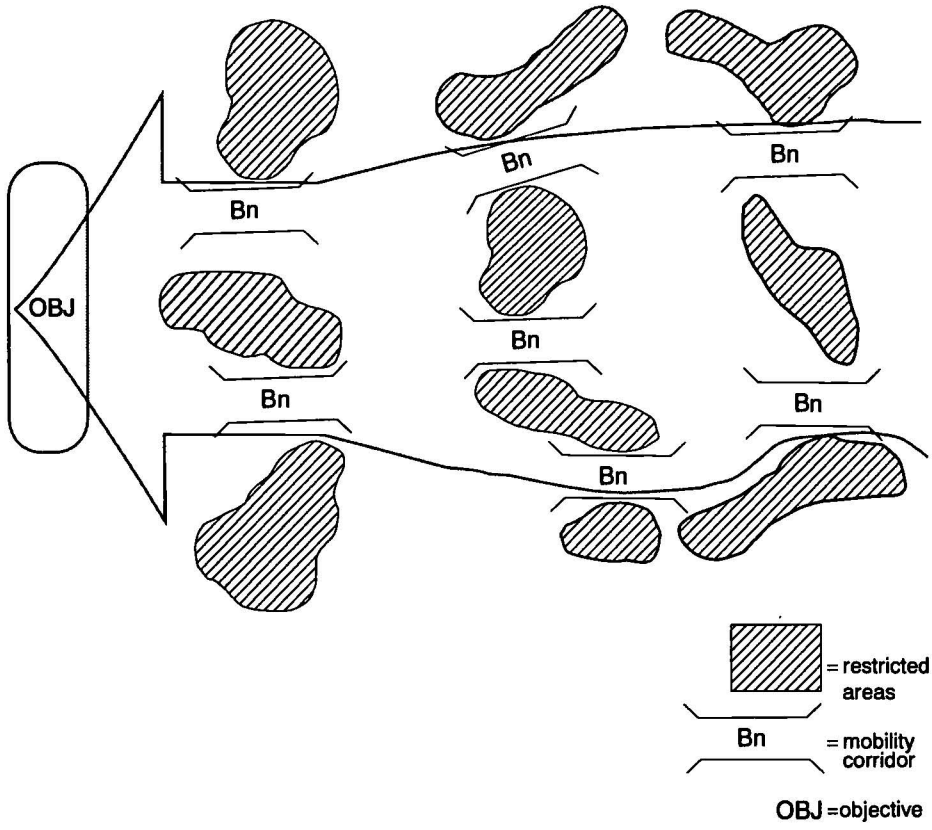


Figure 5-6. Mobility Corridors Grouped to Form an AA.

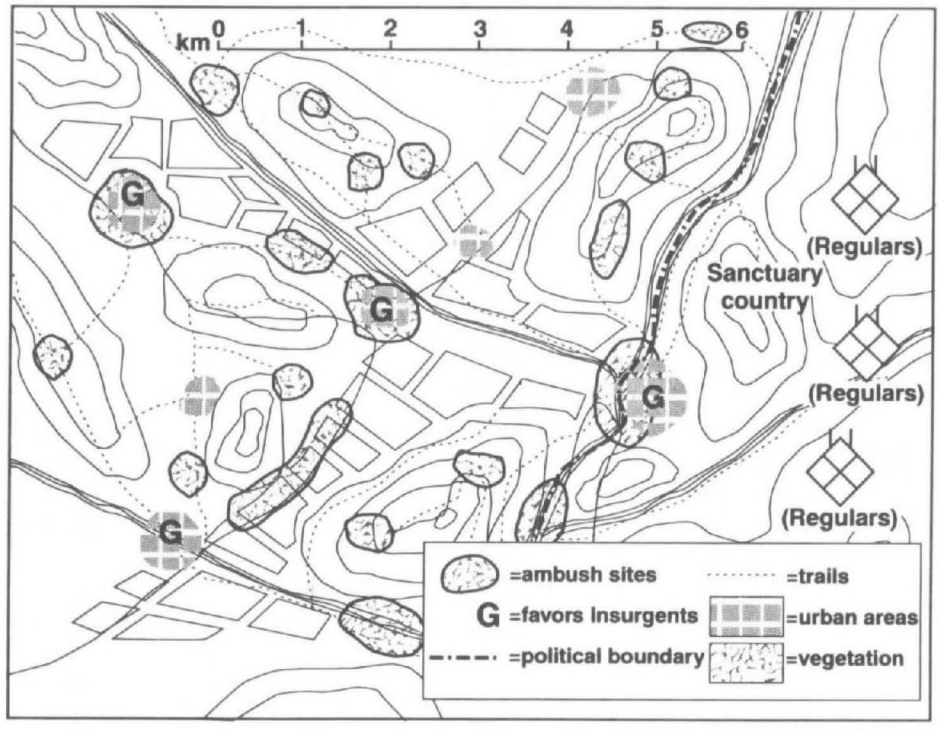


Figure 5-7. Lines of Communications and Likely Ambush Sites.

- Immediate or intermediate objectives—Terrain analysts identify any areas or terrain features that dominate AAs or assigned objective areas. These areas usually correspond to areas already identified as key terrain. As time permits, or situation requires, analysts also identify potential assembly and dispersal areas, observation posts, artillery and air defense positions, LZs, and DZs.

The terrain rarely favors one type of operation throughout the width, depth, and height of the battlespace. Based on the location and nature of the potential engagement areas and battle positions, analysts determine which areas of the battlespace favor attack or defend COAs.

Analysts consider all terrain factors in any order that best supports their analysis, but must focus on the factors most relevant to the specific situation and needs of the commander. To aid the commander's staff in the completion of their estimates and plans, analysts construct a combined obstacle overlay (COO) or a modified combined obstacle overlay (MCOO), which are graphic products that depict battlespace effects on military operations (see fig. 5-8).

Weather

Commanders can take advantage of the weather or minimize its effects through planning based on a weather analysis. During the weather analysis step, weather is studied to determine how it affects friendly and enemy capabilities to move, shoot, and communicate. Terrain and weather are inseparable factors of tactical intelligence and must be integrated. Weather forecasts and assessments contribute to intelligence and must be considered when commanders develop their COAs. The type and amount of weather support needed for a particular mission depends on the mission, the forces, the terrain, and the enemy.

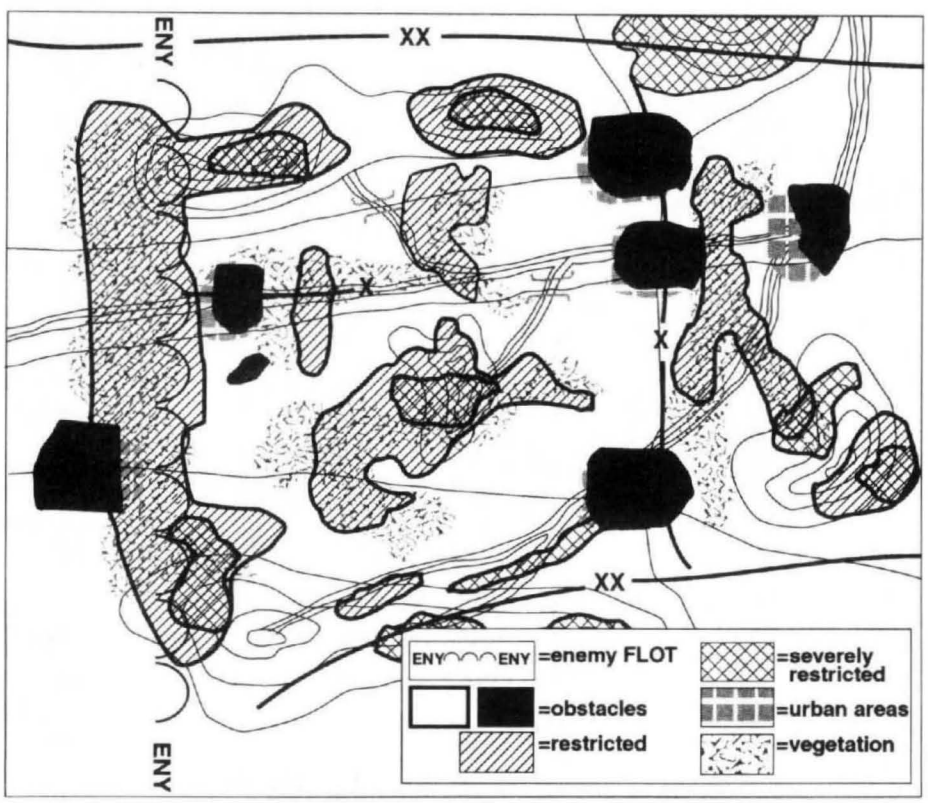


Figure 5-8. Combined Obstacle Overlay.

Evaluation of the direct effects of weather begins by establishing critical values for each aspect of the weather's effects on personnel, equipment (to include all sensors), and military operations the command may be required to perform. Unit intelligence officers and operations personnel develop detailed critical value tables for their units as part of the IPB process. These critical values are used to measure the effects of local weather on both friendly and enemy military operations. See appendix B for an example of a weather critical values table. Weather analysis is covered in more detail in chapter 6 and in Marine Corps Warfighting Publication (MCWP) 3-35.7, *MAGTF Meteorological and Oceanographic Support*. Weather analysis is accomplished by analyzing the military aspects of weather and evaluating the weather's effects on military operations.

Analyze the Military Aspects of Weather

Analysts consider the following five military aspects of weather:

- Temperature and humidity.
- Precipitation.
- Wind.
- Visibility.
- Clouds.

Evaluate the Weather's Effects on Military Operations

Weather has both direct and indirect effects on military operations. Examples of indirect effects include—

- Temperature inversions that might cause some battle positions to be at risk to the effects of chemical warfare.
- Local conditions of visibility, such as fog, that might make some potential engagement areas attractive.
- Hot, dry weather that might force a unit to consider water sources as key terrain.

Other Characteristics of the Battlespace

These characteristics include all aspects of the battlespace environment that affect friendly and threat COAs not incorporated into terrain and weather analysis. For example, an intelligence officer may report that religious considerations will make cordon and search operations on Wednesdays difficult to execute since the local population will be praying at the time of the scheduled search. Examples of other characteristics include—

- Logistic infrastructure (e.g., land use patterns, sources of potable water, bulk fuel storage, natural resources, industries and technologies, chemical and nuclear facilities).
- Population demographics (e.g., living conditions, cultural distinctions, religious beliefs, political grievances, political affiliation, education levels).
- Naval approaches.
- Economics.
- Local, regional, and international politics (e.g., treaties, agreements, legal restrictions, unofficial systems, gangs).

Although effects of other characteristics are usually discussed in text or matrix form, analysts should use graphics wherever possible. Examples of graphic depictions include an overlay showing areas most vulnerable to insurgent activity based on demographic distribution or an overlay showing high-value targets (HVTs) in the logistic infrastructure.

Describe the Battlespace Effects on Threat and Friendly Capabilities and Broad Courses of Action

Intelligence analysts combine the evaluation of the effects of terrain, weather, and other characteristics of the battlespace into one integrated product. They focus on the total environment's effects on COAs available to both friendly and threat forces.

Prior to development of friendly COAs, intelligence analysts provide the operations officer or planning staff with the following IPB products:

- An evaluated and prioritized set of AAs to assist in the designation of axis of advance, direction of attack, or zone of attack for each subordinate unit in offensive operations.
- Sets of defensible terrain along threat AAs to assist in the development of strongpoints, battle positions, or sectors for each subordinate unit in defensive and retrograde operations.
- Periods when weather conditions will optimize the use of friendly target acquisition and aviation operations to help time operations.

After the development of friendly COAs, intelligence analysts provide an evaluation of how each COA does or does not use the opportunities the battlespace provides. When addressing effects on threat COAs, intelligence analysts should view capabilities from the perspective of the enemy. The evaluation of the battlespace effects on the threat must be tailored to include weather and terrain that may affect threat weapon systems, vehicles, and personnel differently than friendly personnel. Operations and planning staffs must understand these battlespace effects on the threat to avoid assumptions that the battlespace will affect both forces equally. Other characteristics may influence threat actions more than weather and terrain, and cultural biases may cause threat personnel to view legal, political, economic, and demographic issues in an entirely different manner than friendly personnel would.

When describing the battlespace effects on threat and friendly capabilities and broad courses of action, intelligence analysts must—

- Evaluate the battlespace from the perspective of the threat.
- Express the evaluation in terms of COAs, not detailed descriptions of the analytical factors that led to the conclusions.
- Focus the commander by relating specific threat activities in both time and space.
- Back their conclusions with the detailed analysis performed.
- Communicate final conclusions in written reports such as the analysis of the AO or intelligence estimate.
- Disseminate graphic products developed during the analysis and evaluation to the staff and other commands for use in their own IPB and planning efforts.

SECTION III. STEP 3—EVALUATE THE THREAT

The third step in the IPB process is to determine the threat force capabilities and the doctrinal principles, tactics, techniques, and procedures it has historically used. This involves a detailed study of the threat's composition, tactical doctrine, procedures, weapons and equipment, and supporting systems. The intelligence section determines threat capabilities and how the threat operates by updating or creating threat models and identifying threat capabilities.

Update or Create Threat Models

Threat models depict how threat forces prefer to conduct operations under ideal conditions. They are based on the threat's normal or doctrinal organization, equipment, tactics, techniques, and procedures. Threat models result from a detailed study of the threat force. Ideally, threat models are constructed prior to deployment. Threat models consist of doctrinal templates, a description of preferred tactics and options, and identification of HVTs.

