10: AAR: Yellow (pistol) shoot with rifle on single shot mode. As TmLdr would assign 203/249 to RGP (Pink)
	SME 11: AAR: Yellow with well-aimed single shot (because of civilians). Pink with well aimed fire, single shot. RPG is greater threat to tank, than pistol is to SME. As TmLdr would only assign Rifles to these targets.
	SME 12: AAR: first target acquired probably would be Yellow. Completely based on target he would notice first.

Slide in Appendix D – Page 41: SME is asked to prioritize targets according to perspective of given sector with additional information. Factors influencing decision include, distance to IC (Yellow closer than Orange or Green), visibility of Targets as a function of camouflage with background (Yellow is most visible, Green and Orange is less visible), orientation of Targets (Yellow facing away from IC, Orange and Green facing IC), firing status/actions of Targets (Yellow moving and not prepared to fire, Orange and Green stationary and prepared to fire), and responsibilities to protect friendly forces.	SME 1: AAR: Yellow since more exposed. Then Green or Orange. Would be using controlled, well-aimed shots because distance is sort of far. SME 4: AAR: As a TmLdr would assign one man on Yellow, 203/SAW on Orange and Green (at minimum to suppress), and TmLdr (self) would take Yellow. Since Yellow is moving, would fire rifle in automatic 3-rnd burst shots. SME 5: AAR: Would target Orange and Green first since they're Yellow's only protection and Yellow is still far from helicopter. Preference in weapons to use would be: M240 cyclic rate, SAW, 204, M4. SME 10: AAR: Would shoot Yellow with rifle on single shot. Use 240/203 on Orange/Green providing cover fire. SME 11: AAR: Would shoot Yellow with SAW and use 203 on Orange/Green, if those weapons were available. If shooting M4s, would shoot in automatic, 3-rnd burst mode. SME 12: AAR: Would target Orange and Green first (since SME not good at hitting moving targets). Would take single shots with M4 and use wall for support.
Slide in Appendix D – Page 42: MOUT Movie #5 may be viewed in enclosed CD-ROM. SME is asked to describe priority of targets, mode of fire, and response as a function of weapons system available.	SME 1: Drill: Guy Shooting AAR: use controlled pairs as quick as SME can acquire the sight. SME 4: Drill: Left guy firing AAR: SME 5: Drill: Left automatic weapon AAR: Would prefer to have 240 or SAW in this situation SME 10: Drill: Guy shooting on Left AAR: Would prefer to have a 249 or rifle in burst mode. SME 11: Drill: Guy on Left side AAR: hard to see anything but muzzle flash. Use SAW (since can't see target) or use burst mode for rifle. But SAW tracer rounds let you see where you're shooting better. SME 12: Drill: Left hand side AAR: in low light muzzle flash catches attention first.
Slide in Appendix D – Page 43: MOUT Movie #6 may be viewed in enclosed CD-ROM.	SME 1: Drill: On Mound (i.e., Target Right) and then on Left AAR: Sweeping right-to-left and noticed guy on Right first.

	SME 4: Drill: 1st Left Guy firing AAR: saw Left muzzle flash first. Would use single shot, since Targets not moving.
	SME 5: Drill: Guy on Right AAR:
	SME 10: Drill: Guy on Right (shooting on mound) AAR: would return fire with M4 as TmLdr, or ask 249 to fire (if there was time)
	SME 11: Drill: Top Left AAR: use SAW or burst.
	SME 12 Drill: Left hand side AAR: saw him first at top of hill since he's backlit
Slide in Appendix D – Page 44: In this slide, SMEs were simply asked what their single preferred weapon would be.	SME 1: AAR: Preferred weapon would be a hand grenade or an M4. If using M4, SME would use controlled shots "Family Style". This means that everybody gets at least one shot before anybody gets 2. It can be considered a method of suppression.
	SME 4: AAR: Preferred weapon would be a SAW, because Targets are so close together
	SME 5: AAR: Preferred weapon would be a SAW and SME would shoot it with a long uncontrolled sweep.
	SME 10: AAR: Preferred weapon would be a 249.
	SME 11: AAR: Preferred weapon would be a SAW or 203.
	SME 12: AAR: Preferred weapon would be a MG
Slide in Appendix D – Page 45: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include distance to IC (Yellow closer than Orange) and stance of target (Yellow crouched and Orange standing).	SME 1: Drill: YELLOW AAR: due to proximity (appears closer) and sees him more quickly and clearly.