Doctrinal Templates

Doctrinal templates illustrate the deployment pattern and disposition preferred by the threat's normal tactics when not constrained by the effects of the battlespace environment. They are usually scaled graphic depictions of threat dispositions for a particular type of standard operation, such as a battalion moving to contact or an insurgent ambush (see fig. 5-9).

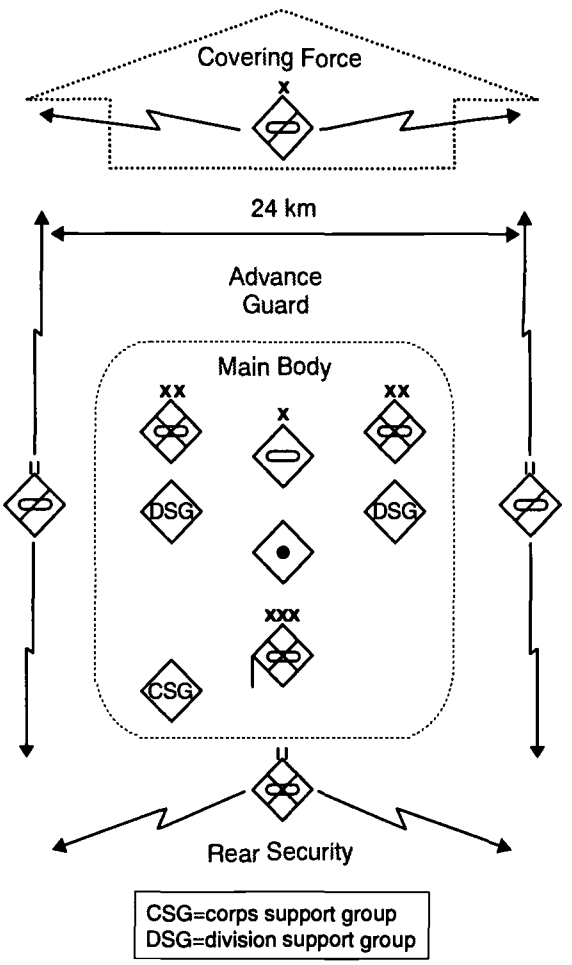


Figure 5-9. Doctrinal Template.

Doctrinal templates must be tailored to the needs of the unit or staff section creating them. Templates are constructed through an analysis of intelligence data bases and an evaluation of the threat's past operations. The analysis should focus on patterns in task organization, timing, distances, relative locations, groupings, and the use of terrain and weather. Some doctrinal templates consider the threat force as a whole, while others focus on a single battlefield function like intelligence or fires.

Description of Tactics and Options

The threat model includes a description of the threat's preferred tactics. It addresses the operations of the major units or elements portrayed on the template and the activities of different battlefield functions. It also contains a listing or description of the options (branches) available to the threat should the operation fail, or subsequent operations (sequels) if it succeeds. Even if the threat's preferred tactics can be depicted graphically, the threat model includes a description.

The description aids in mentally wargaming the operation over its duration during the development of threat COAs and situation templates. It should address typical time lines and phases of the operation, points where units transition from one formation to another, decision criteria, and each battlefield function's contribution to the operation's success. This analysis of the individual role of battlefield functions, related in time and space, will aid in the later identification of HVTs and HPTs.

Identification of Center(s) of Gravity

Marine Corps Doctrinal Publication (MCDP) 1, *Warfighting*, defines a center of gravity (COG) as any important source of strength. It may be mental, moral or physical strength, power or will. COGs may exist at each level of war: strategic, operational, and tactical. It may be tangible or intangible, and there may be multiple COGs. While knowledge of a threat's COGs at all levels is useful, the analyst should focus on the COGs appropriate to the level of operations that concern their friendly force. At this stage of the IPB process, the identification of COGs is an initial assessment.

Critical Vulnerabilities

Aspects of a COG that, if exploited, will do the most significant damage to an adversary's ability to resist are critical vulnerabilities. Vulnerability cannot be critical unless it undermines a key strength. Some vulnerabilities may contribute significantly to the enemy's downfall while others may lead only to minimal gains. Therefore, analysts must focus on a vulnerability that will do the most damage to the enemy's ability to resist.

Identification of Type High-Value Targets

Assets that the threat commander requires for the successful completion of the mission depicted and described on the template are HVTs. Examples of type HVTs include C2, intelligence, fire support, communications and information systems, air defenses, engineers, and logistics and CSS. When evaluating the threat, intelligence analysts must—

- Identify HVTs from an evaluation of the data base, the doctrinal template, the template's supporting narrative, and the use of tactical judgment.
- Develop the initial list of HVTs by mentally wargaming and thinking through the operation to identify assets that are critical to the operation's success, particularly at critical junctures or phases.
- Identify assets, which are key to executing the primary operation, particularly those that are key to satisfying decision criteria.
- Group the identified key assets into one of 13 categories used to develop target sets, thus assisting in the development of targeting strategies.
- Determine how the threat might react to the loss of an HVT; consider his ability to substitute other assets or modify his plan to compensate.
- Rank the identified HVTs with regard to their worth to the threat's operation.
- Identify HVT value changes by phase because that value usually varies over the course of an operation.
- Tailor IPB products to the command's needs by concentrating on HVTs that are important to the mission.

Identify Threat Capabilities

Threat capabilities are the broad COAs and supporting operations that the threat can take to influence the accomplishment of the friendly mission. The following four tactical or broad COAs are generally open to military forces in conventional operations:

- Attack.
- Defend.
- Reinforce.
- Retrograde.

Each of these broad COAs can be divided into more specific COAs. An attack may be envelopment, penetration, or other variations of an attack. A retrograde movement may be a delaying action, a withdrawal, or a retirement. Other threat capabilities include support to

broad COAs or specific types of operations, including—

- Deception operations.
- Riverine operations.
- Psychological operations.
- Intelligence operations.
- Nuclear, biological, and chemical weapons employment.
- Espionage, sabotage, subversive, and terrorist operations.

Threat capabilities take the form of statements, such as—

- The enemy has the ability to insert up to two infantry battalions in a single lift operation.
- The enemy can establish a prepared defense by 14 May.
- The demonstrators can effectively block traffic at up to seven intersections in our zone.

When identifying threat capabilities, intelligence analysts—

- Start with developed threat models.
- Consider other types of operations and broad COAs at other levels of war and during operations other than war.
- Consider the threat's ability to conduct each operation based on all factors related to the current situation. (The threat may be understrength in equipment or personnel, short of logistic support, lacking air support, or his troops may be inexperienced or poorly trained.)

SECTION IV. STEP 4—DETERMINE THREAT COURSES OF ACTION

This step of the IPB process is the identification and development of likely threat COAs that will influence the accomplishment of the friendly mission.

Identify the Threat's Likely Objectives and Desired End State

Depending on METT-T, intelligence analysts generally start identifying threat objectives and desired end state of the threat command at least one level above their own command. Analysts repeat the process for the next subordinate level to at least two levels below their own command, ensuring that each threat level's objective will accomplish the likely objectives and desired end state of its parent command. In operations other than war, analysts may be required to start more than one level above their command (e.g., the government or major clan leadership level). Usually, analysts state the threat's objectives and desired end state as assumptions. The analysts must make sure the assumptions are clearly identified as such and ensure the assumptions are discussed with the commander and staff. During operations other than war, analysts must consider more than the conventional objectives of terrain or friendly forces. This is also true at higher levels of command where the threat's political and economic objectives have a direct influence on his COAs.

Identify the Full Set of Courses of Action Available to the Threat

When identifying the COAs available to the threat, analysts must—

- Consider the COAs that the threat historical doctrine and tactics, techniques, and procedures (TTP) indicate are appropriate to the current situation and the likely objectives identified. This requires an understanding of the threat's decisionmaking process as well as

an appreciation for how he perceives the current situation.

- Consider the threat COAs that could significantly influence the command's mission, even if the threat's doctrine and TTP indicate these as infeasible under current conditions; and consider any indirect COAs that the threat is capable of executing.
- Consider the threat COAs indicated by recent activities and events. To avoid surprise from an unanticipated COA, consider all possible explanations for the threat's activity in terms of possible COAs.
- Consider each COA's subset independently to avoid forming biases that restrict the analysis and evaluation.
- Combine the subsets to eliminate redundancy and minor variations.
- Compare the consolidated list of COAs to threat capabilities identified in step 3 of the IPB process and eliminate any COAs that the threat is incapable of executing.
- Select threat models that will accomplish the threat's likely objectives based on the evaluation of the threat's capabilities.
- Examine how the effects of the battlespace described in step 2 of the IPB process influence the application of COAs (see fig. 5-10).
- Define COAs open to the threat, such as deliberate attack, hasty attack, defend, and delay.
- Define each general COA as a set of specific COAs by integrating the threat models with a description of the battlespace effects.

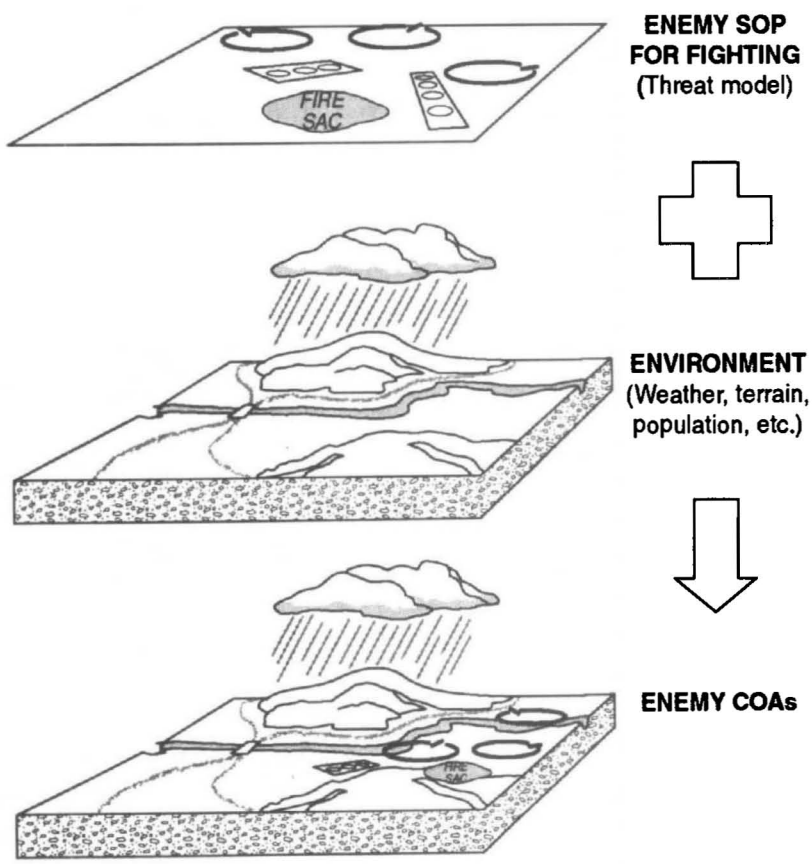


Figure 5-10. Combining Doctrine and Battlespace Effects to Develop Threat COAs.

- Ensure each COA identified is suitable, feasible, acceptable, unique, and consistent with threat doctrine or TTP and recently observed activities and patterns (see figs. 5-11 and 5-12).

Evaluate and Prioritize Each Course of Action

Analysts must evaluate each identified threat COA and prioritize it according to an estimate

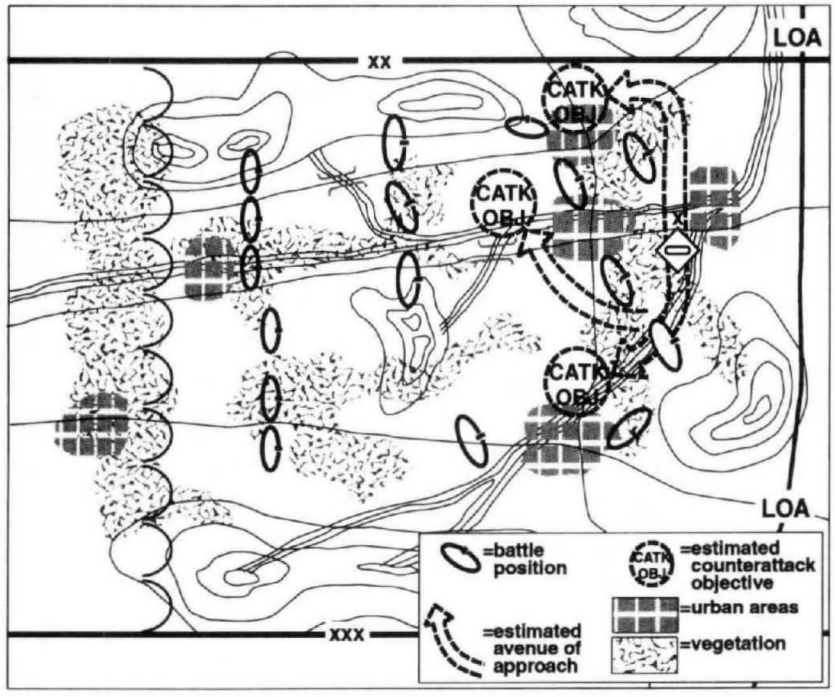


Figure 5-11. Enemy COA 1—Counterattack.

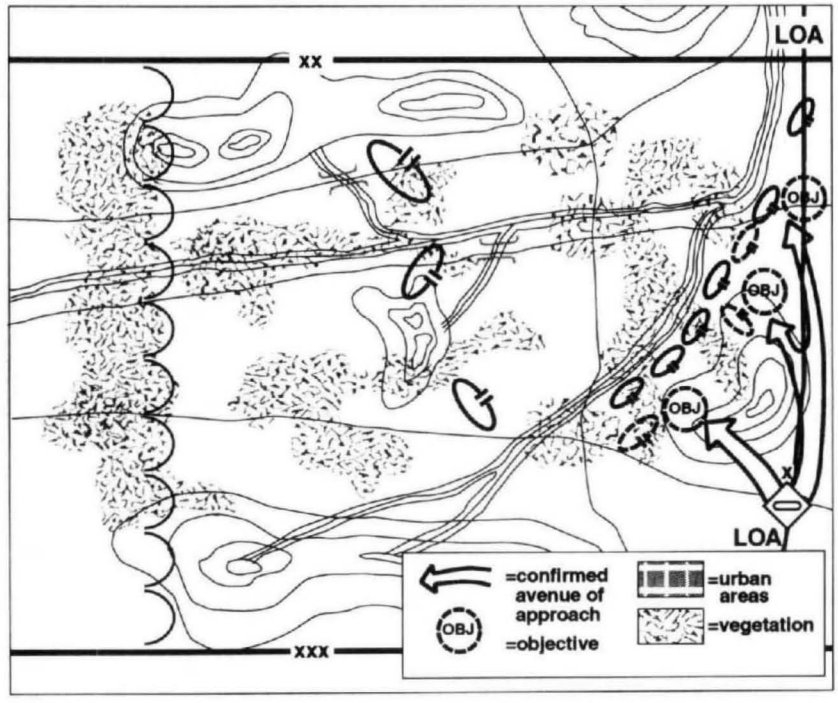


Figure 5-12. Enemy COA 2—Withdrawal from Current Position and Set Up Defense on Eastern Shore of River.

of likely adoption by the threat. The priority list allows the commander and staff to develop a plan for friendly COAs that is based on assumptions about the threat. Once the commander selects a friendly COA, the list may need to be reprioritized to reflect possible reactions to friendly dispositions and activities.

Develop Each Threat Course of Action in the Amount of Detail Time Allows

Once the complete set of threat COAs has been identified, analysts develop each COA in as much detail as the situation requires and time allows. The order in which each COA is developed is based on its probability of adoption and the commander's guidance. To ensure completeness, each COA must answer the following five questions:

- What (type of operation)?
- When (time the action will begin)?
- Where (sectors, zones, axis of attack)?
- How (method by which the threat will employ his assets)?
- Why (objective or end state of the threat)?

When developing each COA, analysts must consider threat forces at least one level above their own command level. For example, a battalion S-2 would consider the COAs available to threat regiments and brigades. This helps account for possible reinforcing forces and the higher threat command's objectives and intent. Generally, analysts consider threat COAs two levels of command below their own command when the MAGTF is in the offense and at least one level below their command when the MAGTF is in the defense. Thus the previously discussed battalion S-2 would depict missions and actions down to the platoon level.

Each developed threat COA has a situation template; a COA description, COGs, critical vulnerabilities, and options; and a listing of HVTs.

Situation Template

Situation templates are graphic depictions of expected threat COAs (see fig. 5-13). Templates usually depict the most critical point in the operation as agreed upon by the G-2/S-2 and G-3/S-3. An analyst may prepare several templates to illustrate different points of time in an operation, starting with the threat's initial array of forces. These templates are useful in depicting points where the threat may adopt branches or sequels to the main COA, places where the threat is especially vulnerable, or other key points in the battle such as initial contact with friendly forces. Situation templates are used to support staff wargaming and to develop event templates. Analysts construct a situation template by—

- Beginning with the threat model representing the operation under consideration.
- Overlaying the doctrinal template on the products (generally, COO or MCOO) that depict the battlespace environment's effects on operations.
- Adjusting the dispositions portrayed on the doctrinal template based on the battlespace environment's effects.
- Viewing the situation from the threat commander's point of view when selecting from among available options.
- Checking the situation template to ensure that all the threat's major assets have been accounted for, particularly the locations and activities of the HVTs listed in the threat model.
- Evaluating time and space factors to develop time phase lines (TPLs) to depict threat movement. The TPLs can be refined during wargaming (see fig. 5-13).

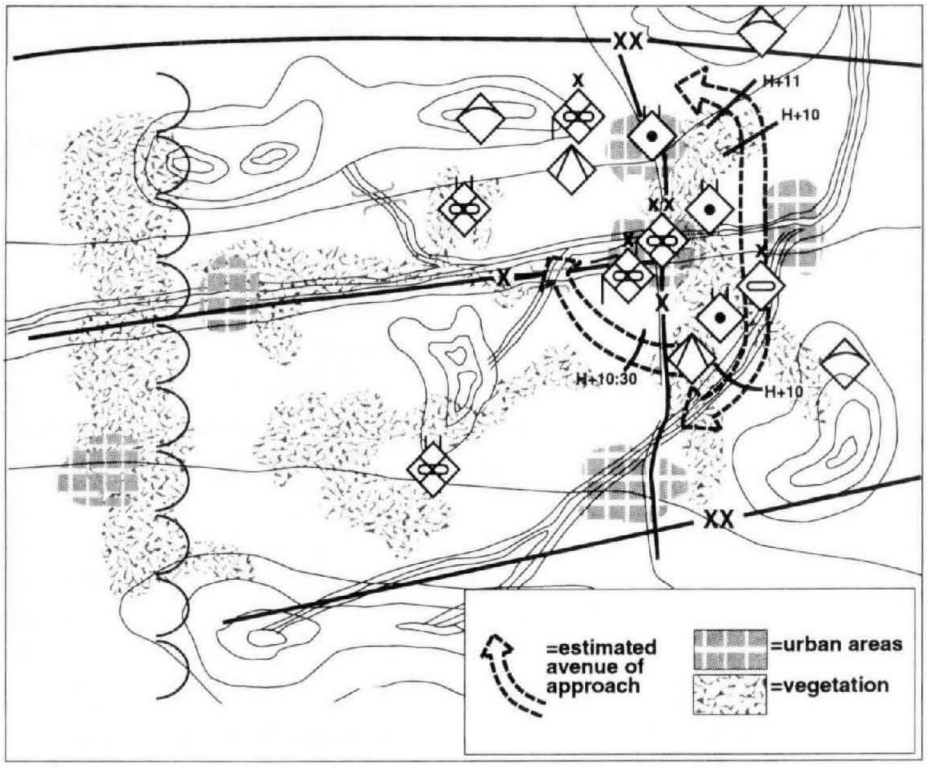


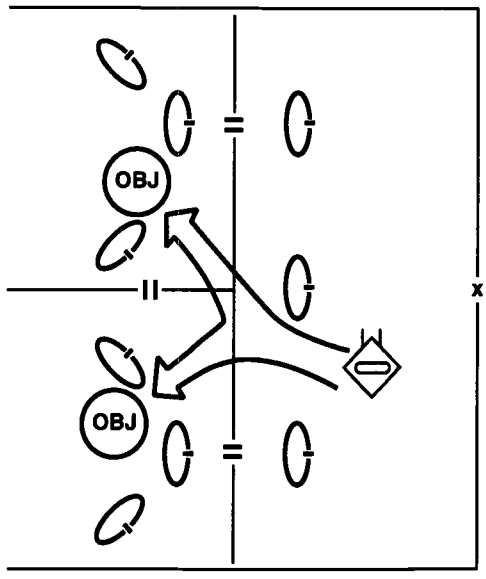
Figure 5-13. Counterattack Situation Template with TPLs and HVTs.

Description of the Threat's Courses of Action and Options

This is a description of the forces' activities depicted on the situation template. It can range from a narrative description or a combined graphics overlay or text matrix (see fig. 5-14 on page 5-20) to a detailed intelligence synchronization matrix depicting the activities of each threat unit and battlespace function in detail (see fig. 5-15 on page 5-20). The COA description supports staff wargaming and the development of the event template and supporting indicators. When preparing the description, analysts mentally war game the COA and attempt to tie threat actions and decisions to both time and space. The description should address the—

- Earliest time the COA can be executed.
- Threat COGs.
- Time lines and phases associated with the COA.
- Decisions the threat commander will make during and after execution of the COA.

Intelligence synchronization is more than simply ensuring that collection systems are operating 24 hours a day. The G-2/S-2 must plan and direct the intelligence system, receive the information it produces, process it, and then produce and disseminate intelligence of value to commanders and planners in time to support their decisions. The coordination of this entire cycle is intelligence synchronization. The IPB process provides the products and tools the G-2/S-2 needs to quickly evaluate incoming information and intelligence as it relates to the command's IPRs and IRs, intelligence synchronization matrix, and the decision support template (DST). These products and tools support the commander's decisions during COA execution and help the commander to quickly confirm or deny the assumptions used during COA wargaming. During operations, the commander and staff track the DST and the intelligence synchronization matrix against incoming intelligence and other tactical reports. As the commander and staff near each decision point, they look to the G-2/S-2 for the intelligence that supports that decision.



Description:

- Defense in two echelons with a reserve.
- Local counterattacks to restore defensive positions.
- Tank battalion counterattacks if defense compromised.
- Detailed and coordinated fire support plan supporting defense and counterattack.
- They prefer obstacle systems (usually minefields) that turn enemy forces into their engagement areas. They seldom employ fixing, blocking, or disrupting obstacles.
- Surface-to-air missiles usually deploy forward with companies. Antiaircraft artillery usually protects battalion assets.

Failure Options:

- Local counterattacks.
- Counterattack by division reserve.
- Withdraw.

Figure 5-14. Threat COA Overlay with Text Description.

TIME	T + 10	T + 24	T + 36	T + 48
Friendly Event	penetrate 80th Corps	shape 90th Corps	shape 90th Corps	shape reserve
Threat Event		reserve departs assembly areas	reserve deploys combat formation	Corps artillery forward deploys
Decision Points	shift main effort to aviation combat element		shift shaping actions	
Intelligence Event (PIR)	NAI 24-will the reserve reinforce 90th Corps	NAI 1-identify reserve HVT AA	NAI 2-identify reserve HVT locations	NAI 3-identify Corps artillery refueler locations
Intel and Recon Collectors	JSTARS Force Recon Rivet Joint UAV/ATARS Radio Battalion Ground Sensors	JSTARS	Force Recon Senior Scout UAV/ATARS	JSTARS Force Recon

Figure 5-15. Intelligence Synchronization Matrix.

Sometimes a battle progresses in a direction unanticipated during the initial IPB and wargaming, because the enemy follows his own plans and time lines. As the operation unfolds and the enemy's intentions become clearer, key staff members reinitiate the IPB and decision-making processes and conduct a modified war game as needed. During these sessions, the G-2/S-2 reviews and modifies the initial IPB. The battle staff then war games the best friendly response or preemptive action based on the updated set of IPB predictions. New decisions and COAs lead to updating and refining the collection plan, intelligence synchronization, and new decision support tools.

The intelligence synchronization matrix and other intelligence tools are consolidated and displayed within the current operations center to provide all watch leaders and personnel with critical current intelligence operations information. This tool is called the intelligence synchronization sheet, which is tailored to the command echelon or C2 node being supported (see fig. 5-16). Generally, the intelligence synchronization sheet includes lists of—

- Threat objectives and battlespace conditions.
- Current PIRs.
- Anticipated critical threat events, critical intelligence actions, and likely threat activities.
- Targeting priorities.
- Intelligence support priorities.
- Key intelligence collections, production, and dissemination activities.

High-Value Targets

While preparing and mentally wargaming the situation template, the analyst notes how enemy systems provide critical support to the COA. This

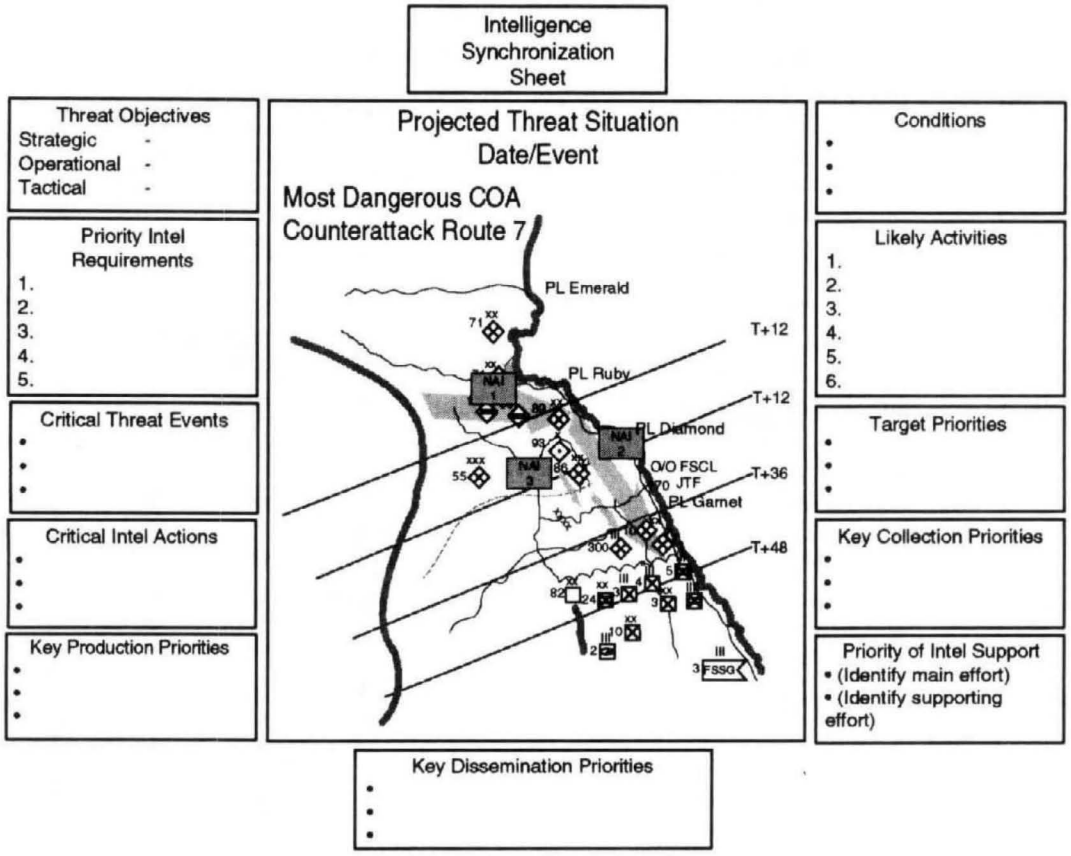


Figure 5-16. Intelligence Synchronization Sheet.

exercise leads to identification of HVTs that may be COGs, critical vulnerabilities, or assets, which if destroyed or neutralized may allow friendly forces to attack a COG or critical vulnerability. Once the HVTs list is compiled, analysts—

- Use the list in the threat model as a guide.
- Determine the effect on the COA of losing each HVT and identify likely threat responses.
- Identify the times or phases in the COA when the target is most valuable to the threat commander and make the appropriate notations on the list of HVTs.
- Transfer the refined and updated list of HVTs to the situation template (see fig. 5-17). The list will support staff wargaming and the targeting process.
- Note on the situation template any areas where HVTs must appear or be employed to make the operation successful.
- Focus on HVT locations at the times they are most valuable or just before. These are potential targeted areas of interest (TAI) and engagement areas that will be refined and used by the G-3/S-3.