	SME 4: Drill: YELLOW AAR: appears to be closest
	SME 5: Drill: YELLOW AAR: kneeling and has steadier platform, already engaging. Would shoot with double tap and then shift to right target and shoot with double tap. Too close for a grenade launcher, but buckshot grenade launcher might work well.
	SME 10: Drill: YELLOW AAR: closest and most threatening
	SME 11: Drill: YELLOW AAR: both looking at me, Yellow is more exposed, some cover to right and can use it to shoot Orange after I shoot Yellow.
	SME 12: Drill: YELLOW AAR: center of alley
Slide in Appendix D – Page 46: SME is asked to prioritize targets according to perspective of given sector with additional information designed to see if SME's reaction changes due to weapon type. Factors influencing decision include weapon type (Yellow has pistol VS Orange has rifle), distance to IC (Yellow closer than Orange) and stance of target (Yellow crouched and Orange standing).	SME 1: AAR: nothing changes due to weapon used by Target (from previous case in 45).
	SME 4: AAR: nothing would change from previous case because Yellow is still close enough that pistol would be effective weapon. If over 50m, then rifle more important. Also, pistol only has 9 rounds and rifle has 20–30.
	SME 5: AAR: Would change target priority to Orange, since Orange has higher threat weapon. SME thinks he would be able to tell which target has which weapon by seeing or hearing them fire. In Haiti, it was SME's experience that he could tell difference between rifles and shotguns.
	SME 10: AAR: Rifles are more accurate, but pistol is still close enough that it could be effective, so would still target Yellow (pistol) first.
	SME 11: AAR: Probably wouldn't recognize these weapons according to targets, so same prioritization scheme as previous slide (page 45).
	SME 12: AAR: Wouldn't realistically have time to notice weapons used by targets. MOUT is significantly higher stressed and faster paced than open field. But, if one of the weapons was an automatic weapon, would probably notice and prioritize that target (in this case).

Slide in Appendix D – Page 47: Drill where SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include distance to IC (Yellow closer than Orange) and stance of target (Yellow crouched and Orange standing).	SME 1: Drill: YELLOW AAR: sees him more quickly
	SME 4: Drill: YELLOW AAR: more visible
	SME 5: Drill: YELLOW AAR: would see him first. Both would make good M4 targets.
	SME 10: Drill: ORANGE AAR: Yellow not near any cover, Orange could dive for cover on rock pile
	SME 11: Drill: YELLOW AAR: closer, easier shot
	SME 12: Drill: YELLOW AAR: in open and closer in
Slide in Appendix D – Page 48: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include weapon system of Target (Orange has rifle in single shot mode, but Yellow is using automatic mode), distance to IC (Yellow closer than Orange) and stance of target (Yellow crouched and Orange standing).	SME 1: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 4: AAR: Targets' weapons do not change SME's target selection criteria. Even if Orange was firing in automatic mode, SME would still pick Yellow
	SME 5: AAR: Targets' weapons do not change SME's target selection criteria. If he noticed Orange, he would probably shoot for Orange (because of higher threat weapon), but SME doesn't think he would notice Orange before engaging Yellow.
	SME 10: AAR: Addition of weapons to scenario doesn't change SME's target selection.
	SME 11: AAR: this assignment of weapons just strengthens case for targeting Yellow before Orange. But, if reversed, SME would target Orange first. That is, if Orange was automatic and Yellow was single shot, SME would select Orange target before Yellow target.
	SME 12: AAR: Addition of weapons to scenario doesn't change SME's target selection.