Identify Initial Intelligence Collection, Production, and Dissemination Requirements

After identifying potential threat COAs, the analyst must determine which one the enemy will adopt. Initial collection requirements are designed to help answer the challenge. The identification of initial ICRs revolves around predicting specific areas and activities, which, when observed, will reveal which COAs the threat has chosen. The area where the analyst expects key events to occur is designated an NAI. The activities that reveal the selected COA are called indicators. Identified IPRs support prioritization and planning of necessary intelligence products, and identified IDRs support prioritization and planning for the eventual

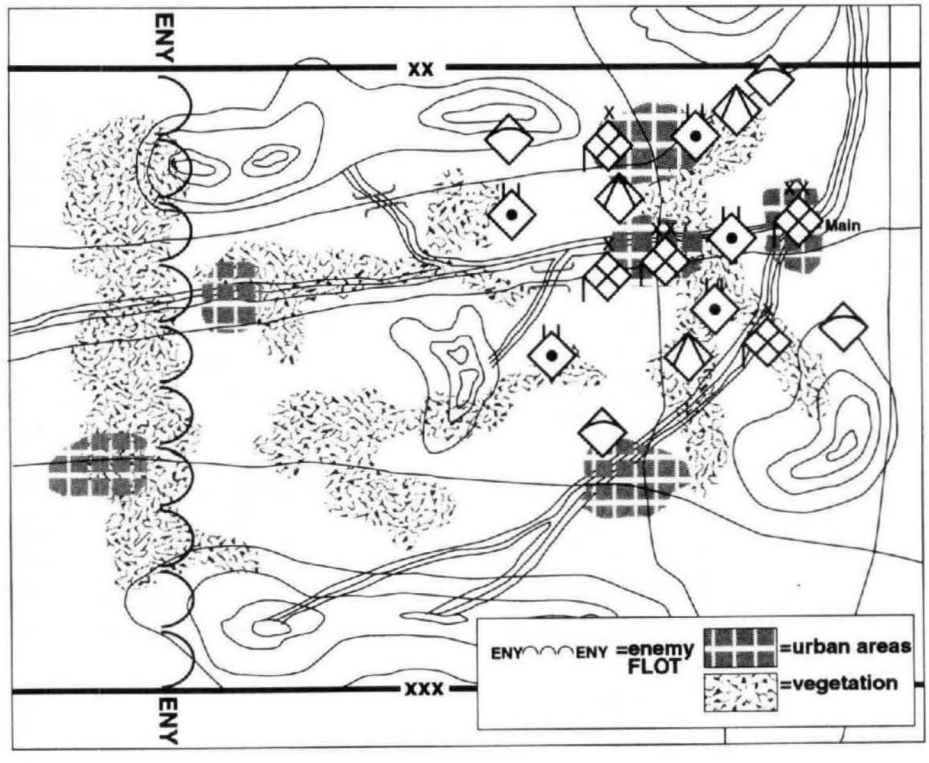


Figure 5-17. Templated Locations of HVTs for Enemy COA 1.

dissemination of intelligence products, such as the event template and event matrix, to commanders and staff sections needing them.

The event template and matrix form the basis for planning integrated collection, production, and dissemination strategies, and synchronize friendly intelligence operations. They enable the G-2/S-2 to develop precise ICRs, IPRs, and IDRs by maximizing the effectiveness of limited resources over extended areas against a vast array of threat targets.

Event Template

The differences between the NAIs, indicators, and TPLs associated with each threat COA form the basis of the event template (see fig. 5-18). The event template is a guide for collection, reconnaissance, and surveillance planning. It depicts where to collect information that will indicate which COA the threat has adopted.

Analysts evaluate each threat COA to identify its associated NAIs. They mentally war game execution of the COA and note places where activity must occur if that COA is adopted. Intelligence analysts must pay particular attention to times and places where the threat's HVTs are employed or areas where HVTs can be easily acquired and engaged. Analysts must also consider places where the threat is expected to take actions or make decisions, such as adoption of a branch plan or execution of a counterattack. These areas will evolve into NAIs in support of targeting.

An NAI can be a specific point, a route, or an area. They can match obvious natural terrain features or arbitrary features, such as TPLs or engagement areas. Analysts must make the NAIs large enough to encompass the activity that serves as the indicator of the threat's COA.

Intelligence analysts compare, contrast, and identify the differences between each COA's NAIs

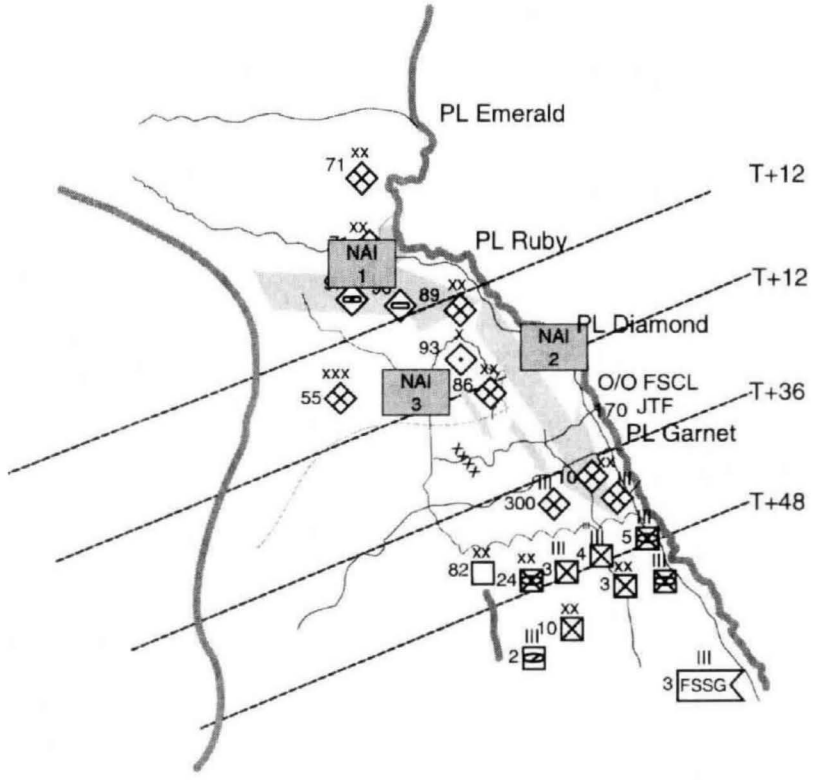


Figure 5-18. Event Template.

and indicators, concentrating on the differences that will provide the reliable indications of COA adoption. Selected NAIs are marked on the event template. The initial event template focuses on identifying which of the predicted COAs the threat has adopted. Analysts update and refine the event template and its supporting matrix to support friendly decisions identified during staff wargaming (see fig. 5-19).

Event Matrix

The event matrix supports the event template by providing details on the type of activity expected in each NAI, the times the NAI is expected to be active, and the relationship of the activity to other events on the battlefield. Primarily used in planning intelligence collection, the event matrix also serves as an aid to situation development (see fig. 5-20).

When preparing the event matrix, intelligence analysts—

- Examine the events associated with each NAI on the event template and restate them in the form of indicators.
- Enter the indicators along with the times the indicators are most likely to occur by using TPLs from the situation template or the description of the COA to establish the expected times.
- Record the latest-time-information-of-value time line, if available, based on the expected flow of events, as a guide for the collection manager.

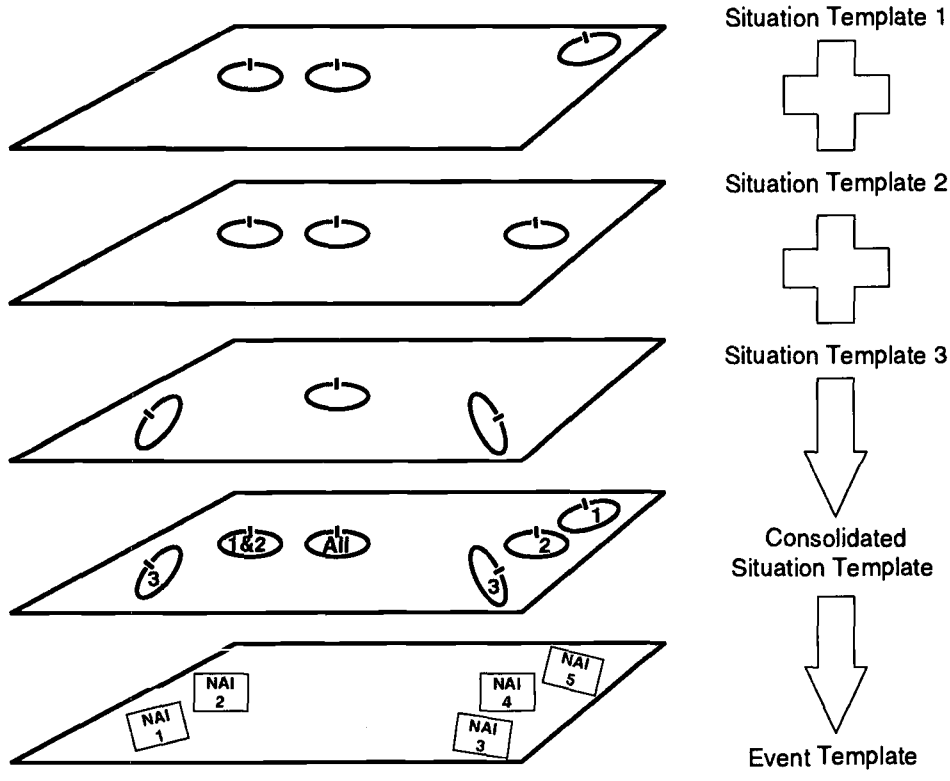


Figure 5-19. Event Template Development by Comparing and Contrasting Each COA's NAIs and Indicators.

NAI	Estimated Time	COA Indicators	COA 2 Indicators	COA 3 Indicators	Other COA Indicators
1	H-15		air assault forces		
2	H-15		air assault forces		
3	H-15	air assault forces		air assault forces	
4	H-15		infiltration of light infantry		
5	H-4		light infantry attack		
6	H-4	light infantry attack NAI 7	light infantry attack		
7	H-4	light infantry attack NAI 8		light infantry attack	
8	H-4	poised to attack		light infantry attack	
9	H-4	poised to attack	poised to attack		tank division attacks
10	H-4		poised to attack	poised to attack abreast	tank division attacks
11	H-6			shifts north	
12	H-18				
13	H-18				1 or 2 brigades attack south

Figure 5-20. Detailed Event Matrix for a Specific NAI.

SECTION V. DECISION SUPPORT TEMPLATE

The DST is the capstone product in the staff planning process and the logical conclusion to IPB, although it is not part of the formal IPB process. The DST relates time, space, and threat actions to assist the commander in determining when decisions need to be made, either to employ fires or maneuver forces (see fig. 5-21 on page 5-26). This template helps the commander think ahead in the battle to reduce uncertainty and aids in recognitive or intuitive decisionmaking.

The DST is normally developed during COA wargaming as threat and friendly actions are compared in time and space. Unlike the previous products, the DST is a staff product prepared under the staff cognizance of the G-3/S-3. It reflects the judgment and expertise of the intelligence, maneuver, fires, CIS, and logistic support staffs. The threat COA models, the event template, and event matrix developed during IPB form the basis for and drive wargaming and development of the DST.

Targeted Areas of Interest

Through event templating, identification is made of those areas on the battlefield where significant events and activities will likely occur and where targets will likely appear. As the wargaming process proceeds, the staff identifies areas where the commander can influence the action through fire and maneuver. These areas are designated TAIs. A TAI is an engagement point or area, usually along a mobility corridor, where the interdiction of threat forces by fires, maneuver, or jamming will deprive or reduce a threat capability. It can also cause the threat commander to abandon a particular COA or require the use of unusual support to continue operations. Times and

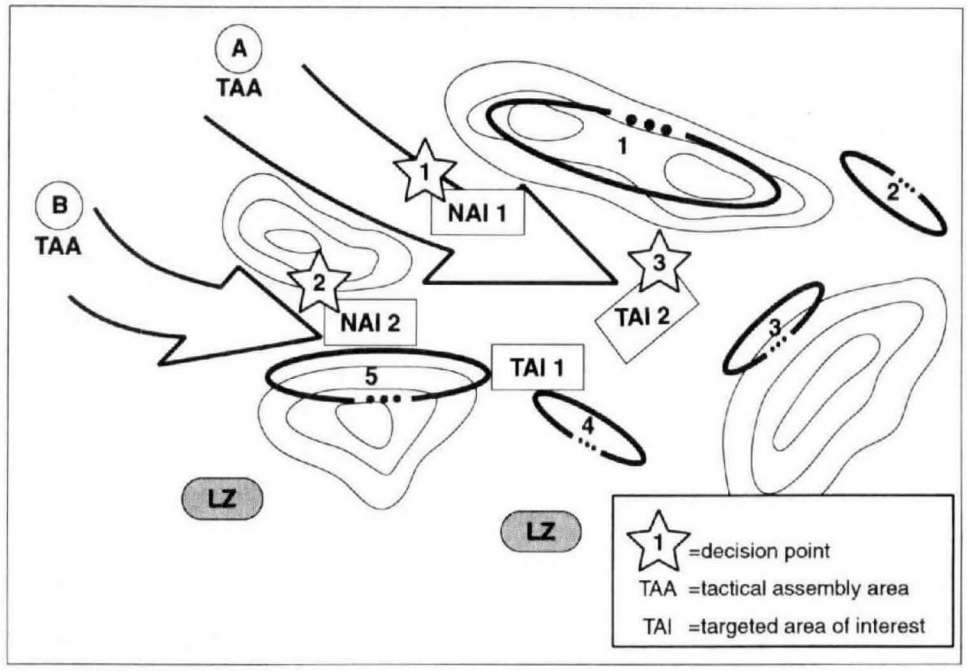


Figure 5-21. Decision Support Template.

locations where HVTs will appear are particularly suited to become TAIs.

The identification of TAIs is a joint effort between the intelligence, operations, and fire support staffs. The intelligence staff identifies the times and places where opportunities present themselves and the effect of interdiction on threat capabilities. The operations and fire support staffs consider the availability of interdiction resources, the effects of interdiction on the accomplishment of the friendly mission, and the priorities for the use of available resources.

Decision Points

Following the selection of TAIs, analysts identify decision points. The location of decision points is largely influenced by the availability and capability of friendly fire and maneuver systems; therefore, decision point selection is primarily a G-3/S-3 function, with support from the fire support coordinator and other key participants in the planning staff.

Types

Decision points identify battlefield events that may require tactical decisions. These points also identify when the tactical decisions must be made for the commander to retain available options. Examples of the types of decisions include—

- Commit the reserve.
- Surge friendly air support.
- Concentrate artillery on TAIs, perhaps in conjunction with electronic attack (EA) operations.
- Deliver scatterable mines.
- Shift the main effort.
- Commence the next phase of an operation.
- Change subordinate unit's overall mission.
- Request assistance from higher headquarters.

Considerations

Decisions must be made early enough to ensure that they can be coordinated across all command echelons and implemented in time to achieve the desired results. The developed NAIs must

provide the required indicators in sufficient time and preciseness to ensure timely decisions.

When identifying decision points, the G-3/S-3 must consider the—

- Time required for intelligence collection, processing, analysis, production, and dissemination to take place.
- Time required to prepare and/or move friendly assets that will execute the mission.
- Activities and movements of the target or threat during the time elapsed between decision and execution.

As the wargaming progresses, a recorder tracks decision points, both by time and location, and develops the synchronization matrix to ensure all battlespace functions are working in harmony toward the same goals. After the commander selects a friendly COA, the intelligence staff develops detailed collection and dissemination plans to support the decision points, NAIs, and TAIs.

SECTION VI. ABBREVIATED INTELLIGENCE PREPARATION OF THE BATTLESPACE PROCESS

Many of the steps involved in IPB are time, labor, and resource intensive, especially at lower tactical echelons where automated systems and personnel support for terrain analysis and other intelligence production functions are usually not available. Those same echelons generally have less time available for the IPB process. Besides the available time, intelligence personnel and resource constraints affect the scope and depth of IPB activities. Consequently, most Marine Corps units use the abbreviated IPB process.

The intelligence product that results from the abbreviated approach is far less than the comprehensive set of previously discussed products. The one-overlay product, when developed to a quality standard and focused on the unit's mission, PIRs, and IRs, has repeatedly proven to be effective on the battlefield. In its most elementary form, the IPB process can be abbreviated by working ahead, focusing on essentials, staying objective oriented, and minimizing essentials.

Work Ahead

When conducting an abbreviated IPB, intelligence personnel should complete as much work ahead of time as possible by—

- Establishing a series of base products, particularly those that deal with the battlespace environment's effects on operations.
- Keeping the products updated by periodic review instead of waiting until receipt of a new mission.
- Updating data bases on potential threats and changing the threat models as intelligence is received that indicates changes or evolution in threat doctrine.
- Conducting periodic reviews to ensure that the base IPB products, such as descriptions of the battlespace environment and the threat, are updated regularly.

- Becoming familiar with the support available from higher headquarters, theater intelligence centers, and Service agencies; knowing how to get needed information and products.
- Submitting PRs for information and intelligence products on areas where the unit is most likely to be employed.
- Developing checklists on how to get support, before, during, and after deployment.
- Maintaining an awareness of plans and priorities for all ICRs, IPRs, and IDRs submitted to higher headquarters.

Focus on Essentials

When starting the IPB effort, intelligence personnel should focus on essentials by—

- Considering the METT-T factors, particularly the factor of time.
- Determining how much time can be devoted to each step of the IPB process, and ensuring that the time line allows for the proper support of the planning and decisionmaking process.
- Deciding which products will be developed and to what degree of detail, and focusing on products most important to the mission.
- Identifying the full range of available threat COAs, rather than fully developing one threat COA at the expense of the others; determining the degree of detail required; and then developing all threat COAs to that level of detail.
- Working in a priority order established by the commander's intent and needs, and developing in detail only those COAs the commander has specified.

Stay Objective Oriented

The objective of IPB is to help the commander and staff make decisions and develop the best possible plans in the time available. This requires models of viable threat COAs that will influence mission accomplishment. Supporting the finished plan with intelligence requires a good event template and matrix.

Minimize Essentials

When minimizing essentials, intelligence personnel can get by with a good set of threat models and a good event template and matrix. They can also save time and materials by—

- Combining threat COA model templates and the event template on a single map overlay or using cartoons and sketches as a map substitute.
- Working directly from the map or sketch of major terrain features if the battlespace environment's effects have not been described.
- Identifying the set of threat COAs and briefly comparing them to determine which is most likely and which is most dangerous based on the current situation and the command's mission; and ranking the remaining threat COAs in order of likely adoption.
- Developing the most dangerous and most likely threat COA, and in the absence of guidance from the commander or G-3/S-3, using judgment in deciding which COA to develop first.
- Constructing an event template that focuses on identifying which of the two COAs the threat adopted, developing the remaining COAs, and working each COA in priority order.
- Incorporating each COA's NAIs in the event template as each threat COA is finished.
- Developing the second most likely or second most dangerous threat COA if the most likely COA is also the most dangerous COA, and ensuring at least two COAs are war gamed.
- Waiting until the staff conducts wargaming before structuring the ICRs.

Output

Throughout the IPB process, various products such as the threat models, threat COA graphics, and the event template are produced to support staff planning. The graphics developed, particularly the weather and terrain effects graphics, the situational templates, and the event template, can be disseminated to assist subordinate units in their own planning. Done correctly, these graphics can provide tremendous volumes of understanding and knowledge in concise and easily usable forms. At other times, however, additional written products can and should be prepared. The two products discussed below are the most commonly used, and both are directly derived from the IPB process.

Intelligence Estimate

In order to facilitate staff planning, the G-2/S-2 prepares the intelligence estimate before the remainder of the staff complete their own estimates. The intelligence estimate is the standard means of conveying key basic and current intelligence and relating it to the operational mission. It is a snapshot in time and forms the basis for the facts and assumptions of the decision-making process, driving the other staff estimates and the remaining steps of the Marine Corps Planning Process.

At higher command levels, the intelligence estimate provides major portions of the commander's written estimate. The products of IPB are the basis for the intelligence estimate. If the G-2/S-2 lacks the time required to prepare a written estimate, usually graphics that depict the results of the IPB evaluations and analysis are used as a substitute. A detailed outline for the intelligence estimate format is provided in appendix A.

Target and Objective Studies

The IPB impacts development through the evaluation of terrain and weather and the association of threat forces at specific times and locations within the battlespace. Situation, event, and decision support templates identify NAIs. Once identified, NAIs can then confirm or deny a threat's activities or adoption of a particular COA. Decision points and TAIs are also identified, requiring key intelligence that supports either fire or maneuver. From the IPB and wargaming processes, HVTs and HPTs are derived. Target and objective studies are focused, detailed intelligence products that aid in the application of fires or the maneuver of forces against a specific target set or area. Small units, such as MEU(SOC)s, can also use these studies for mission preparation and execution. See chapter 8 for a detailed discussion of target development.

CHAPTER 6. ANALYSIS OF THE BATTLESPACE

Analysis of the battlespace is a comprehensive study to determine the characteristics and effects of weather, oceanographic, and terrain environmental factors on enemy and friendly operations throughout the commander's AO and AOI. The battlespace analysis serves as a basis for developing specific friendly COAs and for determining enemy capabilities and COAs. This analysis allows the commander and staff to—

- See the battlespace in both spatial (width, depth, height or airspace) and temporal (time) dimensions.
- Appreciate fully the opportunities and limitations afforded by major terrain and oceanographic features, zones of entry, transportation networks, obstacles, and built-up areas within the AO and AOI.
- Fit an operational concept to that battlespace environment.

The limits of the battlespace are determined for all aspects of air, surface, subsurface, land, space, and the electromagnetic spectrum that can impact friendly forces. Defining the limits of the battlespace is a joint effort between the operations and intelligence staffs based on the commander's guidance.

SECTION I. RESPONSIBILITIES

When time permits, the intelligence officer coordinates the development of a battlespace analysis based on anticipated missions. On receipt of the warning or execute order, the intelligence officer reevaluates the analysis in terms of the commander's assigned AO and potential AOI. Changes in the mission and the commander's AO and AOI, or receipt of additional or more accurate information, necessitate revision of the analysis as the operation progresses. Normally, MEF and higher headquarters staff prepare a detailed written analysis when planning anticipated missions. In MSCs, the G-2s may prepare a written analysis tailored to the unit's specific mission and intelligence needs. However, in most operations, the geospatial information and services officer, the intel bn commander or intelligence support coordinator, and the P&A cell officer in charge use the MEF's analysis supplemented by graphic representations of weather and terrain data covering the MAGTF's AO and AOI.

The intelligence officer is responsible for initiating, coordinating, and ensuring that the analysis of the MAGTF's AO and AOI is completed and disseminated. The final analysis represents a coordinated effort of the intelligence officer, the operations officer, and other staff personnel who contribute within their respective warfighting functional areas. At the MEF or MAGTF level, the following organizations and personnel contribute to the final analysis:

- Topographic platoon, P&A company, intel bn—
  - Provides tailored terrain, littoral, and infrastructure studies and factor overlays.
  - Supports integration of weather factors into terrain studies portraying environmental effects.
  - Disseminates products such as graphic tactical decision aids to support IPB and COA development.
- Staff weather officer, intelligence section, MEF CE provides operational weather forecasts and environmental impact graphics as well as other weather and climatic data (e.g., light and tidal information).

- All-source fusion platoon, P&A company, intel bn—
  - Develops information on sociological, political, economic, technological, and related conditions covering countries of interest.
  - Provides fused, all-source IPB and other intelligence products to support MEF staff planning and decisionmaking.
- Civil affairs officer provides information on civilian personnel, local labor conditions, and capabilities.
- Engineer officer assists in the analysis of routes, potential obstacles and barriers, and other information related to mobility and countermobility.
- Psychological operations officer assists in the assessment of local conditions for psychological operations.

SECTION II. CHARACTERISTICS OF THE BATTLESPACE

The limits of the battlespace are determined for aspects of air, surface, subsurface, land, space, and the electromagnetic spectrum, which can directly or indirectly impact friendly forces. The battlespace generally includes all or most of the AO as well as the AOI. The AOI encompasses that area beyond the AO from which intelligence and information are required to permit planning, decisionmaking, and the successful conduct of operations. Defining the limits of the AO, the AOI, and the battlespace is a joint effort between the operations and intelligence staffs based on the commander's guidance. The AO and AOI are dynamic in nature and include interrelated factors capable of affecting a unit's operation.

The battlespace is measured in four dimensions: depth, width, height, and time. A battlespace analysis of the AO and AOI evaluates and integrates four environmental dimensions: terrain analysis (land), hydrographic analysis (sea), airspace analysis (air), and climatological analysis (weather). The battlespace analysis study allows the operational commander and staff to fully appreciate the opportunities and limitations afforded by major terrain and oceanographic features, zones of entry, transportation networks, obstacles, and built-up areas within the AO and AOI and fit an operational concept to that environment.