Slide in Appendix D – Page 49: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include distance to IC (Yellow closer than Pink), visibility as a function of distance/ background/lighting (Yellow more easily seen than Pink), and stance of target (Yellow crouched and Pink probably standing, but hard to tell).	SME 1: Drill: YELLOW AAR: due to proximity and fact that Yellow is an easy shot. Would take "kill shot".
	SME 4: Drill: YELLOW AAR: closer and hard to discern what Pink is doing.
	SME 5: Drill: YELLOW AAR: So close and can't really see Pink.
	SME 10: Drill: YELLOW AAR: can see Yellow easier than Pink and could easily kill Yellow.
	SME 11: Drill: YELLOW AAR: hard to see pink, Yellow close and exposed, so is an easier hit. Can shift quickly from Yellow to Pink.
	SME 12: Drill: YELLOW AAR: closer in and in open
Slide in Appendix D – Page 50: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include weapon system of Target (Yellow has rifle, but Pink has machine gun), distance to IC (Yellow closer than Pink), visibility as a function of distance/ background/lighting (Yellow more easily seen than Pink), and stance of target (Yellow crouched and Pink probably standing, but hard to tell).	SME 1: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 4: AAR: As TmLdr would use 203 or SAW on MG (Pink) to suppress and Rifleman on Yellow.
	SME 5: AAR: If sees Pink and know Pink has MG, would go after MG with everything SME's got. This, simultaneously, would probably suppress Yellow.
	SME 10: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 11: AAR: Wouldn't recognize weapons unless MG (Pink) was shooting. If Pink was shooting, then would target Pink first. Assuming that we've just come around corner, I would duck back behind the wall. If Pink was shooting (but laying down), I would target Yellow and assign 203 to target Pink.
	SME 12: AAR: even if Pink is firing MG, would still target Yellow because Yellow is too close NOT to react immediately. At a minimum, take a single shot to his knee to hit or suppress.

Slide in Appendix D – Page 51: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, distance to IC (Pink closer than Green closer than Yellow), visibility as a function of lighting and background (Pink in dim lighting, Yellow blends into background, Green more obvious), and Target's exposure as a function of cover (Yellow partly obscured by cover, Green and Pink fully exposed).	SME 1: Drill: PINK AAR: due to proximity, then Green, then Yellow.
	SME 4: Drill: GREEN AAR: Should have picked PINK, but didn't even see Pink!!! If scanning L to R would have seen him. Arrows may have interfered with this process.
	SME 5: Drill: GREEN AAR: Green is most obvious. Next target would be Pink, and then Yellow. Green and Pink are equally threatening, but Pink took more time to detect.
	SME 10: Drill: PINK AAR: closest threat and perhaps close to cover/escape
	SME 11: Drill: PINK AAR: shooting and straight down wall. If I'm coming around corner, I'd probably see Green first. Fire in burst mode (Pink, Green, Yellow). This is a smart set up for the enemy target because the last guy SME would get to is also the biggest threat to you.
	SME 12: Drill: PINK AAR: saw Pink first and then Green. Scanning pattern will shift according to where you have more room in your sector and on position in formation.
Slide in Appendix D – Page 52: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include weapon system of Target (Pink has pistol, Green using rifle in single shot mode, but Yellow using rifle in automatic mode). distance to IC (Pink closer than Green closer than Yellow), visibility as a function of lighting and background (Pink in dim lighting, Yellow blends into background, Green more obvious), and Target's exposure as a function of cover (Yellow partly obscured by cover, Green and Pink fully exposed).	SME 1: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 4: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 5: AAR: IF SME knows all of these weapons used by which targets, would prioritize Yellow, Green, Pink.
	SME 10: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 11: AAR: Close enough that pistol is still as much of a threat. If auto-rifle is shooting, try and shoot automatic while still behind cover. SME 12: AAR: Pink, Green, then Yellow. Still would acquire Pink first and still would scan left to right.