SECTION III. TERRAIN ANALYSIS

Terrain analysis is the evaluation of natural and manmade geographic features. This evaluation provides the planning headquarters with information on AAs (location and trafficability), zones of entry (deep, close, and rear areas), and key or decisive terrain.

Responsibilities

Much of the detailed terrain analysis work is done by P&A company GEOINT support teams attached to or in direct support of the MSCs or by GEOINT teams attached to a MEU(SOC) CE.

The P&A company's topographic platoon and imagery intelligence platoon personnel conduct the major portion of the terrain analysis production by—

- Using data bases as a guide for collection, production, and dissemination planning and operations while focusing on the areas of most importance to the commander and the mission.
- Combining data base information with the results of tactical, aerial, and ground reconnaissance.
- Working closely with staff weather officers to ensure terrain analysis products incorporate the

effects of current and projected weather phenomena.

- Using AO and AOI reconnaissance analysis results to focus on areas of most importance to the commander and the mission.
- Analyzing terrain continuously to evaluate the effects of changes in the battlespace environment.
- Forming conclusions regarding the effects of terrain through analysis of the military aspects of the terrain, and evaluation of the terrain's effects on military operations.

Sources of Information

National Imagery and Mapping Agency produces numerous digital data bases that support the development of geospatial factors and geographic classification. Topographic and geodetic maps, aerial charts, and facility maps are basic sources of information used by terrain analysts. Topographic publications can also be obtained from—

- Geographic societies.
- Engineering and scientific firms.
- Government intelligence agencies.
- Libraries.
- Bookstores.
- Universities.

Geospatial Factors

Terrain analysts need data on the trafficability of soils, the presence of bedrock, as well as the type and density of vegetation when developing cover and concealment, cross-country movement, or other geographic data bases.

Surface Configuration

Surface configuration refers to the shape of the earth's land surface. Terrain analysts study surface features such as mountains, slopes, ravines, embankments, ditches, plowed fields, and rice field dikes, because they can profoundly influence military operations. This factor is limited only by physical shape, size, and arrangement; it is not concerned with whether the feature is manmade or of natural origin.

Analysts categorize surface features or landforms by size and shape. The principal groups of landforms are plains, hills, and mountains; within each of these groups are smaller surface features, such as flat lowlands, and valleys. For geospatial analysis and GEOINT production purposes, major landforms are defined on the basis of local relief. Local relief represents the differences in the elevation of each landform group and subgroup (see table 6-1).

Table 6-1. Landform Elevations.

Landform	Elevation
Plains	less than 150 meters
Flat	less than 15 meters
Undulating	15 to 50 meters
Gently rolling	50 to 100 meters
Rolling	100 to 150 meters
Hills	150 to 600 meters
Low	less than 300 meters
High	300 to 600 meters
Mountains	more than 600 meters
Low	600 to 1500 meters
High	more than 1500 meters

Hydrologic Features

Hydrology is the science of surface and subsurface waters. Terrain analysts are concerned with the shape, size, distribution, and temporal

variance of water bodies. Analysts classify hydrologic features as surface water, subsurface water, and wet areas.

Surface Water

This hydrologic feature encompasses inland waters, which are classified as watercourse (e.g., streams, rivers, canals) and standing bodies of water (e.g., lakes, ponds, glaciers). Terrain analysts evaluate watercourses because drainage conditions vary from place to place and from time to time. Military planners are concerned with the flow and channel characteristics of these watercourses and their effect on military operations. Water bodies affect the characteristics of surface drainage by storing precipitation and runoff and by retarding or augmenting flood flows. These water bodies can obstruct cross-country movement or provide AAs when sufficiently frozen.

Subsurface Water

Groundwater or subsurface water is located beneath the surface of the earth. Groundwater is less susceptible to contamination and may be the only source of water in arid regions.

Wet Areas

These tracts of ground are covered with water seasonally or perennially (e.g., swamps and marshes). These areas are treated separately in the collection of data because information requirements differ from other water bodies, especially in evaluation for cross-country movement.

Vegetation Features

Vegetation includes plant life growing on the surface of the earth or other flora in or on the water. Terrain analysts evaluate area vegetation to determine the potential effect on vehicular and foot movement, concealment, cover, observation, airdrops, and construction. The vegetation present indicates the climatic conditions, soil, drainage, and water supply. Vegetation is grouped by type (e.g., trees, scrub and shrubs, grasses, crops).

Trees

This group of vegetation includes perennial woody plants at least 10 feet in height, with single stems and defined crown shapes. An area extensively covered by trees is classified as a forest. Smaller areas covered by trees are classified as woods, groves, or woodlots. On military maps, any perennial vegetation high enough to conceal troops or thick enough to be a serious obstacle to free passage is classified as woods or brushwood.

Scrub and Shrubs

Either deciduous or coniferous, scrubs include a variety of trees that have had their growth stunted because of soil or climatic conditions. Scrub growth includes cactus, stunted shrubs, sagebrush, mesquite, and similar plants found in arid or semiarid areas.

Shrubs, like trees, are either deciduous or coniferous. Shrubs comprise the undergrowth in open forests; in arid and semiarid areas they are the dominant vegetation. Shrubs normally offer no serious obstacle to movement and provide good concealment from ground observation; however, they may restrict fields of fire.

Grasses

This vegetation group includes nonwoody plants. A grassland is an extensive area where the natural vegetation consists primarily of grasses and herbaceous plants, the dominant type in alpine and certain semidesert areas. In low latitudes, grasslands often are termed savannas; in middle latitudes, they are called prairies (tall grass) and steppes (short grass). Grasslands in wet or poorly drained areas are commonly called meadows. For geospatial analysis purposes, grass more than 1 meter (3 feet) high is considered tall, and below that height, grass is considered short. Grass often improves the trafficability of some

soils; very tall grass may also provide concealment for foot troops.

Field Crops

The predominant class of cultivated vegetation is field crops. Vine crops and orchards are common but not widespread, and tree plantations are found in relatively few areas. Sizes of cultivated areas range from paddy fields covering a quarter of an acre to vast wheat fields extending for thousands of acres. In a densely populated agricultural area where all arable land is used for the crop that brings the highest yield, it may be possible to predict the nature of the soils from information about the predominant crops.

For example, rice requires fine-textured soils. Other crops generally must have firm, well-drained land. An area of orchards or plantations usually consists of rows of evenly spaced trees, which shows evidence of planned planting that can be distinguished on aerial photographs. Usually such an area is free from underbrush and vines. Rice fields are flooded areas surrounded by low dikes or walls. Some crops, such as grain, improve the trafficability of soils, while other crops, such as vineyards, present a tangled maze of poles and wires that are definite obstacles to vehicles and dismounted troops. Wheeled vehicles and some tracked vehicles are unable to cross-flooded paddy fields, although they can negotiate them when the fields are drained or frozen.

Surface Materials

Terrain analysts evaluate the composition and physical properties of the earth's surface materials, which are classified as soil and rock, to determine their effects on military operations and construction.

Soil

This unconsolidated material is an accumulation of disintegrated and decayed rock and vegetation that overlies bedrock. This accumulation can be hundreds of feet thick or it may be absent in given areas. Soils between 15 centimeters (6 inches) and 2 meters (6 feet) in depth are the most important. Next in importance are the soils from 2 to 6 meters (6 to 20 feet). Soil depth can be measured directly from borrow pits, road cuts, building excavations, and stream banks. For field identification, analysts classify soils as gravel, sand, silt, clay, and organic matter.

Rock

Rock is the firm or consolidated mineral matter of the earth's crust. Bedrock is solid undisturbed rock either exposed at the surface or underlying the soil. Terrain analysts evaluate the physical and engineering characteristics of bedrock for use in construction and in locating ground water.

Military Aspects of Terrain Evaluation

Using portions of the IPB process, the intelligence officer evaluates the battlespace in terms of **K**ey terrain, **O**bservation and fields of fire, **C**over and concealment, **O**bstacles, and **A**As and mobility corridors (KOCOA). The KOCOA analysis is appropriate at the battalion, squadron, regimental, Marine aircraft group, and CSS detachment levels. At division, Marine aircraft wing, force service support group (FSSG), and higher levels, KOCOA is absorbed into the terrain analysis process. Analysts use KOCOA to determine which friendly COAs can best exploit the opportunities the terrain provides and how the terrain affects the threat's available COAs.

Key Terrain

Key terrain is any location or area that the seizure, retention, or control of affords a marked advantage to either combatant. Terrain analysts depict key terrain on overlays with a large "K" in a circle that encloses and follows the contours of the designated terrain.

Observation and Fields of Fire

Cover and concealment factors can limit or deny observation. Observation analysis is useful in—

- Selecting LZs and DZs.
- Planning helicopter forward arming and refueling point (FARP) locations.
- Identifying areas vulnerable to aerial intelligence collection systems.
- Selecting low-level flight routes and aerial battle positions.

An ideal field of fire for flat trajectory weapons is an open area in which the threat can be seen and on which he has no protection from the fire of those weapons, out to the weapon's maximum effective range.

Geographic factors that offer good observation and fields of fire generally favor defensive COAs. Analysts represent areas of poor observation and fields of fire on an overlay with marked parallel diagonal lines or crosshatching. Observation and fields of fire evaluations identify—

- Potential engagement areas (often referred to as fire sacks or kill zones).
- Defensible terrain and system or equipment positions.
- Locations where maneuvering forces are most vulnerable to observation and fires.

Cover and Concealment

Analysts can combine the cover and concealment evaluation with the overlay developed during the observation and fields of fire evaluation (see fig. 6-1). When preparing the overlay, analysts identify factors that provide cover and concealment. Commanders and staffs use the results of the evaluation to—

- Identify and evaluate AAs.
- Identify defensible terrain and potential battle positions.
- Identify potential assembly and dispersal areas.

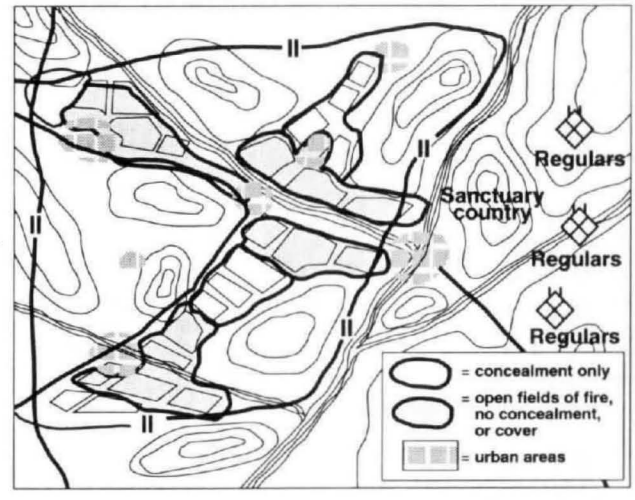


Figure 6-1. Concealment and Cover Overlay.

Cover that provides protection from the effects of direct and indirect fires can be provided by—

- Ditches.
- Caves.
- Riverbanks.
- Folds in the ground.
- Shell craters.
- Buildings.
- Walls.
- Embankments.

Concealment that provides protection from observation can be provided by—

- Woods.
- Underbrush.
- Snowdrifts.
- Tall grass.
- Cultivated vegetation.

Obstacles

Analysts identify natural and manmade obstacles that stop, impede, or divert military movement. Obstacles to air mobility include features that exceed the aircraft's service ceiling, restrict nap-of-the-earth (NOE) flight, or force the aircraft to employ a particular flight profile. An evaluation of obstacles leads to the identification of mobility corridors. This in turn helps identify defensible terrain and AAs.

Evaluation

When evaluating obstacles, analysts—

- Identify pertinent obstacles in the AO by considering—
  - Vegetation.
  - Surface drainage.
  - Surface materials.
  - Surface configuration.
  - Transportation systems (e.g., bridge classifications, road conditions).
  - Weather effects (actual or projected).
- Determine the effect of each obstacle on the mobility of the evaluated force by preparing a separate overlay for each factor, or combine the effects of individual obstacles into an integrated product or COO, which depicts the battlespace effects on mobility.

Classification

Analysts graphically depict and classify the cumulative effects of obstacles as unrestricted, restricted, and severely restricted areas, which are defined below:

- Unrestricted. Indicates terrain free of any restrictions to movement. Nothing needs to be done to enhance mobility. Typically this terrain is flat to moderately sloping terrain with scattered or widely spaced obstacles such as trees or rocks, which allows for armored or mechanized forces and wide maneuvers.
- Restricted. Indicates terrain that hinders movement to some degree. Units may have difficulty maintaining preferred speeds, moving in combat formations, or transitioning from one formation to another. This terrain slows movement by requiring zigzagging or frequent detours. Moderate to steep slopes or moderate to densely spaced obstacles such as trees, rocks, or buildings may restrict armored or mechanized forces. Swamps or rugged terrain may restrict dismounted infantry forces. Poorly developed road systems may restrict logistical and rear area movement. Analysts depict restricted terrain on overlays and sketches by marking the areas with parallel diagonal lines.
- Severely restricted. Indicates terrain that severely hinders or slows movement in combat formations unless some effort is made to enhance mobility. The mobility enhancement efforts could include committing engineer assets to improve mobility, moving in column instead of line formations, or moving at slower than preferred speeds. Steep slopes and large or densely spaced obstacles with little or no supporting roads typically characterize severely restricted terrain for armored and mechanized forces. Analysts depict this type of terrain on overlays and sketches by marking the areas with crosshatched diagonal lines.

Avenues of Approach and Mobility Corridors

To develop the air or ground routes of an attacking force, analysts must identify and categorize mobility corridors. Mobility corridors are areas where a force is channeled around obstacles. The best mobility corridors use unrestricted terrain with enough space for a force to move in its preferred doctrinal formations while avoiding major obstacles. These corridors usually follow the direction of roads and trails.