Slide in Appendix D – Page 53: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, distance to IC (Orange and Pink closer than Green, visibility as a function of lighting and background (Pink in dim lighting, Green blends into background, Orange more obvious), and Target's exposure as a function of cover (Green partly obscured by cover, Orange and Pink fully exposed).	SME 1: Drill: PINK AAR: due to proximity of Target and SME's preference to sweep right-to-left. SME 4: Drill: PINK AAR: firing directly at me SME 5: Drill: ORANGE AAR: Only target he saw, others are in shadows. SME 10 Drill: PINK AAR: close to me and close to cover SME 11: Drill: PINK AAR: Orange is looking the other way, Pink is looking at me, can't really see Green. Use M4 on 3-rnd burst. Prioritize Pink then Orange then Green. SME 12: Drill: PINK AAR: closest in and closest to 12 o'clock, then Green then Orange
Slide in Appendix D – Page 54: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include weapon system of Target (Green has RPG, Pink using rifle in single shot mode, but Orange using rifle in automatic mode), distance to IC (Orange and Pink closer than Green, visibility as a function of lighting and background (Pink in dim lighting, Green blends into background, Orange more obvious), and Target's exposure as a function of cover (Green partly obscured by cover, Orange and Pink fully exposed).	SME 1: AAR: Targets' weapons do not change SME's target selection criteria. SME 4: AAR: As TmLdr, assign 203 to take out RPG (Green), use single shot on Pink. Rule of thumb is to use single shot as much as possible in MOUT to conserve ammo. High volume weapons are useful for area targets. SME 5: AAR: If he can discern targets and weapons, would prioritize Orange, Pink, Green. But, if in building, would prioritize Green, Pink, Orange. SME 10: AAR: Targets' weapons does not change SME's target selection criteria SME 11: AAR: Targets' weapons do not change SME's target selection criteria. Even if SME was in building/cover, would still prioritize Pink then Orange then Green. SME 12: AAR: Pink first target then Green (RPG). If knew Green had RPG, would prioritize Green, Orange, Pink, but probably wouldn't know this by sight. Would probably "hear" automatic rifleman next.

Slide in Appendix D – Page 55: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include, distance to IC (Green and Pink closer than Yellow, visibility as a function of lighting and background (Pink in dim lighting, Yellow blends into background, Green in peripheral of scene), Target's exposure as a function of cover (Yellow partly obscured by cover, Green and Pink fully exposed), and Target's aiming/firing status (Green and Yellow both prepared to fire, Pink not poised to fire).	SME 1: Drill: GREEN AAR: highest threat with readied firing status, then Yellow, then Pink.
	SME 4: Drill: GREEN AAR: firing at me
	SME 5: Drill: GREEN AAR: important to kill instantly, as Green is ready to shoot. Would take single shot to kill Green and multiple single shots to kill Yellow. Pink is temporarily out of fight.
	SME 10: Drill: GREEN AAR: Pink is reloading, Green is ready to fire, Yellow is behind cover.
	SME 11: Drill: GREEN AAR: Green is closer to me and more exposed than Yellow is. Overall priorities would be Green then Yellow then Pink, particularly since the angle between Green and Yellow is small and only requires a small adjustment.
	SME 12: Drill: GREEN AAR: nearer and actively engaged
Slide in Appendix D – Page 56: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include weapon system of Target (Green and Pink have rifles but Yellow had rifle plus grenade launcher), distance to IC (Green and Pink closer than Yellow, visibility as a function of lighting and background (Pink in dim lighting, Yellow blends into background, Green in peripheral of scene), Target's exposure as a function of cover (Yellow partly obscured by cover, Green and Pink fully exposed), and Target's aiming/firing status (Green and Yellow both prepared to fire, Pink reaching for a hand grenade).	SME 1: AAR: Targets' weapons do not change SME's target selection criteria.
	SME 4: AAR: Targets' weapons do not change SME's target selection criteria. Would use double tap for MOUT even with pistols.
	SME 5: AAR: still same because Pink must take time to prepare grenade. But, if grenade was ready to throw, then would raise threat level of Pink in target priority scheme.
	SME 10: AAR: Targets' weapons do not change SME's target selection criteria
	SME 11: AAR: Targets' weapons do not change SME's target selection criteria. Even if SME was in a building, his target prioritization scheme wouldn't change.
	SME 12: AAR: Green is first target. If knows Pink is reaching for HG, would target Pink second. Yellow would be third target.

Slide in Appendix D – Page 57: SME is asked to prioritize targets according to perspective of given sector. Factors influencing decision include visibility as a function of lighting, background, and Target's exposure (Yellow more visible than Green), Target's exposure as a function of cover (Green mostly obscured by cover, Yellow fully exposed), and Target's aiming/firing status (Yellow prepared to fire, Green may be prepared to fire, but it's harder to discern because of visibility).	SME 1: Drill: YELLOW AAR: seems to be bigger threat and is more exposed SME 4: Drill: YELLOW AAR: not hiding behind anything and other guy (Green) is harder shot SME 5: Drill: YELLOW AAR: can see him easier and could hit him easier. Would use M4 on double tap. Couldn't use SAW in this situation because ½ the rounds would be inside the room since building is concrete. SME 10: Drill: YELLOW AAR: most exposed, easy target SME 11: Drill: YELLOW AAR: Yellow is aiming at me, exposed, can shoot him and use window for cover on green. M203 would be useful here. SME 12: Drill: YELLOW AAR: easily visible
Slide in Appendix D – Page 58: SME is asked to prioritize targets according to perspective of given sector. This slide is designed to measure changes in response of previous slide, based on weapons systems of Targets. Factors influencing decision include weapon system of Target (Green has RPG, Yellow has rifle), visibility as a function of lighting, background, and Target's exposure (Yellow more visible than Green), Target's exposure as a function of cover (Green mostly obscured by cover, Yellow fully exposed), and Target's aiming/firing status (Yellow prepared to fire, Green may be prepared to fire, but it's harder to discern because of visibility). One interesting note about this scenario is that the IC clearly has cover.	SME 1: AAR: Targets' weapons do not change SME's target selection criteria, because SME wouldn't know about the RPG unless it had been used, in which case RPG (Green) would be higher priority target. SME 4: AAR: Targets' weapons do not change SME's target selection criteria. Would use rifle in single shot mode now, because distance is a little further. SME 5: AAR: Probably would still shoot for Yellow (rifle) since can't really see RPG to make a good shot or discern what Green (RPG) is doing to determine if Green is a threat. When in doubt, go for surer target. SME 10: AAR: Targets' weapons do not change SME's target selection criteria. SME 11: AAR: If Green (RPG) was about to shoot, he would be higher priority, given that SME is in cover. SME 12: AAR: If SME knew that Green had RPG, then SME would target Green. Else, he'd continue to target Yellow first (as in slide 57). Would use hand grenade or 203 if he had one, but SAW would come in handy too.

Slide in Appendix D – Page 59: MOUT Movie #7 may be viewed in enclosed CD-ROM. SME is asked to describe priority of targets, mode of fire, and response as a function of weapons system available.	SME 1: Drill: Left then Right AAR: due to tactical priority (i.e., wouldn't expose himself to Right Combatant before eliminating threat from Left Combatant). Would shoot as quickly as he could get flash and shoot at Left Combatant until killed and before moving on to Right Combatant.
	SME 4: Drill: Left then Right AAR: Shoot Left with double tap, then right with double tap. Would prefer to have pistol in this scenario.
	SME 5: Drill: Left then Right AAR: First thing he saw. Use SAW or M4 (could walk SAW through wall). If walls are concrete, use M4 (double tap left, then double tap right).
	SME 10: Drill: Guy on Left AAR: first guy I see to shoot and in middle of doorway exposed. Use single shot rifle. Would shoot and drop Left before moving on to Right target.
	SME 11: Drill: Left AAR: saw guy on left first, use as much fire power as I can burst.
	SME 12: Drill: Left the Right AAR: Take well-aimed shots using laser designator and NVG. Would shoot 2-3 at Left, then shift to Right. Suppression can take two forms: 1. I know where target is, but I don't have time to set up kill shot, or 2. area targets where I don't know exactly where the target is and I'm firing in the general direction.