Considerations

Analysts use the COO to identify mobility corridors wide enough to permit maneuver in tactical formations. If friendly and threat forces require

mobility corridors of different widths as a result of organizational or equipment differences, analysts may conduct two separate evaluations. Identification of mobility corridors requires some knowledge of friendly and threat organizations for combat and preferred tactics. When identifying mobility corridors, analysts must evaluate obstacles and force mobility. The analyst should also consider that—

- Mechanized and armored units generally require large open areas to move.
- Dismounted infantry, most insurgents, and terrorists are less restricted by the presence of obstacles or hindering terrain and prefer areas that provide concealment and cover.
- The mobility corridor used by a jet aircraft with a minimum operating altitude of 1,000 feet is quite different from that considered by a helicopter with a maximum service ceiling of 10,000 feet.

Categories

Once identified, mobility corridors are categorized according to the size or type of force they will accommodate. Mobility corridors are normally identified for forces two echelons below the friendly command. In addition, where terrain is restrictive, the evaluation may need to look several echelons below the friendly command.

Analysts group mobility corridors together to form AAs. Avenues of approach may include areas of severely restricted terrain since they show only the general area through which a force can move. Analysts depict AAs on an overlay using an outline arrow that encompasses the mobility corridors. Threat AAs are generally depicted in red, friendly AAs are depicted in blue.

Evaluation

During offensive operations, analysts evaluate AAs to recommend the best route to the command's objective and to identify avenues available to the enemy for force withdrawal or movement of reserves. During the defense, analysts identify AAs that support the threat's offensive capabilities and avenues that support the movement and commitment of friendly reserves.

An evaluation of AAs identifies those that best support maneuver capabilities. This evaluation should be a combined effort performed by the intelligence section, the imagery and mapping officer or GEOINT support team, and the operations section. These AAs are evaluated for—

- Access to key terrain and adjacent avenues.
- Degree of channelization and ease of movement.
- Use of cover and concealment.
- Use of observation and fields of fire.
- Sustainability.
- Directness to the objective.

SECTION IV. HYDROGRAPHIC ANALYSIS

Sea or hydrographic analysis is the study of areas containing shorelines. Intelligence of coasts and landing beaches is important to military planners because the coast is a country's first line of defense. The hydrographic analysis is subdivided into the offshore, nearshore, and foreshore environments. The land analysis is subdivided into the beach and inland environments. Intelligence personnel conduct hydrographic P&A to evaluate coastal conditions that support amphibious operations. Amphibious operations require detailed oceanography studies that are discussed in Joint Publication (JP) 3-02, *Joint Doctrine for Amphibious Operations,* and FM 34-81, *Weather Support for Army Tactical Operations.*

Sources of Information

The Naval Oceanographic Office (Major Shared Resource Center, John C. Stennis Space Center, National Aeronautics and Space Administration, MS), conducts comprehensive analysis of littoral and hydrographic factors worldwide. Joint Intelligence Center, Pacific; Joint Forces Intelligence Command; and Marine Corps Intelligence Activity (MCIA) produce detailed imagery-based beach studies. Graphic and text-based analysis are available both online via intelligence link (INTELINK) or intelligence link-SECRET (INTELINK-S) and via request for production validated through the operational chain.

Hydrographic Conditions

Analysts evaluating the hydrographic conditions of a coastal region study seas and surf, tides, and currents that can affect amphibious landings.

Seas, Swells, and Surf

Seas are waves that originated in local storms. Swells are waves that have traveled hundreds to several thousands of miles from a distant storm before arriving at the landing site. Breaking waves or surf 4 feet in height normally are considered too high for amphibious assault operations or for logistics over the shore. By identifying the following types of breakers, analysts can determine the trafficability of the nearshore bottom:

- Spilling breakers indicate a gentle sloping bottom. The waves lose energy gradually as they approach shore by breaking only at the crest, and it is common to see a number of such breakers existing simultaneously.
- Plunging breakers indicate an unstable nearshore bottom. These waves break in a rollover, plunging action that causes abrupt changes in the form of a longshore bar or degree of steepness at the shore.
- Surging breakers indicate a steep nearshore gradient and are the least common of all types of breakers. This type of wave peaks near the shoreline, but instead of breaking or spilling, it actually surges up the face of the beach.

Tides

Tides are the alternate rising and falling of the sea caused by the gravitational attraction of the moon and sun. The tidal range is the complicated product of various forces, including local bottom configuration and the size and configuration of oceanic basins that can alter the height and time of the tides. When identifying beach widths, hazards, and depths, analysts must specify the time of day observations were made to permit tidal computations. Tidal information for most places on the coasts of the world can be obtained from tide tables published by the U.S. Department of Commerce.

Currents

Currents in the nearshore zone which influence amphibious landing operations are generally classified as wave-generated, tidal, or river currents.

Wave-Generated Currents

These currents are caused by the angular breaking of waves on the beach slope and the resultant back rush normal to the beach, which results in a littoral current (longshore current) in the nearshore zone, flowing generally parallel with the shoreline. It is found shoreward of the outermost edge of the breaker zone and varies in velocity or force with the force of the waves, their angle of impingement upon the shore, and the steepness of the foreshore. Littoral currents may be insignificant in terms of amphibious operations, or they may be strong enough to cause personnel to lose their footing, to make maneuvering of craft difficult, and to throw landing or assault craft out of control and expose them to broadside attack by the surf. Littoral currents are particularly significant where depths

shoreward of the breaker zone are such as to make wading hazardous.

Tidal Currents

These currents affect amphibious landings in the proximity of tidal inlets, estuaries, river mouths, and similar restricted channels. With large tidal ranges these currents may make the maneuver of landing craft on beaches adjacent to the tidal inlet extremely hazardous.

River Currents

Currents that extend from rivers into the open sea are frequently of such strength that they affect the maneuver of landing craft near the river's mouth.

Beach Selection Considerations

Beaches are the most prevalent natural features of the coastal region. They are accumulations of loose sand, gravel, or boulders that are shaped by waves and currents acting on the shore. Along many lowland coasts, beaches occur as barrier islands that parallel the coast and are separated by a lagoon or bay. Along other stretches of coast, beaches are backed by eroding cliffs, or the beach may be absent with high rocky cliffs facing the waves.

Hydrographic conditions shoreward of the 30-meter depth curve should be thoroughly investigated and surveyed. Shallower depths of the surf zone from 0 to 30 meters are of primary concern in amphibious operations because crafts ground and troops and vehicles disembark in this area. When preparing hydrographic beach surveys, analysts must—

- Record accurate locations of obstructions.
- Determine clear boat passages to the beach.
- Determine trafficability of bottom materials.
- Select suitable beaching locations for amphibious vehicles.
- Determine maneuver areas for crafts.

From a tactical perspective, the ideal sea approaches to the beach should have—

- No obstructions.
- Deep water close inshore.
- Nearshore gradients deep enough for dry-ramp beaching of landing craft and ships.
- Soil composed of firm sand with gentle gradients.
- Small tides.
- No currents or surf.

The ideal beach terrain should be—

- Flat or gently rising.
- Backed by a coastal range high enough to mask the landing area.
- Relatively clear.
- Firm with adequate drainage.

Analysts evaluate the following beach features to determine those areas that come nearest to the optimum landing requirements.

Size

Analysts measure the beach to determine the force size that can be supported. The beach size also defines requirements for follow-on logistical forces and establishment of logistical base sites or dumps. Analysts determine the usable beach length by measuring, in kilometers, the gross length minus unsuitable landing features, such as rivers and rock outcroppings. When preparing the overlay, analysts describe and plot—

- Unsuitable beach sections.
- Features that might affect movement along the beach.
- Beach widths available at the low-water tide stage (maximum width) and at the high-water tide stage (minimum width), noting each stage of the tide.
- Locations of major changes in width.

Approaches

Analysts identify major obstructions and obstacles in the offshore approaches for an area seaward of the 30-meter depth curve. More detailed analysis and information are provided shoreward from the 30-meter depth curve giving distances and azimuths of obstructions and obstacles from the centerline of the beach. When describing general approach conditions, analysts note the presence of—

- Shoals.
- Bars.
- Kelp beds.
- Island groups.
- Exposed rocks.

Gradient

The foreshore gradient may be so steep as to prohibit the landing of vehicles from beached craft without use of matting, or it may be so flat as to cause personnel and vehicles to move great distances from boats over exposed areas to cover. Analysts express the gradient as one unit of vertical rise in relation to horizontal distance (e.g., 1 foot vertical height over 20 feet of horizontal distance = 1:20). Gradient may also be given in percent of slope or degree of angle. Analysts record gradients when—

- High-water zone of the foreshore is much steeper than the foreshore.
- Seasonal gradient changes information is available.
- Backshores are not level.

Composition

A description of the characteristics of the beach material gives a valuable clue to the slope or gradient of a beach when other information is lacking. Analysts can determine the gradient by the size of the beach material and the character of wave action. The depth of beach materials and the nature of subsurface materials are also indications of beach firmness and trafficability.

Trafficability

The beach's ability to sustain troop and vehicle traffic depends on factors such as moisture content, slope, grain size, and compacting. When evaluating beach trafficability, analysts must consider the following general rules:

- Changes in beach firmness may occur in short periods of time.
- Sandy beaches are more firm when damp.
- Beach backshores are frequently dry and therefore soft.
- Pebbles and cobbles are firm for bearing capacity but are loose for vehicle traction.
- Clay is soft when wet, but combinations of clay and sand may be firm.
- Fine to coarse sand mixtures tend to be firm.
- Soft zones are common near the upper level of wave wash at high tide because air pockets are trapped under the wet sand.
- Sand beaches exposed to wave action are generally firmer than beaches of similar material in sheltered locations.

Vegetation

Beach vegetation rarely affects military operations except for mangrove. These tropical trees and shrubs normally grow in sheltered tidal areas that have a soft, fine bottom material, but they may exist on foreshores that do not experience heavy wave action. Analysts identify the mangrove's interlaced roots, which constitute a barrier to movement.

Natural Obstacles

Analysts evaluate cusps, beach ridges, scarp, and berm to identify areas that could impede movement.

Natural Cusps

These are more or less evenly spaced ridges or horns of beach material and intervening crescent shaped troughs. The horns trend at right angles to the shoreline and taper to their point seaward. Cusps present on beaches should be noted. There are several characteristics of this beach feature that may be significant in amphibious landings. Along gravel beaches, the cusps may develop very large proportions, rising several feet above adjacent troughs and becoming a serious hindrance to traffic. Cusps are soft, whereas the troughs are usually of the same firmness as the normal beach face.

Beach Ridges

These continuous mounds or ridges are created by wave action along the upper limits of the beach. They may occur as single ridges or as a series of parallel ridges extending some distance inland. Commonly 3 to 8 feet in height above mean high tide, beach ridges can attain a height of 30 feet on pebble beaches. Ridges may consist of sand, pebbles, or gravel. Gravel or shingle ridges are high and loose and are very difficult to traverse.

Scarp

This near-vertical face cut into beach materials is caused by erosive wave action and may be a formidable barrier to movement across the beach. Scarps cut into the backshore have permanence, but normal wave action will eliminate foreshore scarps.

Beach Berm

A horizontal formation of material deposited by wave action, beach berm begins at the limit of normal-wave up rush and extends landward. Where more than one berm exists, they are separated by beach scarps in various stages of deterioration. The seaward margin of a berm is know as the berm crest. Berms are usually dry and soft but may be firm for a short time when damp.

Manmade Obstacles

Groins, jetties, bulkheads, and sea walls are manmade structures that could hinder beach operations.

Groins

These structures are used to stabilize a beach. They are long, low, narrow structures extending seaward from the backshore that are built to trap water-suspended sand on shore. Because groins are usually built as a system of structures spaced at regular intervals along the beach, analysts identify them as obstacles to the lateral movement of vehicles.

Jetties

Used to improve and stabilize inlets and river mouths, jetties project seaward from the shoreline through the normal surf zone. They are larger and more massive than groins. They prevent sand deposits in the channel, regulate the inflow and outflow of tides and river discharge, and protect vessels entering the inlet or river. Analysts evaluate jetties to determine if they are high enough to protect vessels against storm wave action and to prevent sand movement in the channel.

Bulkheads and Sea Walls

These structures protect areas of the coast against heavy storm wave action. They limit the shoreward movement of destructive waves, but under severe wave action they may cause the removal of sand from the beach. Analysts evaluate bulkheads and sea walls because they are normally strongly built and difficult to break through, which can prevent troop and vehicular movement from the beach to inland areas.

Exits

Uninterrupted movement inland from a beach is necessary to provide direct, rapid support and supply of combat forces and to avoid the creation of lucrative targets of accumulated material

and personnel on beaches. However, movement off a beach inland onto favorable terrain in many localities is one of the most difficult aspects of a landing because of the prevalence of bluffs, dunes, swamp, or lagoons close behind the beach. Existing exits require little or no preparation. They may be manmade or natural, such as roads, ramps, stairs, paths, gullies, dry stream beds, and gaps between dunes. Another characteristic of an exit requiring evaluation is the width. An exit should have a minimum width of 8 feet to permit the passage of vehicles.

SECTION V. AIRSPACE ANALYSIS

The addition of the airplane and helicopter to the arsenal of war requires that the battlespace be viewed in terms of width, depth, and a third dimension, height or airspace (measured in cubic kilometers). Because airspace has no reference points to guide the analyst and evidence of air activity is erased seconds after the activity occurs, it is often difficult to establish NAIs, TAIs, and air operations decision points. Airspace analysts are required to tie air events to time and the ground and to integrate the terrain analysis with analysis of—

- Aircraft maximum service ceilings.
- Minimum operating altitudes for fixed- and rotary-wing aircraft.
- Maximum effective ranges of air defense weapons systems.

Geospatial Analysis Support

The intelligence staff receives support from the terrain team during airspace analysis. However, this support must be augmented by personnel from other functional areas with an understanding of the air threat, air defense systems and operations, and close air support techniques.

Geospatial analysis and GEOINT production in support of air defense, counter air, and air-associated operations deal with an environment that extends several thousand meters above ground level and with forces whose mobility is limited only by the ability of their equipment. Terrain analysis is required because aircraft and air defense elements use the terrain to their best advantage.

Standard military topographic maps are not normally considered suitable for other than the most basic airspace analysis. Standard 1:50,000-scale topographic maps are most useful when analyzing the ability of an aircraft to approach, acquire, and engage a target. The analysis of an aircraft's approach (from air base to target vicinity) or of enemy air corridors should be conducted using standard 1:250,000-scale joint operations graphic-air (JOG-A) specifically designed for this purpose.

Airspace Evaluation

The third dimension of the battlespace includes the air AO and the air AOI. The air AO is the area where the commander is assigned responsibility and authority for military operations. The air AOI includes airspace adjacent to the air AO and extends into enemy airspace upward to the maximum service ceiling of enemy aircraft and the maximum effective altitude of enemy air defense weapons systems. It takes into consideration any space-capable system, i.e., satellites. In addition, the air AOI may extend as far as enemy airfields and to the maximum range of enemy surface-to-surface missile systems. During the airspace evaluation of the battlespace, analysts identify potential locations of LZs, DZs, FARPs,

and forward assembly or expeditionary airfields to pinpoint requirements for further analysis.

Military Aspects of Terrain Evaluation

Terrain analysis for air operations focuses on the same military aspects of terrain as ground operations. However, the analysis of these aspects is directed first at their effects on airspace operations and then on their resultant effects on the overall operation.

Key Terrain

Key terrain in airspace analysis is any terrain feature that allows air defense weapons to engage channeled or constrained air or airborne forces. Analysts should identify—

- Areas that limit aircraft lateral movement.
- Areas that restrict air maneuver.
- Elevations higher than maximum aircraft service ceilings.
- Airfields.
- LZs and DZs.
- Fixed or surveyed air defense weapons and radar sites.
- FARPs.

Observation and Fields of Fire

As with ground operations, observation involves the effects of the terrain on reconnaissance and surveillance as well as target acquisition. Fields of fire involve the effects of terrain on weapon's effectiveness. In air defense, both counterair and other air operations are closely related to line of sight (LOS). Ground operations are concerned primarily with horizontal LOS; air and air-associated operations are primarily concerned with air and ground oblique and vertical LOS.

Attack aircraft and air defense assets want as much protection as possible from enemy observation, and both require direct LOS to the target. It is, therefore, necessary to analyze airspace regarding the routes which provide the best protection for aircraft entering the target area and those which provide the best fields of fire for the aircraft once it reaches the target area. Similarly, the analysts must consider where air defense assets can best be hidden from observation and retain good fields of fire against the primary air AAs and mobility corridors.

Cover and Concealment

Friendly force operations require cover from aerial direct fires and concealment from aerial reconnaissance and surveillance. The enemy also uses terrain to provide cover from direct fires and to conceal their operations from friendly detection. Analysts evaluate airspace routes that provide the best protection for aircraft entering the target area and identify locations where air defense assets can best be hidden from observation.

While not considered as either concealment or cover in the strictest sense, NOE flight enhances both fixed- and rotary-wing aircraft survivability. An NOE flight makes the optimum use of available terrain for concealment and cover and hinders quick countering responses by ground forces and air defense assets.

Obstacles

When evaluating terrain, analysts identify the following types of obstacles, which channel aircraft movement and restrict evasive' actions:

- Obstacles to the effective employment of air defense target acquisition or weapon systems (e.g., terrain that masks LOS, built-up areas, tall buildings, vegetation).
- Obstacles that restrict NOE flights, which are below 22.8 meters or 75 feet in height (e.g., tall trees; radio, television, and microwave relay towers; power transmission lines; support towers; smoke and obscurants; tall buildings).

- Obstacles that force aircraft to employ a particular profile or attack route or to gain excessive altitude that is above 22.8 meters in height (e.g., mountains, large hill masses, built-up areas, excessively tall trees).
- Obstacles that restrict lateral movement within the air AA or mobility corridor. These obstacles have the same effect on aircraft as ground obstacles, that is, channeling movement and restricting evasive action. They often become key terrain for the employment of air defense weapons systems.

Avenues of Approach

A good air AA permits maneuver while providing terrain masking from air defense weapons systems. In addition to the criteria evaluated for ground AAs, analysts consider the following variables when analyzing air AAs:

- Type of aircraft.
- Maximum service ceiling of the aircraft.
- Attack profile being employed.
- Weapon system or expected ordnance.
- Type of target to be attacked.

Weather

Aviation operations are especially susceptible to weather effects, because temperature, humidity, and cloud cover can have a significant impact on an aircraft's ability to use a particular AA. Analysts must evaluate the effects of visibility, wind speed and direction, precipitation, cloud cover, temperature, and humidity when conducting analysis for airspace operations.

SECTION VI. WEATHER ANALYSIS

Commanders and their staffs must acquire weather information about the entire battlespace area and know how to exploit the opportunities the weather offers while minimizing its adverse effects on personnel, equipment, and mission accomplishment.

Responsibilities

The following units and personnel are responsible for determining weather effects on the battlespace environment:

- MEF topographic platoon.
- MSC supporting GEOINT support teams.
- MEU(SOC) CE GEOINT teams.
- Staff engineer officer.
- Staff weather officer.
- Weather team.

Weather Effects

Weather, climate, and terrain are so interrelated they must be considered together when planning MAGTF operations. Weather elements are capable of drastically altering terrain features and trafficability. Conversely, terrain features exert some influence on local weather. This relationship of weather and terrain must be carefully correlated in terrain studies to produce accurate geospatial analysis. Terrain features are affected by such elements as visibility, temperature, humidity, precipitation, winds, clouds, and electrical phenomena. The specific factors described vary with the geographic area, time, and season. Terrain features also influence the climate of an area. The effects of temperature, humidity, precipitation, visibility, wind speed and direction, clouds, and atmospheric pressure can affect the battlespace environment, which can enhance or limit military operations.

Temperature and Humidity

Temperature is the value of heat or cold recorded by a thermometer, which is normally placed 6 feet above the ground. Temperatures are recorded in Fahrenheit and Celsius values.

Humidity is the water vapor content in the atmosphere. It is expressed as relative or absolute humidity.

When evaluating temperature and humidity, analysts must consider the following effects on operations:

- Aircraft efficiency is reduced in areas of high temperature and high humidity, because when temperature and humidity are high, the air is denser.
- Extreme temperature and humidity will reduce personnel capabilities and may necessitate a reduction of aircraft payloads.
- Tactics devised for one climatic zone may require considerable revision if used in another zone.
- High temperature and humidity conditions found in the tropics are conducive to growth of dense foliage and jungles, which affects trafficability and cross-country mobility.
- Cold weather periods—
  - Create a need for heated shelters.
  - Make the construction of fortifications difficult.
  - Increase the amount of dependence upon logistical support.
  - Necessitate special clothing, equipment, and combat skills.
- Periods of freezing temperatures—
  - Increase the trafficability of some soils.
  - Create ice sheets on roads, making movement more difficult.
  - Decrease a projectile's ability to penetrate the earth.
  - Increase the casualty effect of contact-fuzed shells.
- Melting snows may cause floods and avalanches.
- Temperature inversions (air nearest ground is colder than overlying air) cause the air to remain stable and to hold dust and smoke near the ground, which reduces both visibility and air purity.
- The amount of water vapor in the air affects the trajectory of projectiles.
- Humidity affects the distance sounds travel, thus affecting listening posts and sound-ranging operations.

Precipitation

Precipitation is any moisture falling from a cloud in frozen or liquid form. Common types of precipitation are rain, snow, hail, drizzle, sleet, and freezing rain. The intensity of precipitation is described as light, moderate, or heavy.

The primary significance of precipitation is its effect on the state of the ground and trafficability, on the efficiency of personnel, and on visibility. The effects of restricted visibility caused by precipitation are just as important as those caused by airborne particles such as dust or smoke. When evaluating precipitation, analysts must consider the following effects on operations:

- Rain, snow, and fog mask patrol and guerrilla activities by decreasing the enemy's surveillance and detection capability.
- Precipitation severely reduces trafficability by altering the surface condition of different soils to varying extents.
- Heavy rain may make some types of unsurfaced roads impassable.
- Heavy or prolonged precipitation usually aids the protected defense by limiting the mobility of an offensive force.
- Precipitation can drastically reduce the efficiency and effectiveness of exposed personnel.

- Precipitation may aid offensive operations by degrading the surveillance capabilities of radar, electro-optical, and infrared devices.
- Seasonal precipitation may change soil trafficability and affect cross-country movement.
- Seasonal floods or swelling streams may make fording and bridging operations difficult or impossible.
- Snow and sleet hamper movement on roads, often making them impassable in mountainous areas.
- Snow accumulations in mountains afford lower, drier regions with a water supply throughout the year.
- Precipitation usually has an adverse effect on visibility and observation.
- Rain may wash excessive impurities from the air.
- Rain and snow aid concealment, which may facilitate surprise attacks.
- Precipitation often limits operations of listening posts and many electro-optical systems.

Visibility

Weather personnel determine visibility by measuring the horizontal distance that the unaided eye can discern a large object or terrain feature. Visibility is reported in meters or fractions of a mile for the prevailing value of the visibility in all directions. Diminishing visibility measurements are noted in the remarks section of the weather observation report.

When evaluating the weather effects on military operations, analysts must consider that poor visibility—

- Aids ground offense and withdrawal.
- Restricts visual reconnaissance and surveillance.
- Tends to conceal concentrations and maneuver of friendly forces from the enemy, which enhances the possibility of achieving surprise.
- Hinders the defense because defensive cohesion and control are difficult.
- Decreases the ability to place aimed fire on the advancing force, making target acquisition less accurate.
- Enhances patrol activities and guerrilla operations by masking and screening movement.

Wind Speed and Direction

When weather personnel determine wind speed or velocity and direction, they measure the air movement rate past a given point and the direction from which the wind is blowing. A gust is a rapid fluctuation in wind speed with a variation of 10 knots or more between peak and lull.

When evaluating wind speed effects on the environment, analysts must consider the following effects on operations:

- Wind velocity on the surface and aloft favors the upwind force in any type of operation.
- Chemical and biological weapons will saturate the low-level, downwind atmosphere with contaminating aerosols.
- An upwind force, with the wind at its back, has better forward visibility and can advance easier and faster.
- Strong winds in arid or semiarid areas frequently raise large clouds of dust and sand, which greatly reduce observation.
- Blowing snow may reduce visibility over wide areas, which may ground observation aircraft and sensors.
- Winds tend to deflect projectiles from their normal paths, particularly when they are fired at long ranges. The effect that wind will have on a projectile increases with an increase in the wind velocity and the projectile size. The wind direction and velocity must be known to apply compensating corrections to firing data.

- Strong winds hinder amphibious operations by creating high seas, which can prevent landing craft from landing or retracting and restrict helicopterborne operations during the ship-to-shore movement.

Cloud Conditions

Cloud conditions are described by the amount and height of the cloud cover. Weather personnel measure the height of the cloud base from ground level and report that measurement in feet. A cloud base is the height of the lowest broken or overcast layer, while a cloud ceiling is the height of the highest layer of several scattered cloud layers. The types of clouds help determine the intensity and amounts of precipitation.

The type and amount of cloud cover, as well as the height of cloud bases and tops, influence ground tactics because they affect the entire range of both friendly and enemy aviation. Analysts should consider the following effects on operations when evaluating cloud conditions:

- Extensive cloud cover reduces the effectiveness of air support but provides a tactical advantage as cloud cover increases, as cloud bases lower, and as associated conditions increase (e.g., icing, turbulence, poor visibility).
- Clouds affect ground operations because they may limit illumination and visibility.
- As solar radiation interceptors, clouds tend to reduce extremes of surface temperature.
- Daytime cloudiness reduces the amount of heat received from the sun at the earth's surface, slowing down the drying of roads and affecting the trafficability of soils.
- Extensive night cloudiness prevents the loss of heat from the earth's surface, resulting in higher nighttime temperatures.
- Cloudiness affects air operations by limiting aerial observation and reconnaissance.

Atmospheric Pressure

The pressure exerted by the atmosphere at a given point is atmospheric pressure, which is measured by a barometer in millibars or in inches of mercury. The air density is measured at high and low altitudes and is reported as high pressure and low pressure. High pressure is critical to air operations because it affects the lift capability of helicopter and fixed-wing aircraft.

Weather Forecast and Weather Effects Products

While planners cannot control the weather, they should be able to exploit the opportunities offered by weather effects while reducing or minimizing its adverse effects on battlespace operations. Analysts provide planners with weather forecasts that cover the geographical layout of the battlespace and meet or exceed the duration of the planning and execution cycles. Using weather critical values tables created during IPB and weather forecast graphics (see fig. 6-2), analysts can quickly identify and determine the impact of weather effects on personnel, equipment, and planned operations. These impacts are displayed in the weather effects matrix (see fig. 6-3).